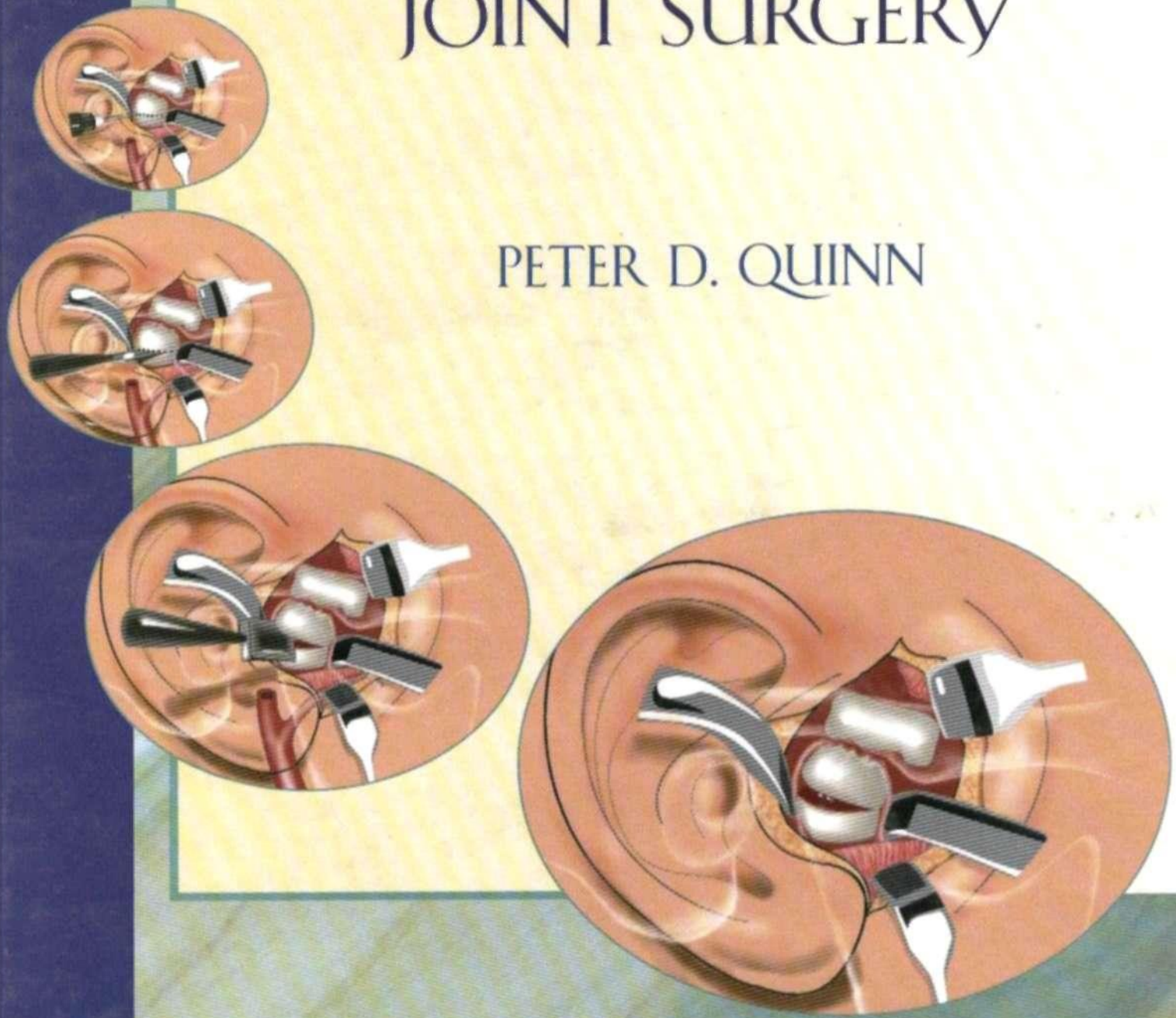
Color Atlas of TEMPOROMANDIBULAR JOINT SURGERY

PETER D. QUINN



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CHAPTER ONE

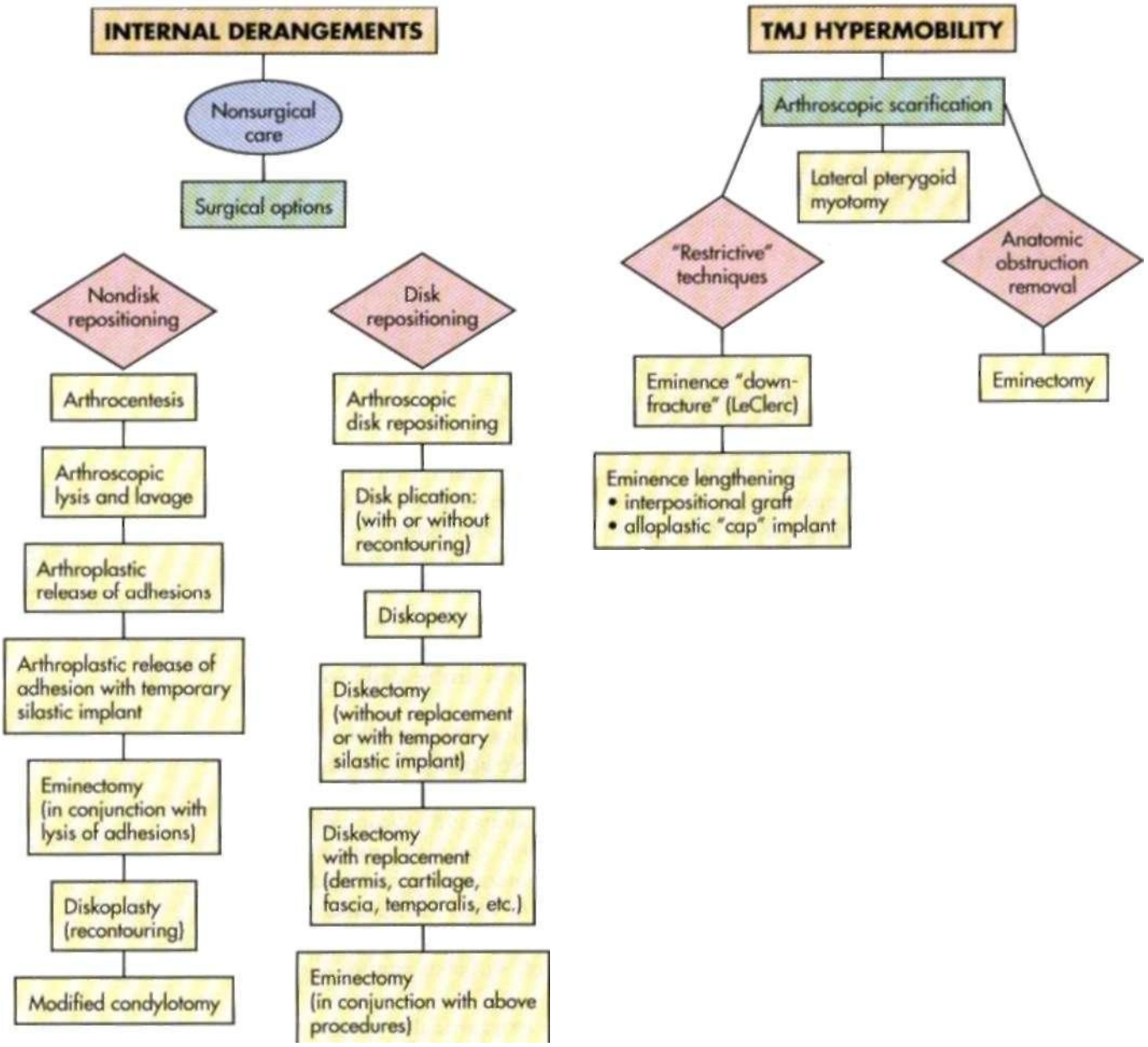
SURGICAL DECISION MAKING IN TEMPOROMANDIBULAR SURGERY

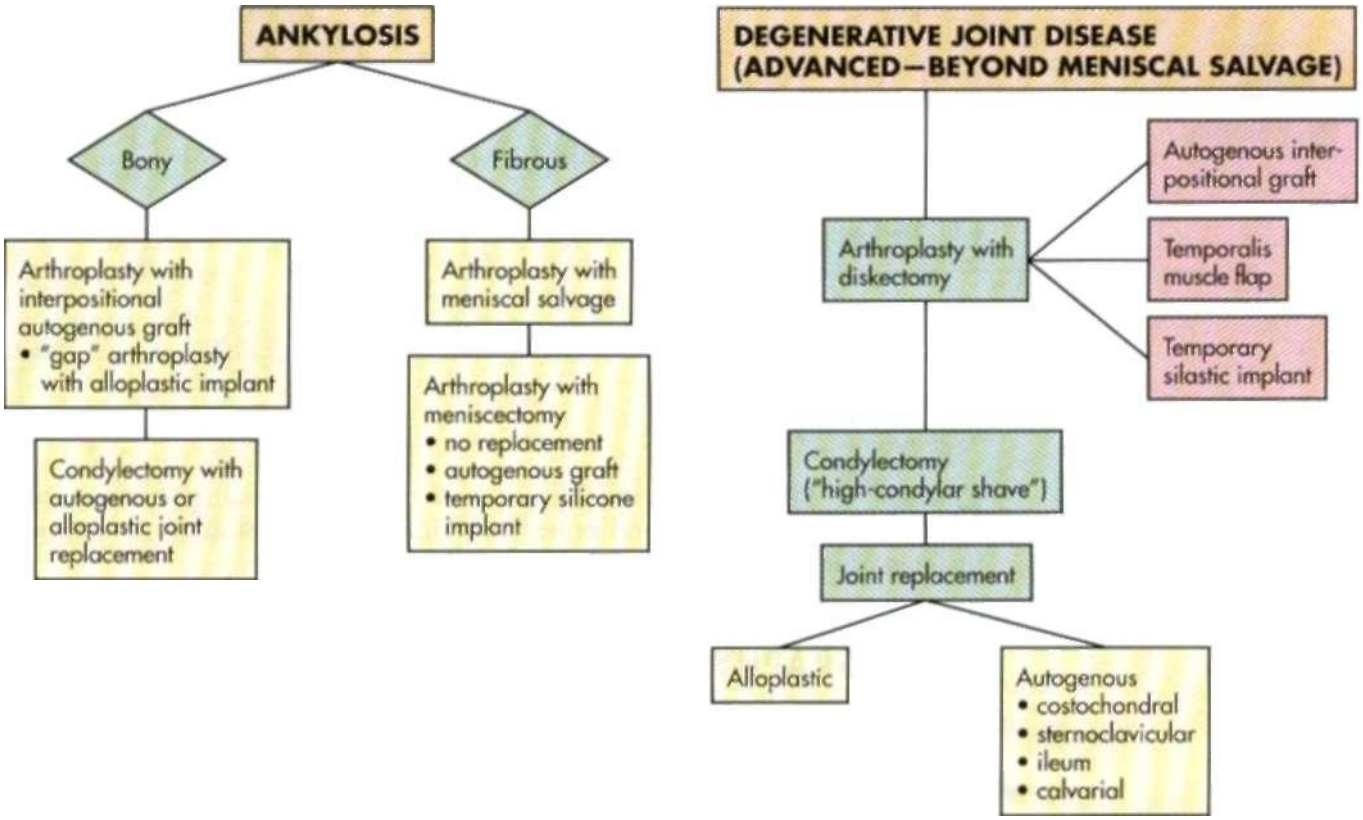
" Who shall decide when doctors disagree?»
ALEXANDER POPE IN "OF THE USE or RICHES"

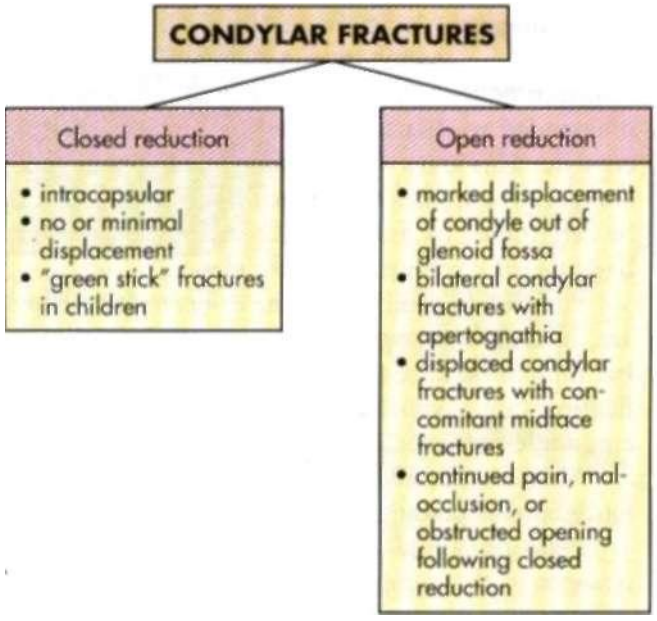
Clearly, one of the most vexing problems for oral and maxillofacial surgeons has been selecting the proper surgical option for those patients who have exhausted all conservative methods of dealing with temporomandibular joint pain and dysfunction. Well-reasoned controversy can complicate decision making in temporomandibular joint surgery for internal derangement, trauma, and management of benign and malignant disorders. Several excellent comprehensive textbooks on temporomandibular joint disorders explore the basis for these controversies and provide a historical and scientific overview of this problematic area of maxillofacial surgery.

The intent of this text is simply to illustrate the technical aspects of the various surgical procedures on the temporomandibular joint. No attempt was made to champion a single approach to temporomandibular joint surgery. Ultimately, only well-designed clinical studies can prove or disprove the safety and efficacy of the individual procedures. It is our hope scientific evidence will one day provide the *sine qua non* that will dictate the proper role for all the potential surgical modalities, including arthroscopy, meniscal repair, and the use of both autogenous and alloplastic materials in joint reconstruction. Although serious mistakes have been made in the management of the temporomandibular joint, surgeons cannot allow the sins of the past to obscure the needs of the future.

This text is based on the assumption that primarily extraarticular conditions are most amenable to nonsurgical care. Patients with true internal derangements may benefit from nonsurgical care, and all these modalities should be exhausted before proceeding with any surgical option. The following algorithms are useful as guidelines but must always be modified according to the needs of the individual patient. Because several excellent comprehensive texts dealing with arthroscopic techniques are available, this book deals only with open joint surgical procedures.


INTERNAL DERANGEMENTS
Nonsurgical care
Surgical options
Nondisk repositioning
Arthrocentesis
Arthroscopic lysis and lavage
Arthroplastic release of adhesions
Arthroplastic release of adhesion with temporary silastic implant
Eminectomy (in conjunction with lysis of adhesions)
Diskoplasty (recontouring)
Modified condylotomy
Disk repositioning
Arthroscopic disk repositioning
Disk plication: (with or without recontouring)
Diskopexy
Diskectomy (without replacement or with temporary silastic implant)
Diskectomy with replacement (dermis, cartilage, fascia, temporalis, etc.)
Eminectomy (in conjunction with above procedures)
TMJ HYPERMOBILITY
Arthroscopic scarification
Lateral pterygoid myotomy
"Restrictive" techniques
Anatomic obstruction removal
Eminence "down-fracture" (LeClerc)
Eminectomy
Eminence lengthening
• interpositional graft
• alloplastic "cap" implant


ANKYLOSIS
Bony
Fibrous
Arthroplasty with interpositional autogenous graft
• "gap" arthroplasty with alloplastic implant
Condylectomy with autogenous or alloplastic joint replacement
Arthroplasty with meniscal salvage
Arthroplasty with meniscectomy
• no replacement
• autogenous graft
• temporary silicone implant
DEGENERATIVE JOINT DISEASE (ADVANCED—BEYOND MENISCAL SALVAGE)
Arthroplasty with diskectomy
Autogenous interpositional graft
Temporalis muscle flap
Temporary silastic implant
Condylectomy ("high-condylar shave")
Joint replacement
Alloplastic
Autogenous
• costochondral
• sternoclavicular
• ileum
• calvarial


CONDYLAR FRACTURES
Closed reduction
• intracapsular
• no or minimal displacement
• "green stick" fractures in children
Open reduction
• marked displacement of condyle out of glenoid fossa
• bilateral condylar fractures with apertognathia
• displaced condylar fractures with concomitant midface fractures
• continued pain, malocclusion, or obstructed opening following closed reduction

CHAPTER TWO

DIAGNOSTIC IMAGING OF THE TEMPOROMANDIBULAR JOINT

Because of the anatomic complexity of the temporomandibular joint and its proximity to the temporal bone, mastoid air cells, and auditory structures, imaging of the joint structures can be problematic.

PLAIN FILM, TOMOGRAMS, AND PANORAMIC RADIOGRAPHY

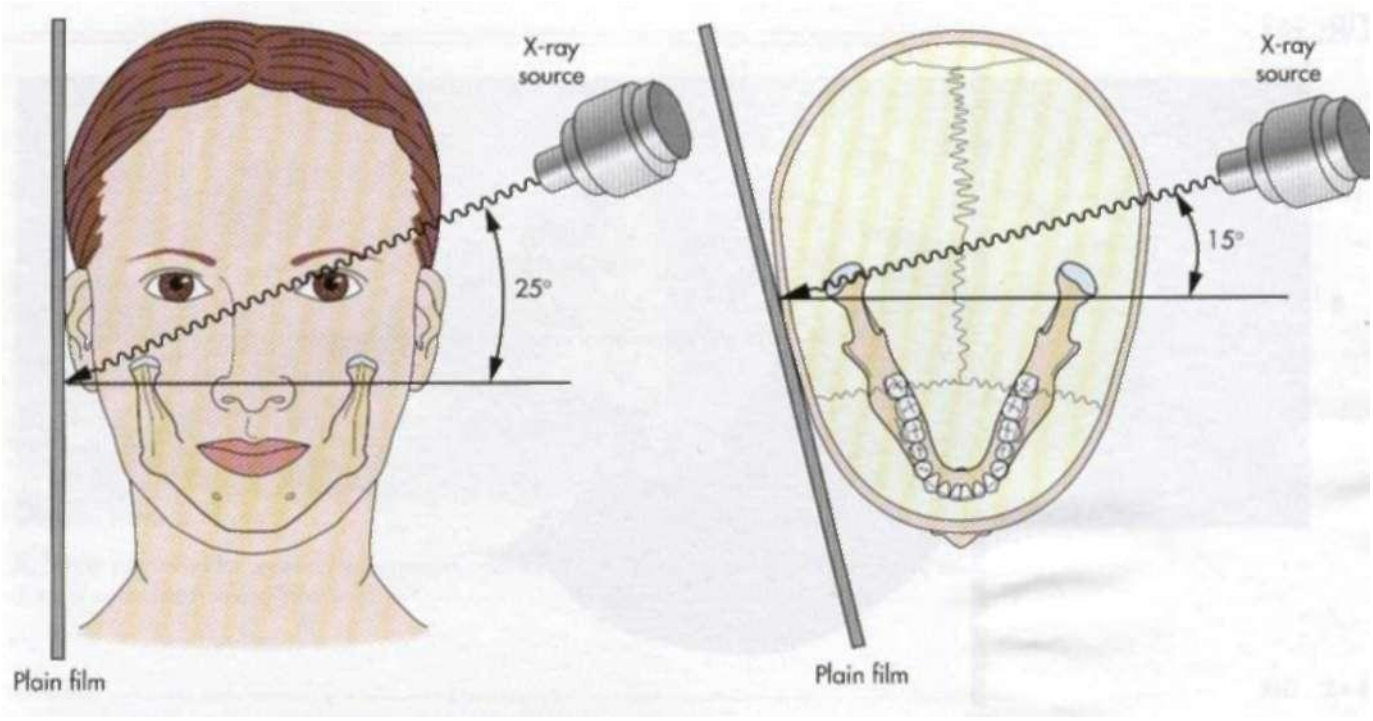
Initial screening for gross osseous abnormalities can be performed with standard transcranial (lateral oblique) views. The x-ray beam is angled superiorly to project the joint away from the base of the skull. The transcranial perspective provides a global view of gross bony architecture of the articular surfaces. If possible, a submental vertex film can be taken to allow the lateral oblique transcranial projection to be angled directly through the long access of the condyle. This improves the image quality and also allows standardization of subsequent transcranial views.

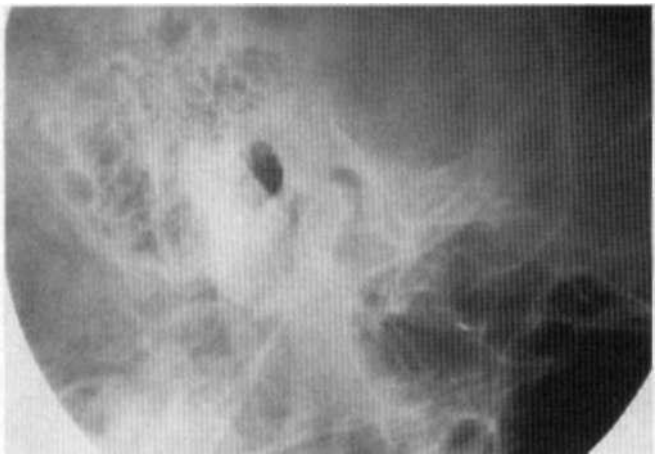
Tomography has been widely available since the early 1940s and provides finer detail for the examination of osseous abnormalities than that detected by plain film techniques. The angle-corrected tomograms for sagittal tomography are recommended so that the sectioning is always perpendicular to the long axis of the condyle. This gives a truer picture of the condylar position and allows subsequent comparative studies to be performed by use of a standard method. The angle can be determined by measuring the angle between the condylar axis and a horizontal baseline on a submental vertex view.

Panoramic radiographs have been described as "curved tomograms." They are, in fact, laminograms of a single plane that are adequate for gross screening but limited because of inherent problems with distortion, "ghost" images, magnification (approximately 20%), and a loss of sharpness compared with multiple-cut, angle-corrected, condylar tomograms.

Newer units allow for separate positioning of right and left joints, creating more correct placement of the condyle in the zone of focus.

Plain films and tomographic images are a great benefit in assessing osseous changes in the condyle and eminence. However, the use of these films to assess condylar position with any accuracy is questionable at best. Several studies have shown that the position of the condyle, as depicted in these radiographic techniques, is of little clinical significance. Open- and closed-mouth tomographic views can provide valuable information with regard to condylar translation. Although





Transcranial radiograph to image contralateral temporomandibular joint. **A,** Correct positioning. **B,** Radiographic image.

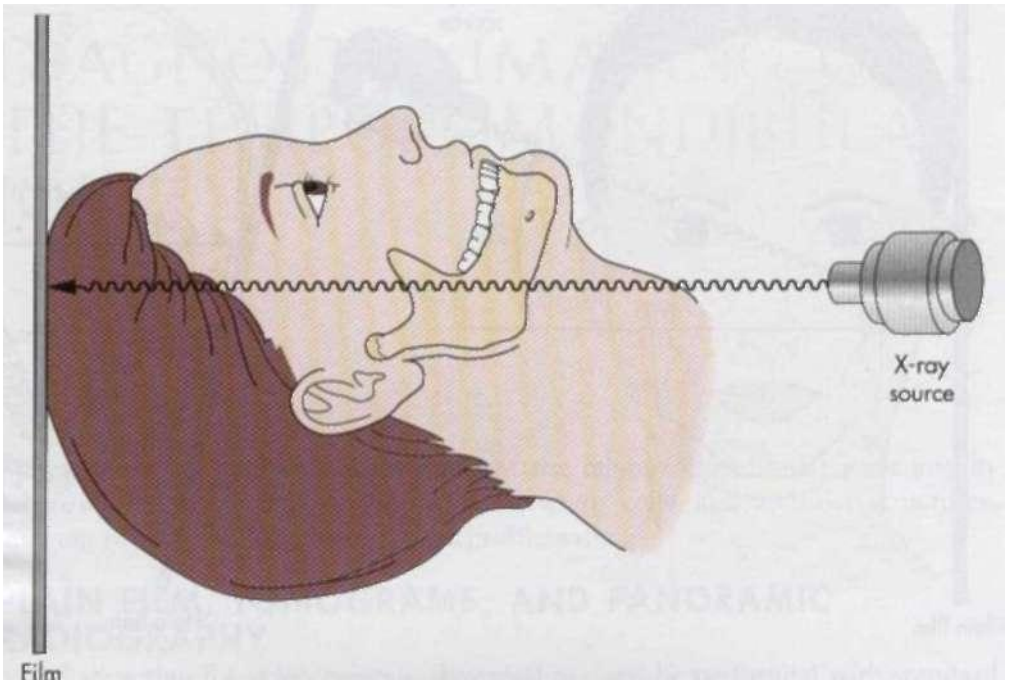
FIG. 2.1

conventional textbooks have claimed that during normal range of motion the greatest convexity of the condyle reaches the greatest convexity of the articular eminence, several studies have shown that a majority of patients actually can translate beyond the greatest convexity of the articular eminence without subluxation, dislocation, or any symptoms. These studies can diagnose restricted range of motion bur do not provide enough information to determine the etiology of that restriction.

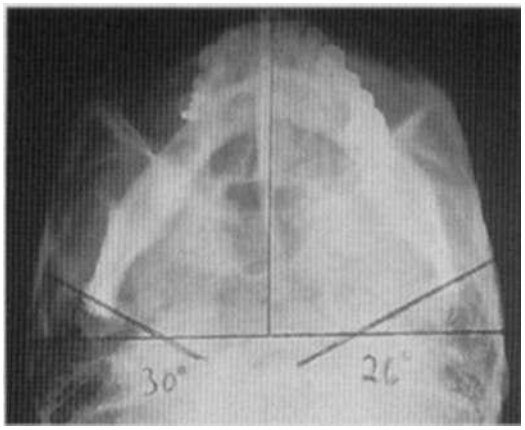
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FIG. 2.2

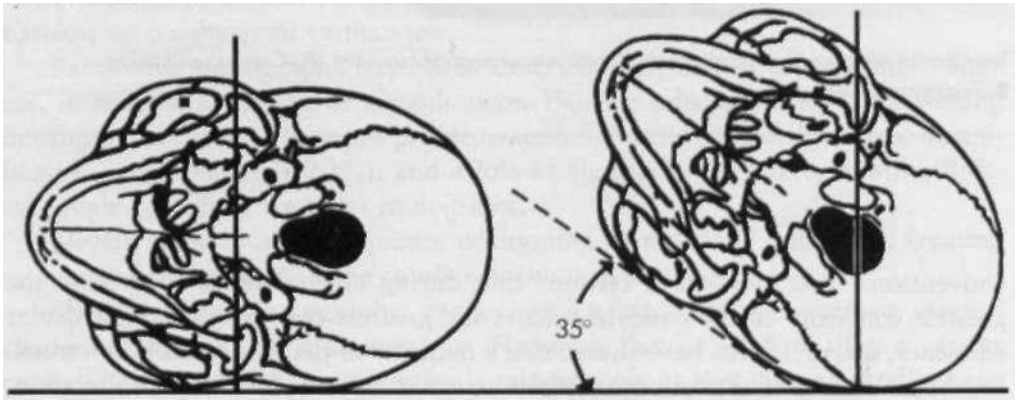
A



B



C



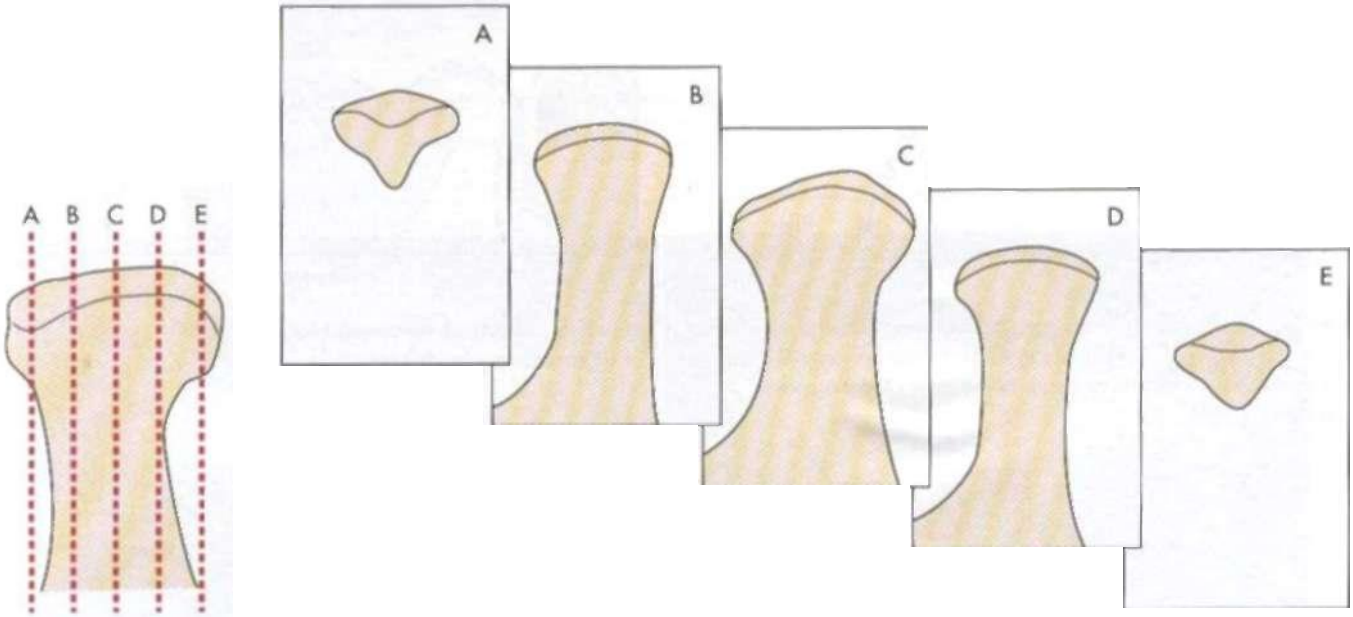
A, Positioning for submental vertex film to determine angulation of condylar head for angle-corrected tomograms. **B,** Submental vertex view of skull with measurements for angle-corrected tomogram technique. **C,** Example of 35-degree correction to ensure that tomograms are perpendicular to line drawn from the medial to lateral pole of the condyle.

FIG. 2.3



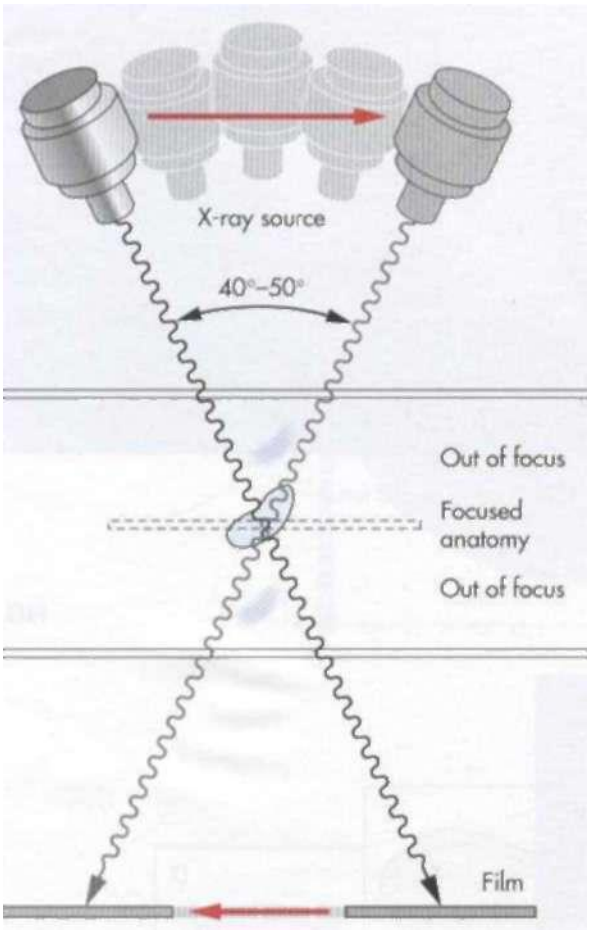
A, Patient positioned for angle-corrected temporomandibular joint tomograms. **B,** Angl&corrected tomogram of right temporomandibular joint.

FIG. 2.4

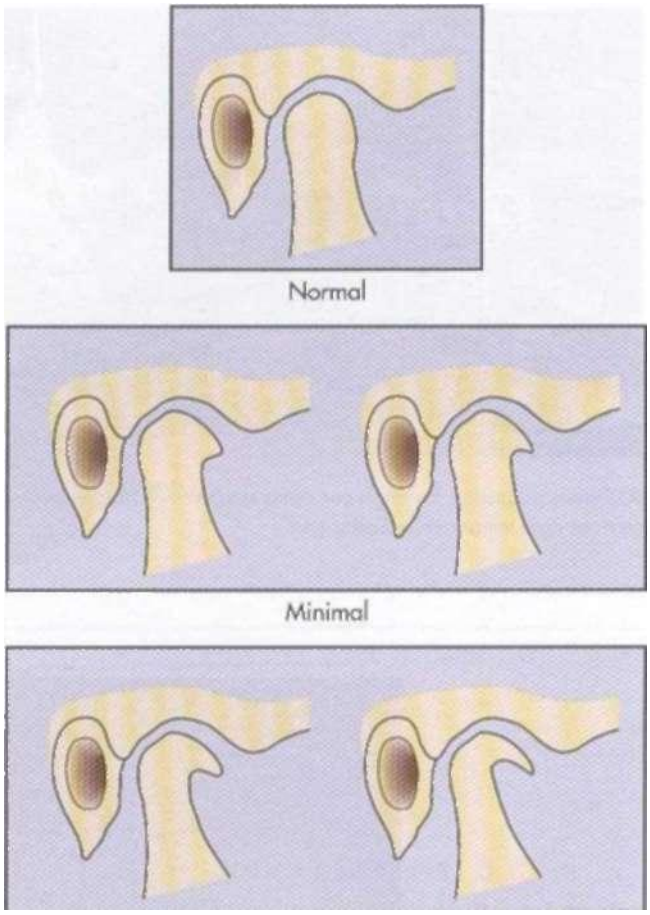


Representation of sagittal cuts in standard tomographic condylar films, showing representative anatomy from the most lateral to the most medial cut.

FIGS. 2.5, 2.6

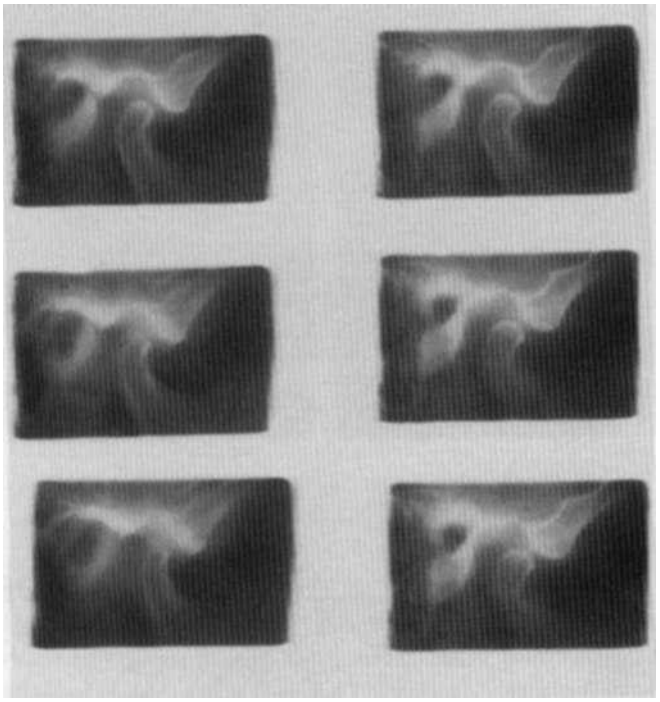


Tomographic technique—Basic principle of tomographic x-rays. Both the radiation source and film are moving simultaneously to blur all the anatomy anterior and posterior to the point of plane convergence.



Expected contours of lateral condylar tomograms in varying stages of degenerative joint disease,

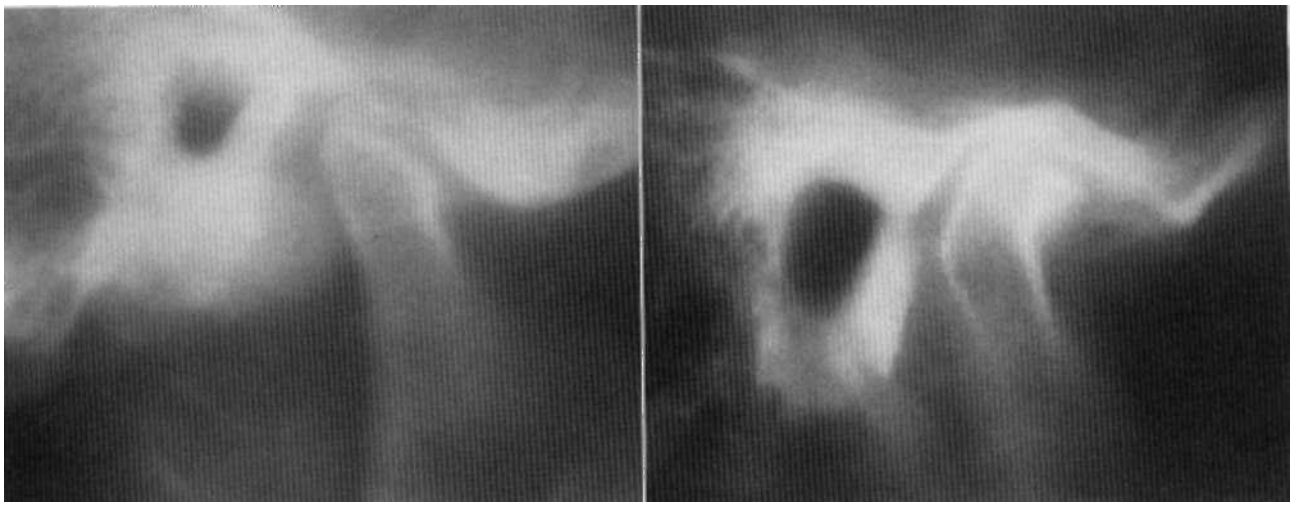
FIG. *2.7*



Temporomandibular joint-tomographic series depicting excellent osseous detail with 5 mm cuts.

FIG. 2.8

A

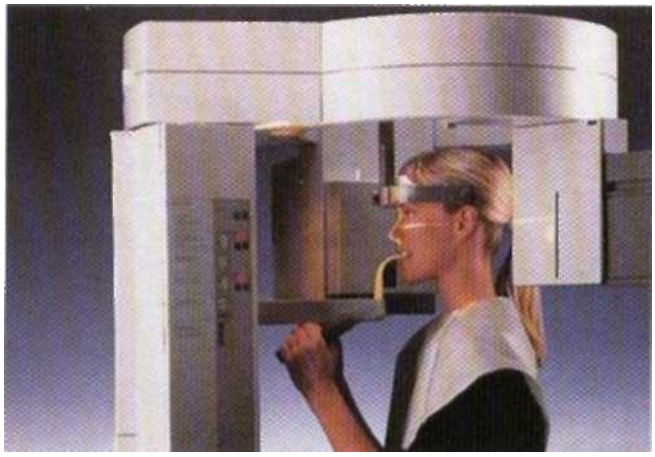


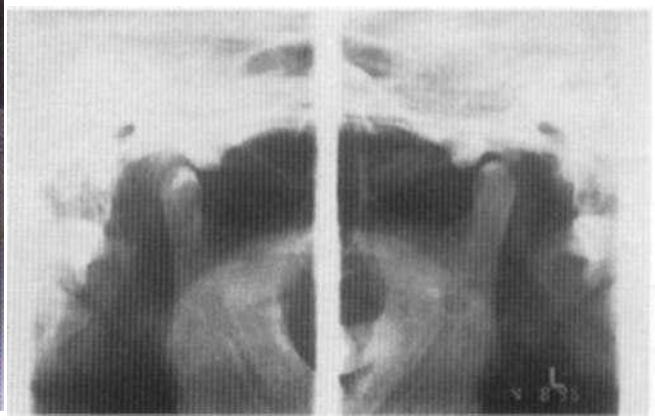
B

Degenerative condylar changes. **A,** Stage **I. B,** Stage II "birds beaking"

FIG. 2.9

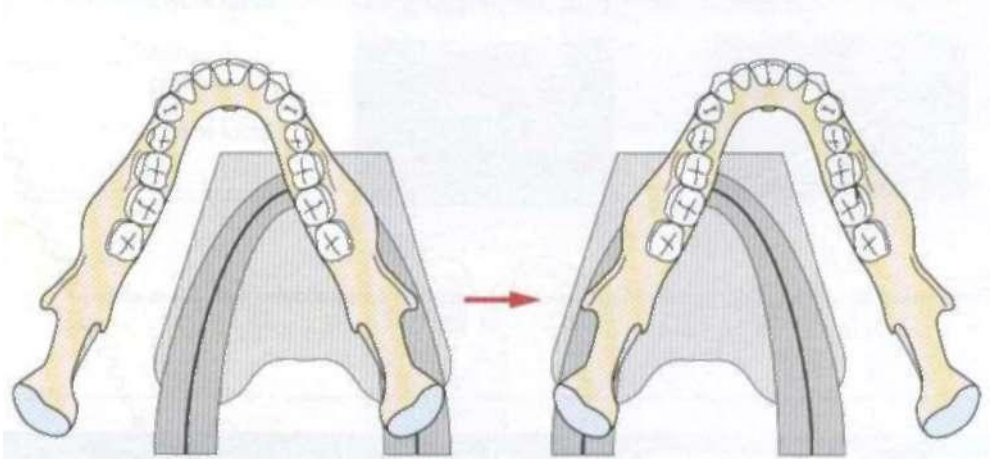
A



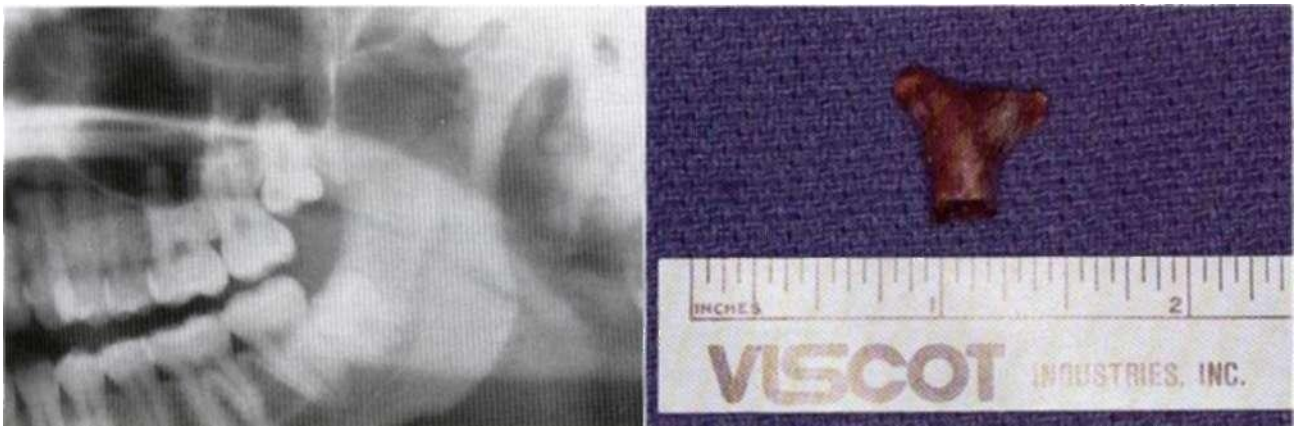


B

C



A, Patient positioned for panoramic tomogram of the temporomandibular joints. **B,** Example of programmed condylar views available on most panoramic tomographic units. **C,** Bilateral positioning techniques for specific temporomandibular joint-panoramic x-ray imaging positioned to align the condyle into the center of the "trough" of resolution of the panoramic tomogram.



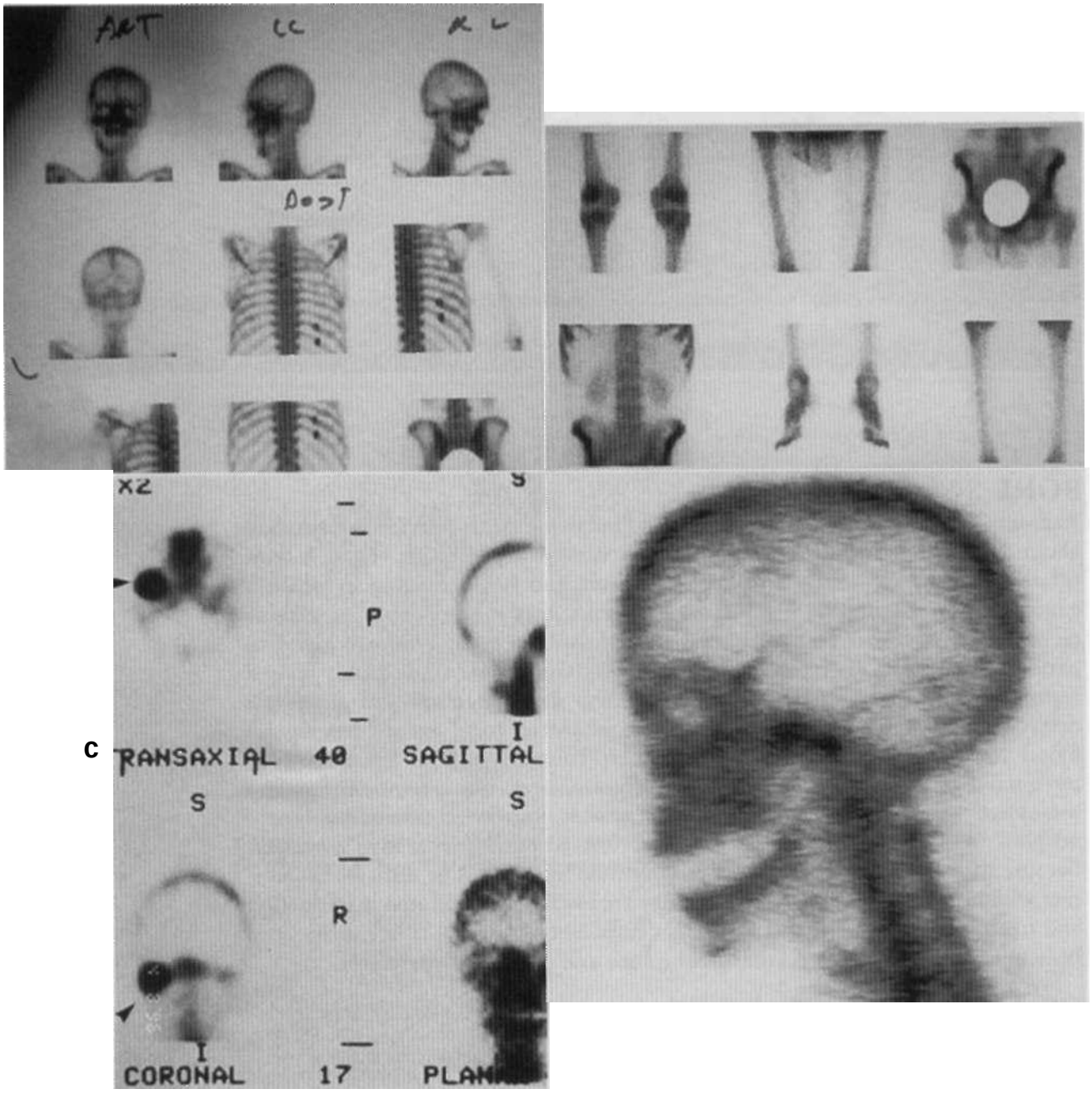
"Hoof" deformity in condylar head, secondary to condylar trauma during growth.

FIG. 2.10

BONE SCANS

Radionuclide imaging of the temporomandibular joint can provide information about the dynamics of bone metabolism in a variety of pathologic states. A scintillation camera can be used for both dynamic and static imaging in which a gamma detector quantifies gamma ray emissions from injected isotopes such as technetium 99. These technetium-labcled phosphate complexes are given to patients by intravenous injection, and then the patients are studied in a phased technique with images performed immediately after injection and at several delayed intervals. The uptake of these radiopharmaceutical agents depends on blood flow to the temporomandibular joint structures. The profusion of the temporomandibular joint is affected by inflammation, bone remodeling, and osteoblastic activity. Higher activity is seen at sites of growth, inflammation, and neoplasia and areas where reactive bone is formed during reparative processes. Because they arc rather nonspecific, radionuclide images can be difficult to interpret without good clinical correlation. They are usually not indicated in evaluation and treatment of osteoarthritis and disk displacements. Radionuclide images can be helpful in cases such as occult osteomyelitis and condylar hyperplasia.

FIG. 2.11



Technetium 99 bone scan. **A, B,** Total body bone scan. **C,** Positive bone scan with enhancement of right temporomandibular joint, secondary to condylar hyperplasia. **D,** Nonspecific positive bone scan of left temporomandibular joint, secondary to psoriatic arthritis.

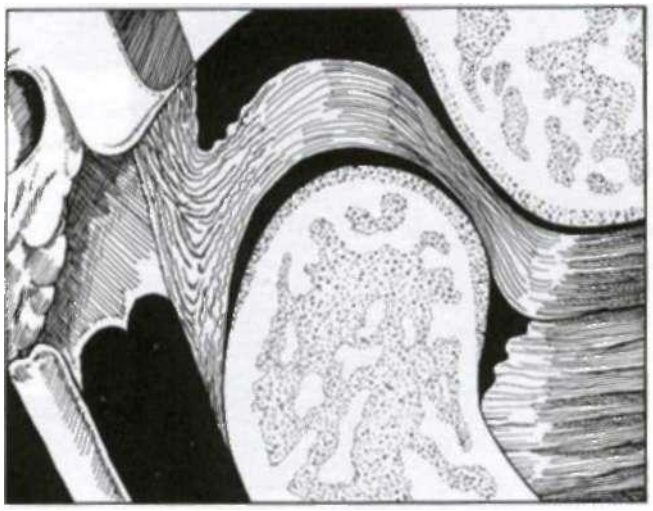
ARTHROGRAPHY

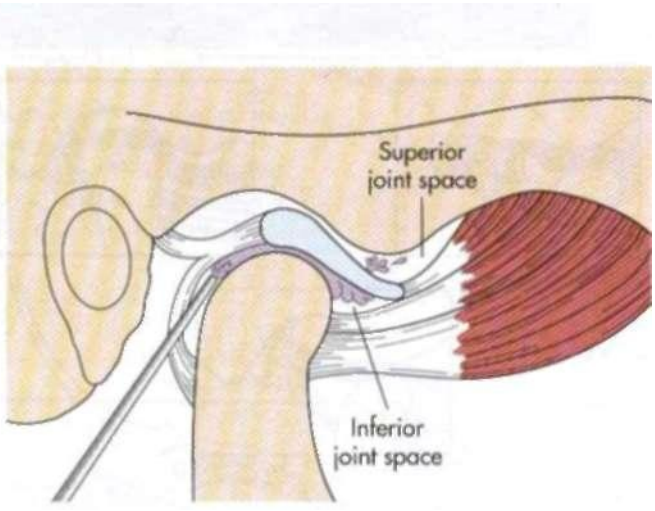
Although arthrography is not widely used, it can offer valuable information nor always available through any other imaging technique. The usual technique involves injection of a water-soluble, iodinated contrast material into the inferior joint space under fluoroscopy. A videotaped arthrofluoroscopic study could clearly show the various stages of disk displacement with or without reduction. It is the only imaging technique that demonstrates perforations in the disk in "real-time" because the operator can see the dye escape from the inferior to the superior joint space during the initial injection. The majority of temporomandibular joint arthrograms are performed with single space injection (inferior joint space), although double space arthrograms can also be performed. Basically, for single space arthroscopy, the auricular temporal nerve is anesthetized, and a small amount of local anesthetic is injected into the region of the joint puncture. Under fluoroscopic guidance, a 23-gauge needle is directed into the posterior inferior joint space. When the tip of the needle encounters the condyle, 0.2 to 0.4 ml of contrast material is injected into the posterior recess of the inferior joint space. Alter confirming that the contrast is in the proper space, the clinician instructs the patient to open and close the mouth, and dynamic videotape images are recorded during opening and closing. The pattern of dye deformation within the inferior joint space is the basis for diagnosing internal derangements.

Text continued on p. 18

FIG. 2.12

A





B

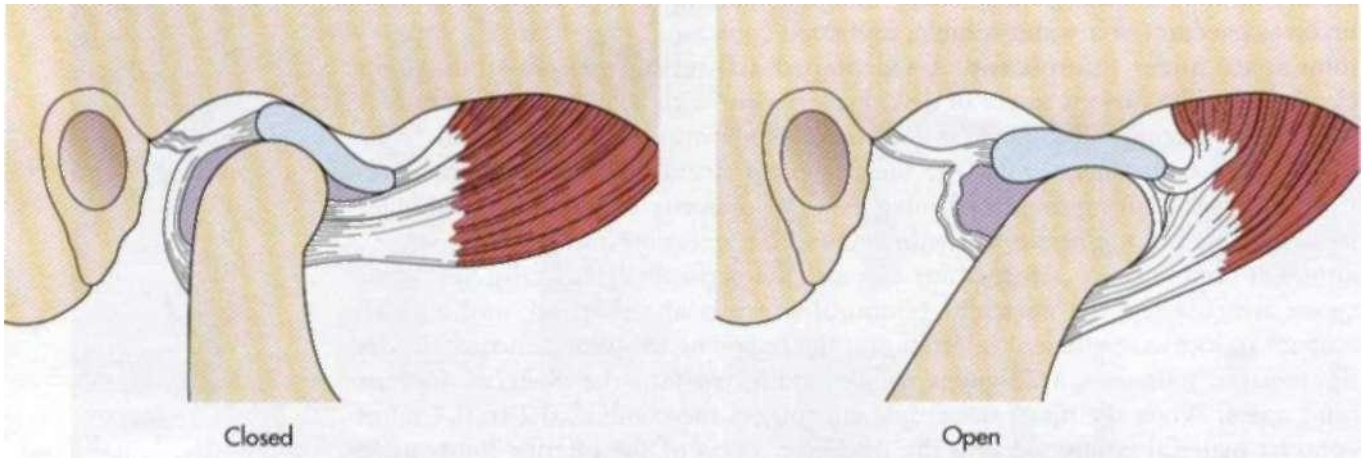
A, The normal condyle-disk relationship in the closed position. Mote that the junction of the posterior attachment and the posterior band correlates to the condylar head at the 12 o'clock position.
B, Arthrogram — Note 23-gauge needle entering the inferior joint space from a posterior inferior approach. This is performed under fluoroscopy to ensure that the dye is being injected into the inferior joint space and to note any immediate egress of the dye into the superior joint space, which would be consistent with meniscal perforation.

Continued

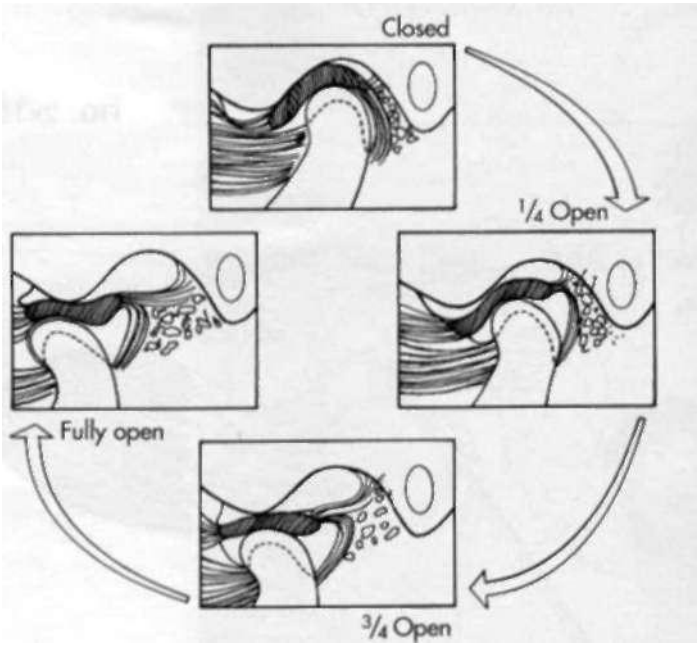
FIG. 2.12, CONT'D

Normal Temporomandibular Joint

C



D



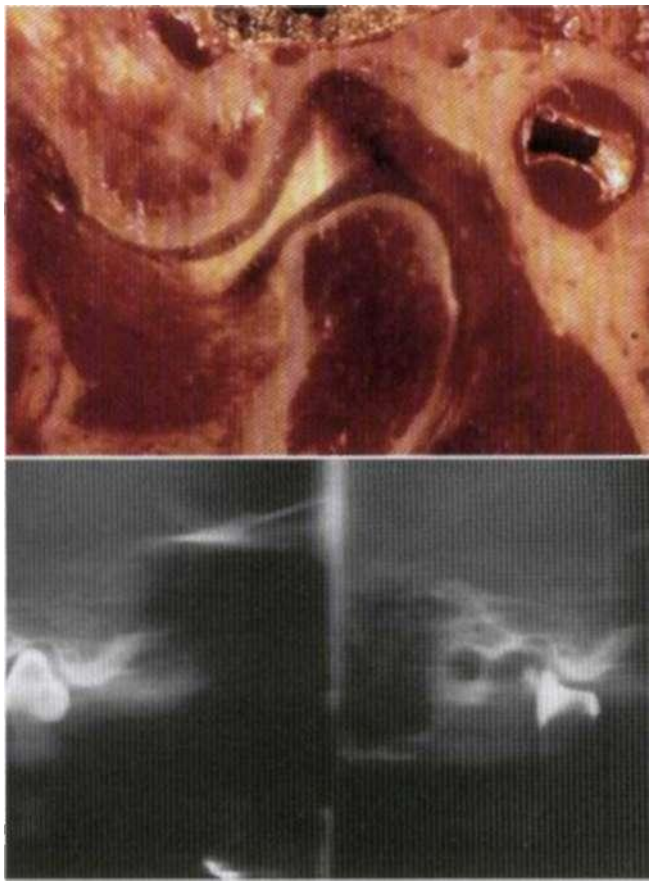
E

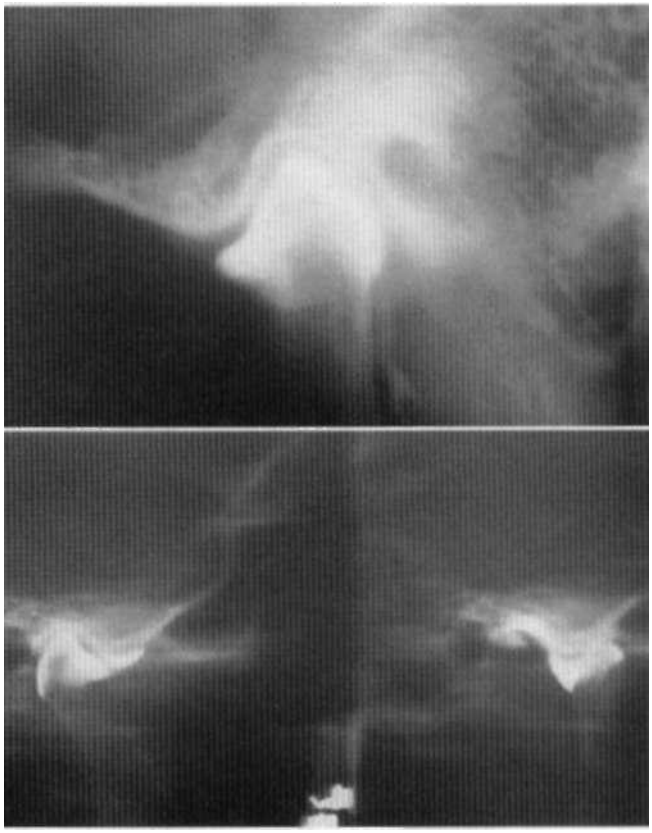


C, Arthrography findings in a normal temporomandibular joint articulation in the closed and open positions. Note that almost all the dye in the anterior recess of the inferior joint space is forced into the posterior -ecess at the terminal opening position. **D,** Diagrammatic representation of changes in inferior and superior joint spaces during condylar translation. **E,** Placement of 23-gauge needle into posterior recess of inferior joint space for placement of approximately 0.5 ml of iodinated contrast material.

FIG. 2.13

A



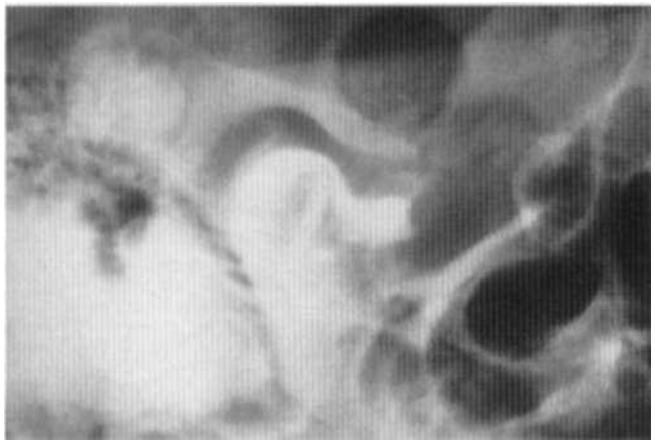


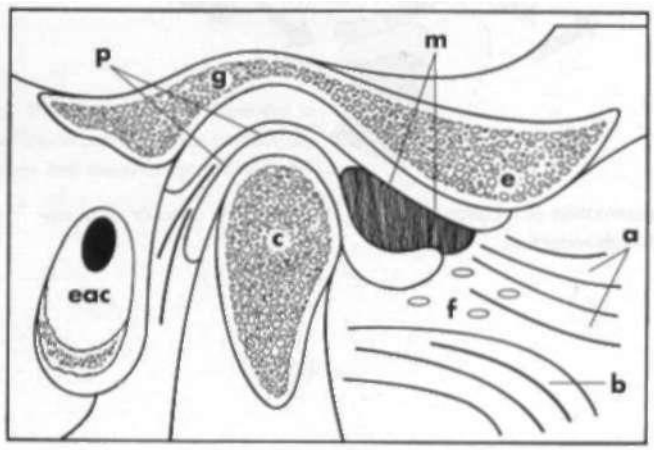
B

A, Sagittal section depicting normal condyle disk relationship. The inferior border of the meniscus outlines the superior boundary of the inferior joint space, as depicted in the single space arthrogram. **B,** Normal configuration of the inferior joint space in single space arthrography in the closed position **C,** Open and closed mouth views of normal, asymptomatic, healthy volunteer patient depicting expected deformation of inferior joint space during open and closed maneuvers. **D,** Same patient as in **C** with double contrast technique (injection of dye into both inferior and superior joint spaces).

FIG. 2.14

A





B

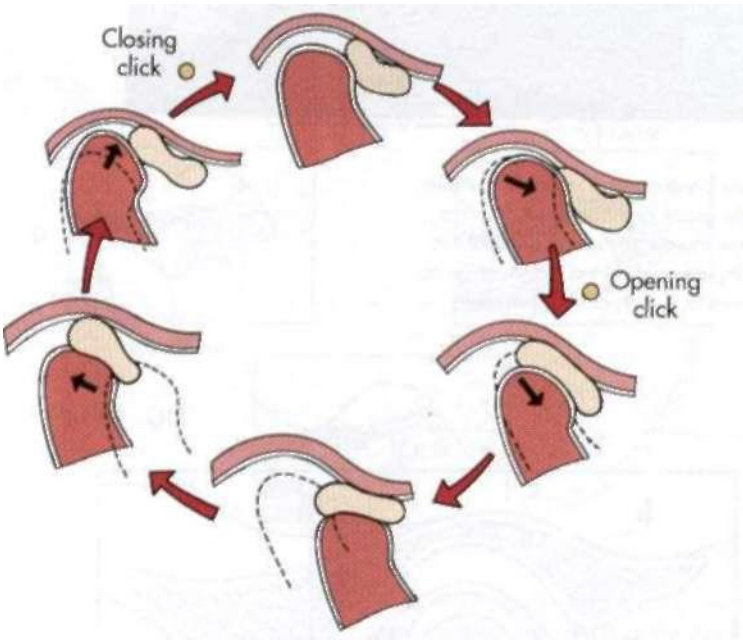
A, Inferior joint arthrography depicting anterior meniscal displacement with secondary deformity in the anterior recess of the inferior joint space. **B,** Arthrographic findings in **A.**

FIG. 2.15

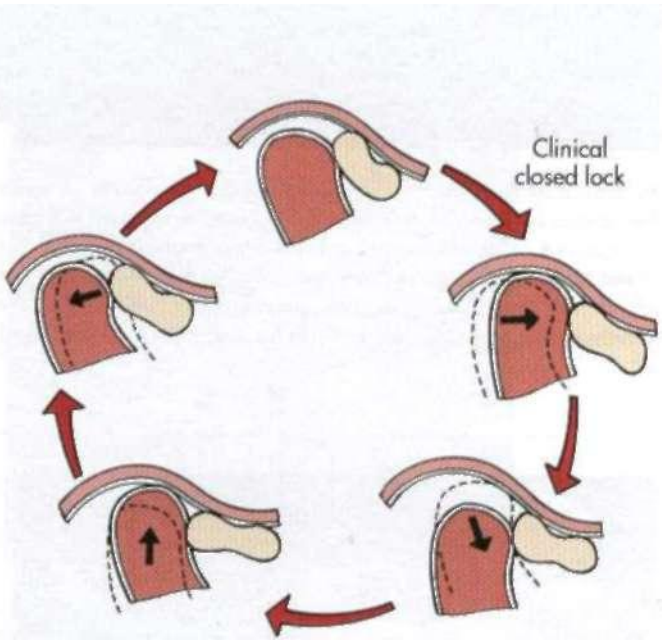


Anterior dislocation of meniscus secondary to stretching an elongation of the posterior attachment. Note that the junction of the posterior attachment and the meniscus approximately at the 3 o'clock position with regard to the condylar surface.

FIGS. 2.16, 2.17



Representation of reciprocal clicking, secondary to anterior displacement with reduction.

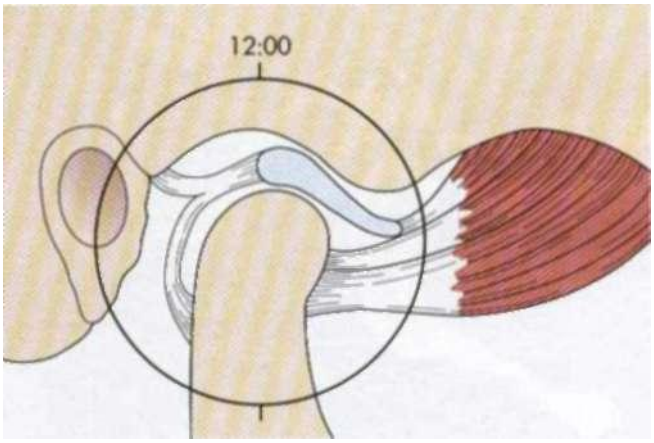


The closed-lock position, secondary to anterior displacement without reduction.

FIG. 2. 18

A

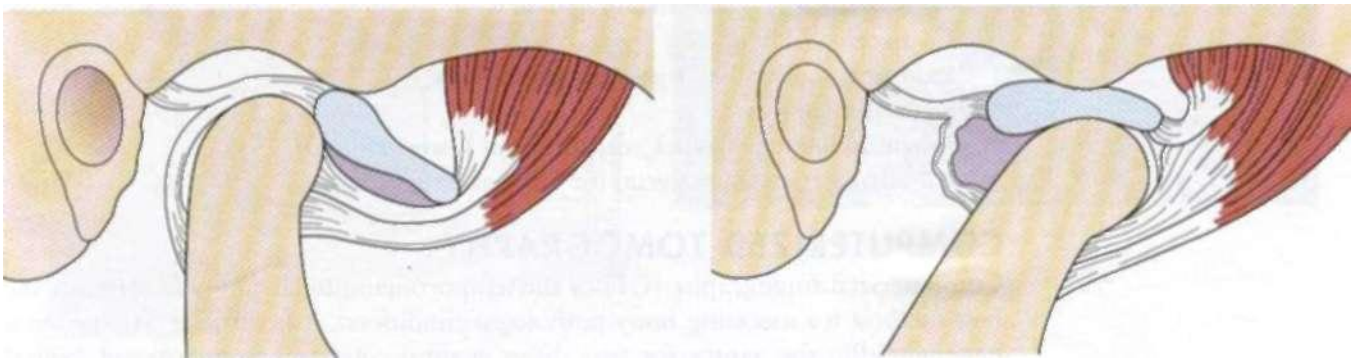




B

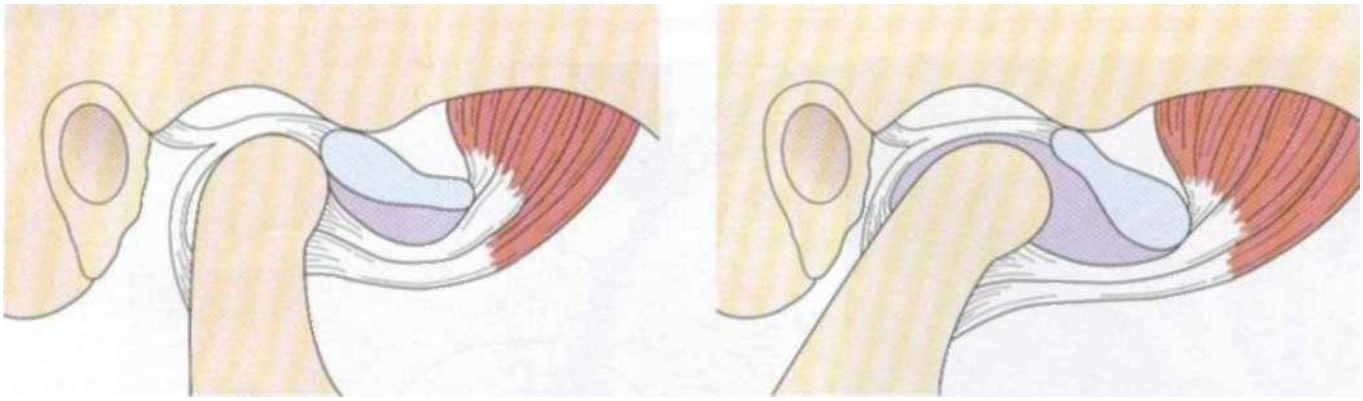
A, Sagittal section showing normal condyle disk position with junction of posterior attachment and posterior band of disk aligned approximately at the 12 o'clock position with regard to the condylar surface. **B,** Diagrammatic representation.

FIG. 2.19



Closed Open

Abnormal arthrogram in a patient with anterior dislocation with reduction. The abnormality is apparent in the closed position because the dye in the anterior recess is being pushed into a more inferior position by the displaced disk. On terminal opening, after reduction, the dye repositions into the posterior recess of the inferior joint space.



Closed Open

FIG. 2.20 Anletior dislocation without reduction (closed-lock) — arthrographic findings in a patient with a closed position. Even when the patient is in the position of maximol interincisal opening, the expected displacement of the dye into the posterior recess does not occur.

Potential complications from arthrography include allergic reaction to the contrast material, infection, and pain and swelling secondary to the mechanical instruments used during the procedure.

Magnetic resonance imaging has replaced arthrography in most instances for soft tissue imaging of the temporomandibular joint.

Disadvantages of Arthrography

- Invasiveness
- Pain (intraoperative or postoperative)
- Risk of infection
- Potential damage to disk, capsule, and fibrocartilage
- Allergy to contrast material (or local anesthetic)

COMPUTERIZED TOMOGRAPHY

Computerized tomography (CT) of the temporomandibular joints is currently the best method for assessing bony pathologic conditions. It is difficult to position a patient within the gantry for true direct sagittal cuts, and reconstructed sagittal views can be less than ideal.

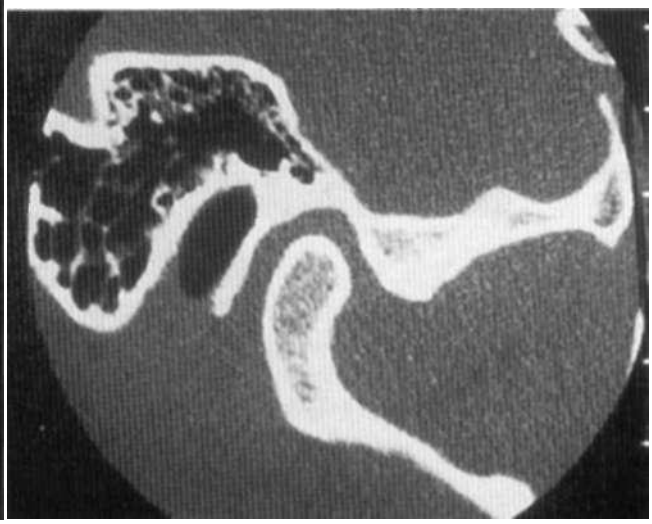
Axial and coronal views are excellent for assessing normal and abnormal osseous anatomy. CT images arc rarely used as the primary mode of diagnosing disk displacement. In most instances, accurate differentiation between meniscal tissue and portions of the lateral pterygoid muscle is difficult on CT. Disk displacement is frequently inferred from the degenerative changes seen on CT scanning, such as flattening of the anterior superior slope of the condyle, increased sclerosis, gross remodeling of the condylar head and articular eminence, and osteophyte formation.

Three-dimensional CT images can be helpful in cases of gross asymmetry for planning orthognathic surgery or joint reconstruction.

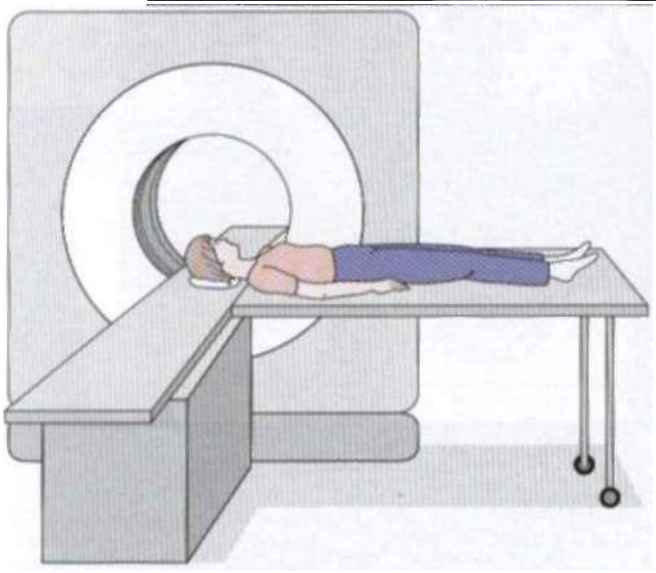
FIG. 2.21



A



B



C



D

A, Seoul film for direct sagittal CTs. Note thai even with ihese maneuvers, it is difficult to position the palient for a true sagittal view of the craniomandibular articulation. **B,** Direct sagittal bone window view of the temporomandibular joint. Note the detail and clarity of the osseous structure.**C,** Positioning of a patient for a direct sagittal CT scan of the temporomandibular joints. Note that a separate gurney must be used to bring the patient in at an angle to the CT gantry. The patient in this representation must also extend the left arm through the gantry to bring the joint into the proper plane for imaging **D,** Patient positioning for direct sagittal CT of temporomandibular joints.

FIG. 2.22

Direct sagittal CT scans of the right temporomandibular joint with a bone window **(A** and **B)** and the same patient image with a soft tissue window **(C** and **D).** Note the difficulty in ascertairing the exact position of the meniscus in the soft tissue windows. This is clearly the reason that CT scanning remains the gold standard in the diagnosis of osseous pathologic conditions within the joint but is not widely used for diagnosis of internal derangement.

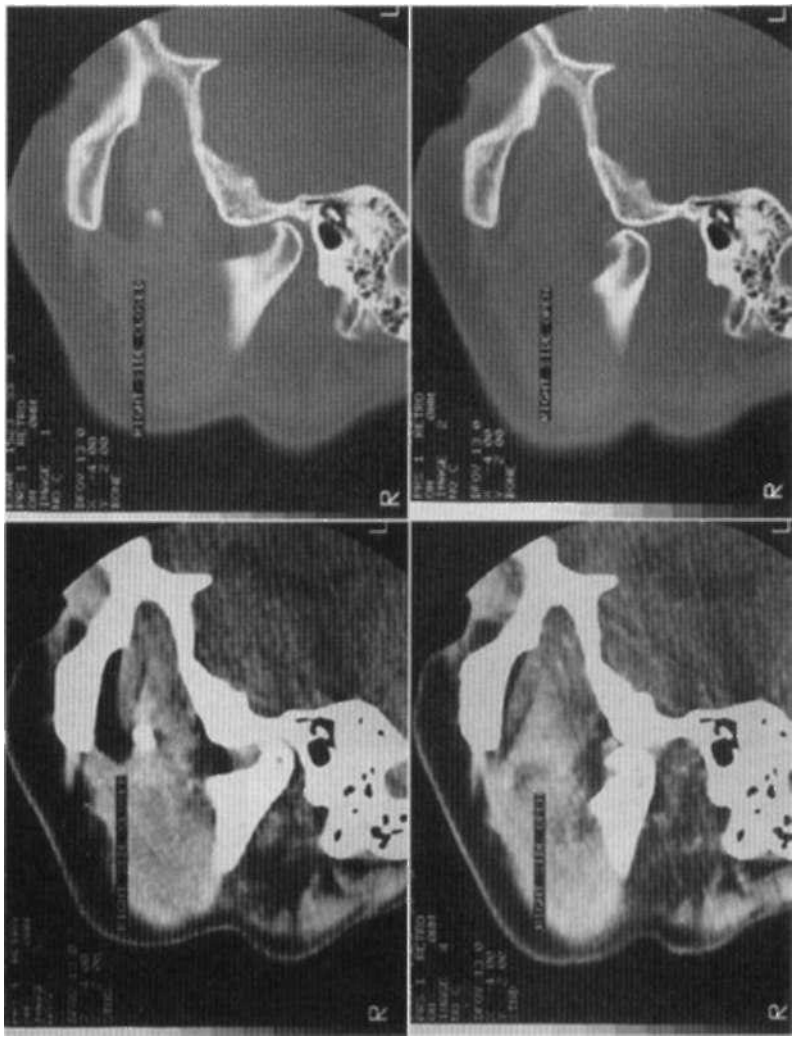


FIG. 2.23

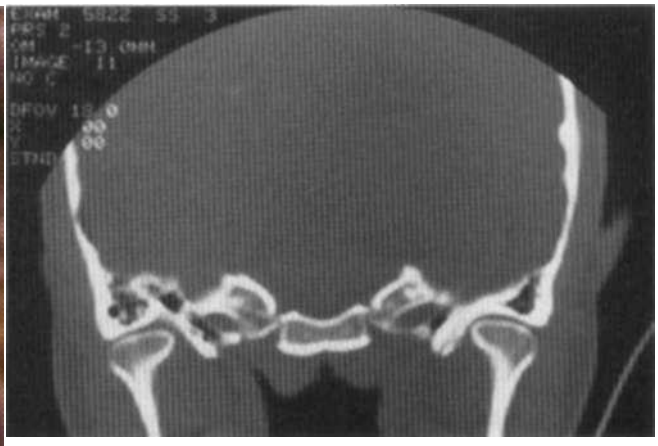


A, Computer tomogram of the temporomandibular joint in coronal plane depicting marked sclerosis of the temporomandibular joint with evidence of fibroosseous ankylosis of the joint. **B,** Axial computer tomogram of the same patient, depicting that sclerosis also affects the base of the skull.

FIG. 2.24

A



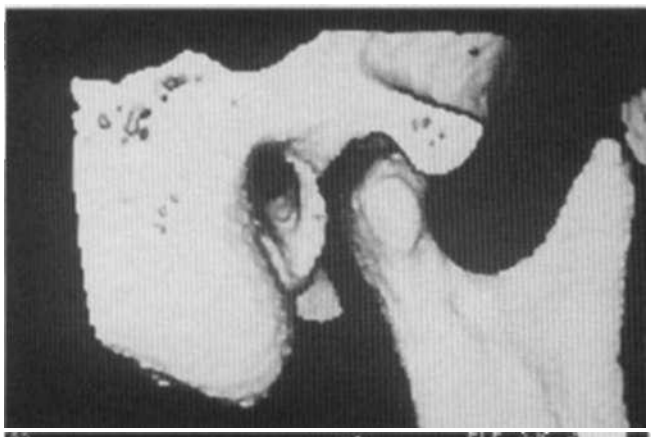


B

A, Autopsy specimen of mandibular condyle in anterior posterior view showing dimensions from medial to lateral pole, which can average between 17 and 23 mm. **B,** Coronal CT scan through midpoint of condyle, showing normal condylar structure and joint space dimension.

FIG. 2.25

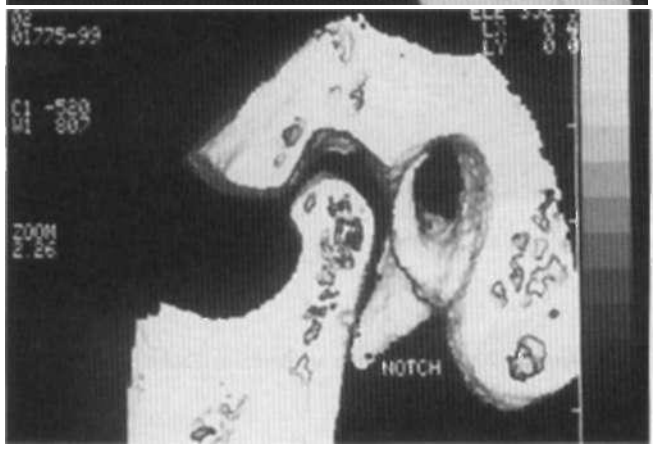
A





B

C

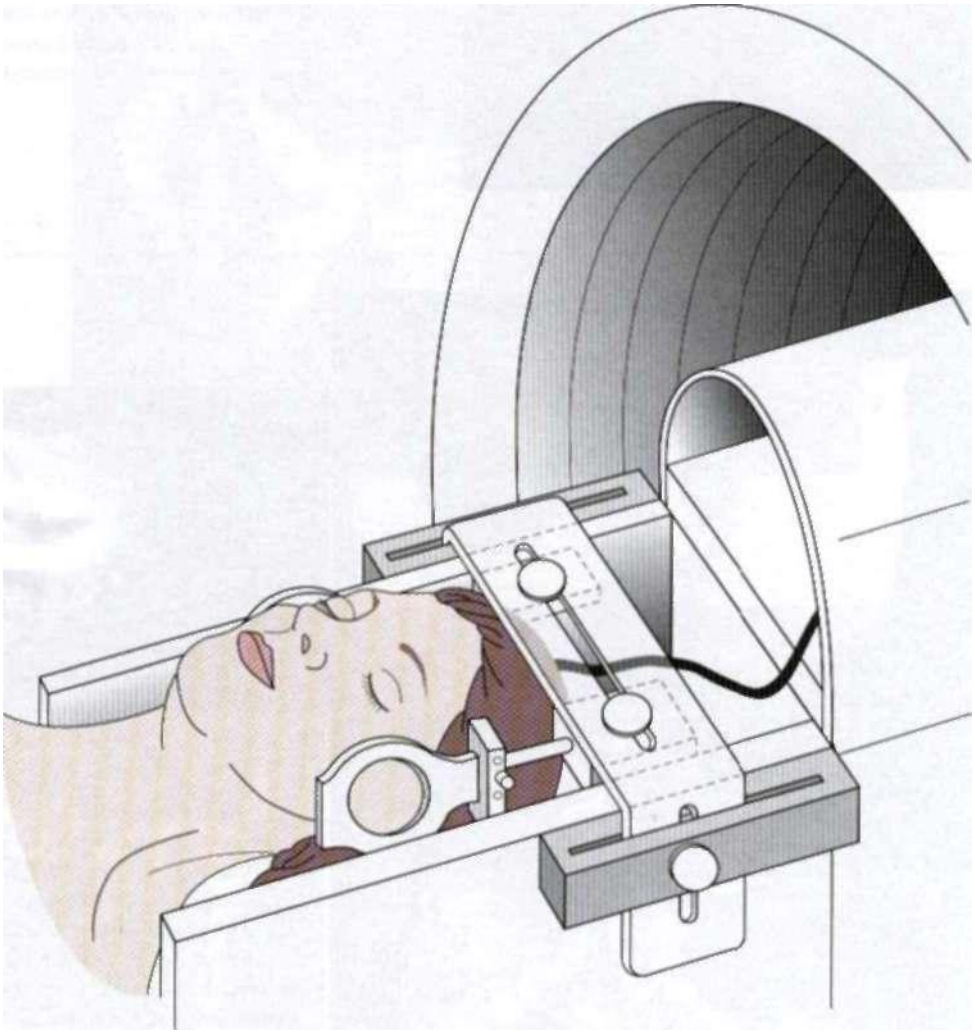


A, Three-dimensional CT scan reconstructed with axial and coronal cuts. Note that there is no edging at the boundaries of the individual CT cuts because the software interprets the imaging gaps based on standard algorithms. **B, C,** Computer manipulation of three-dimensional CT scan that allows selected and specific views of osseous anatomy. Note the small defect on the posterior surface of the neck of the condyle in **B.** It depicts a defect created with '/2-mm round bur in an autopsy specimen to illustrate the sensitivity of this imaging technique.

MAGNETIC RESONANCE IMAGING

Magnetic resonance (MR) images can be obtained in the sagittal, axial, and coronal planes. Slice thickness usually varies between 3 and 10 mm. Thinner sections result in improved image quality because "volume averaging" of the structures is reduced. In most normal scanning sequences, both Tl weighted and T2 weighted images will be obtained. With the most commonly used pulsed sequence (spin-echo), Tl weighted images highlight fat within the tissues and T2 weighted images may give a poorer image quality but highlight water-containing structures. These T2 weighted images are particularly helpful when the operator is attempting to determine whether a joint effusion exists. The major contraindication to magnetic resonance imaging (MRI) is posed by ferromagnetic metals. Ferromagnetic clips used to treat

FIG. 2.26



Proper head positioning for dual surface coil MR study of the temporomandibular joints.

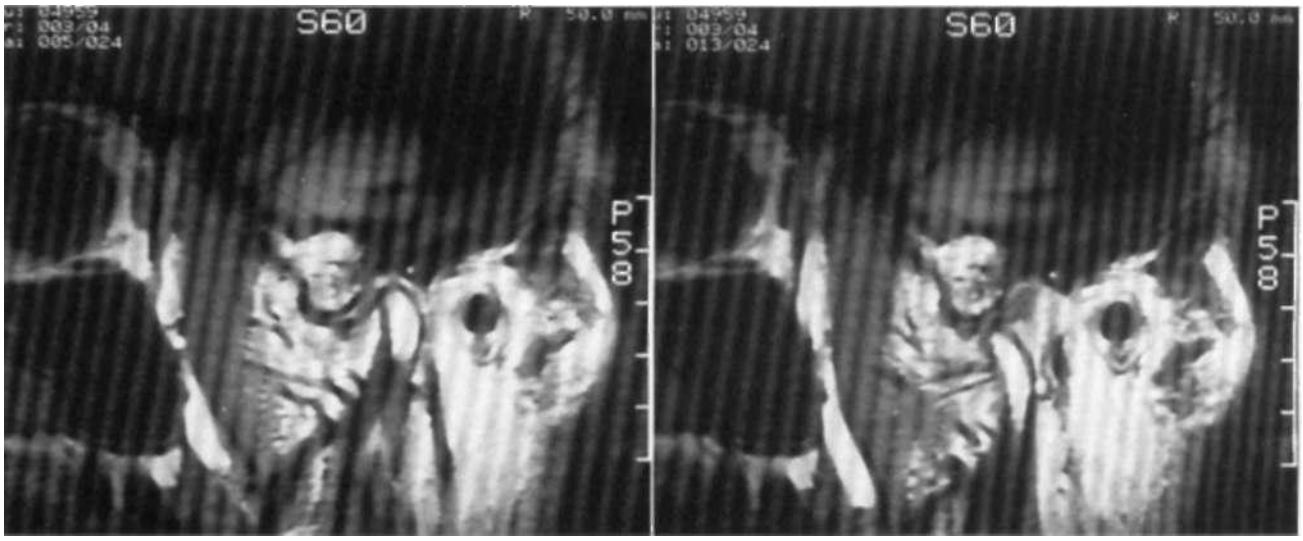
a cerebral aneurysm are an absolute contraindication to MR scanning. The other absolute contraindication occurs with patients who have cardiac pacemakers. Nonfcrromagnetic metals, such as those used in orthodontic braces and Vitallium prostheses, do not pose problems related to magnetic fields but do compromise image quality because of artifact production. Although MRI is clearly preferred for assessing internal derangements, all patients with joint symptoms do not require MR studies. Transcranial radiographs or condyle-specific panoramic films are certainly adequate to assess whether a patient has gross degenerative changes within the joint. If a reasonable attempt at conservative therapy does not improve symptoms and further documentation of the internal derangement is necessary to determine whether the patient may be a surgical candidate, then MRI should be considered.

FIG. 2.27



A, B, Coronal **MR** images of temporomandibular joint in asymptomatic individual.

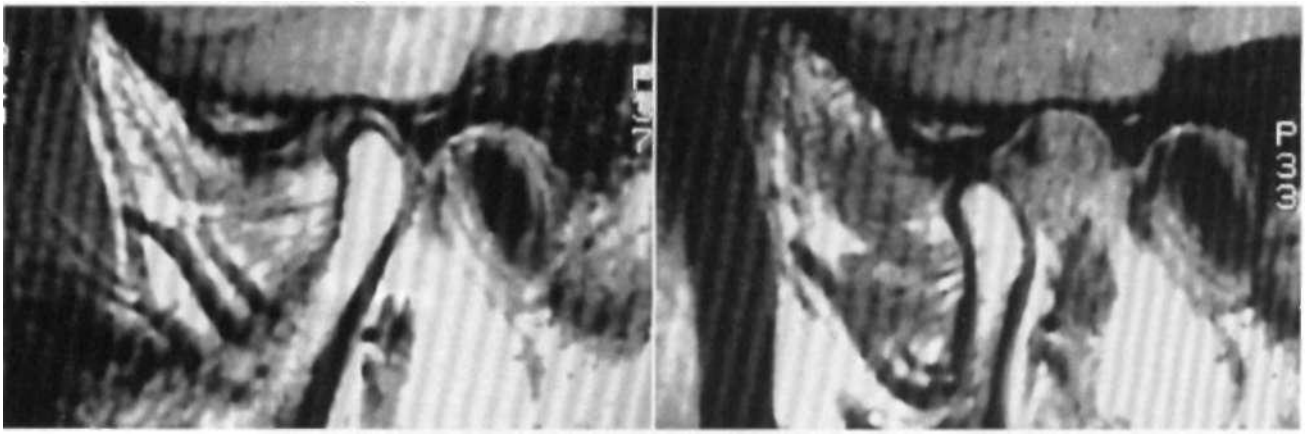
FIG. 2.28



A B

A, B, Open and closed views of right temporomandibular joint with early anterior disk displacement with reduction. Note absence of any osseous degenerative changes in condyle.

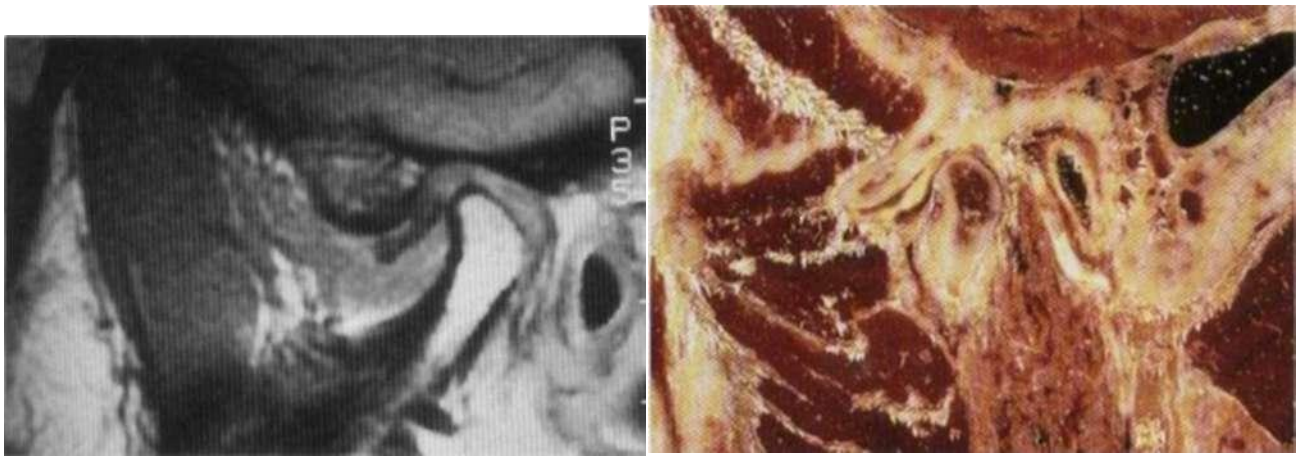
FIG. 2.29



A B

A, B, Open and closed views of right temporomandibular joint with anterior disk displacement with reduction. Note thickening of cortical bone on anterior superior slope of condyle, which suggests early reactive sclerosis secondary to increased loading from anterior disk displacement.

FIG. 2.30



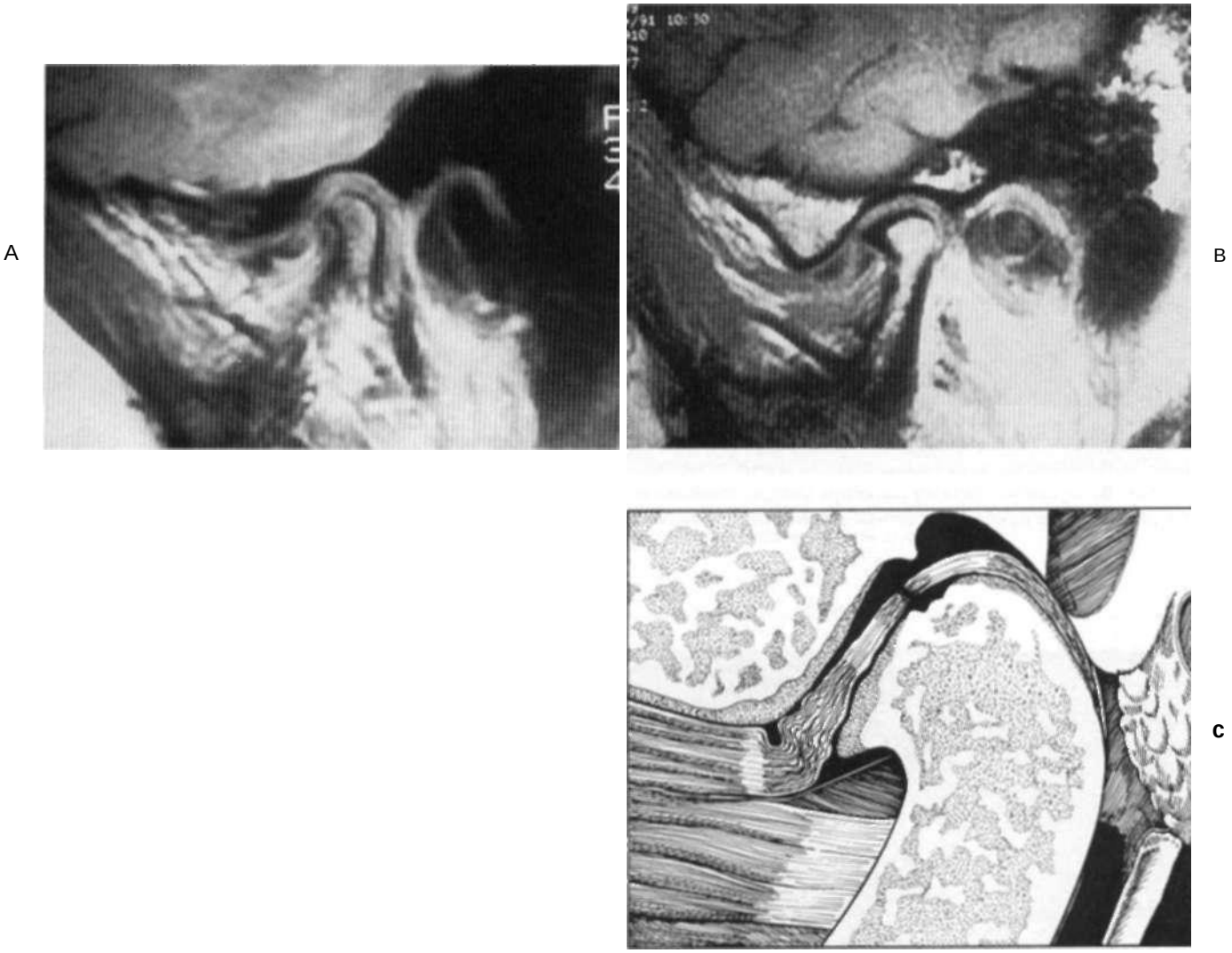
A, Closed mouth MRI of joint with reciprocol clicking. Note displacement of disk with the junction of the posterior band and the posterior attachment at approximately the 2 o'clock position relative to the condyle. **B,** Cryosection showing pathologic changes consistent with displaced disk. Note thickening of the posterior band as one of the earliest morphologic changes associated with anterior displacement.

FIG. 2.31



Open **(A)** and closed **(B)** MR image of right temporomandibular joint showing anterior disk displacement without reduction.

FIG. 2.32



A, Closed mouth MR image showing late stage degenerative changes of condylar head with marked nonreducing anterior displacement of disk. Note distortion of meniscal tissue with shortening of the anterior-posterior disk length. Also, note loss of cortical bone on the anterior-superior slope with early beaking of the condyle, which suggests degenerative joint disease. **B,** Advanced degenerative changes of condylar secondary to long-standing disk displacement. Note birds beaking of condyle with complete loss of meniscal structure. **C,** Advanced degenerative joint disease secondary to long-standing disk displacement.

FIG. 2.33

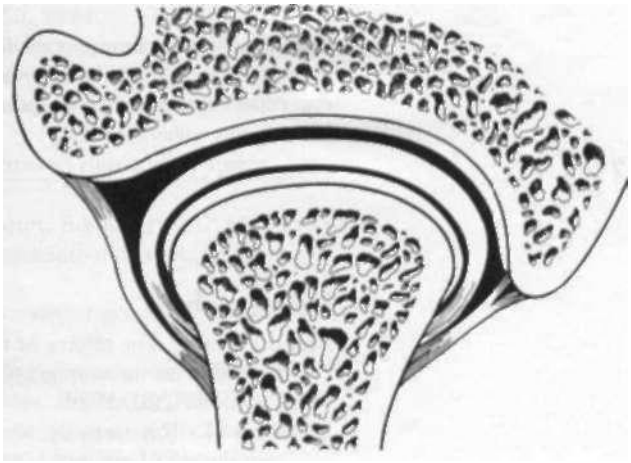


Coronal MRI—normal joint.

FIG. 2-34



A



B

A, Coronal MRI showing lateral herniation of meniscol tissue. **B,** Condylar coronal view with capsular and meniscal medial and lateral attachments.

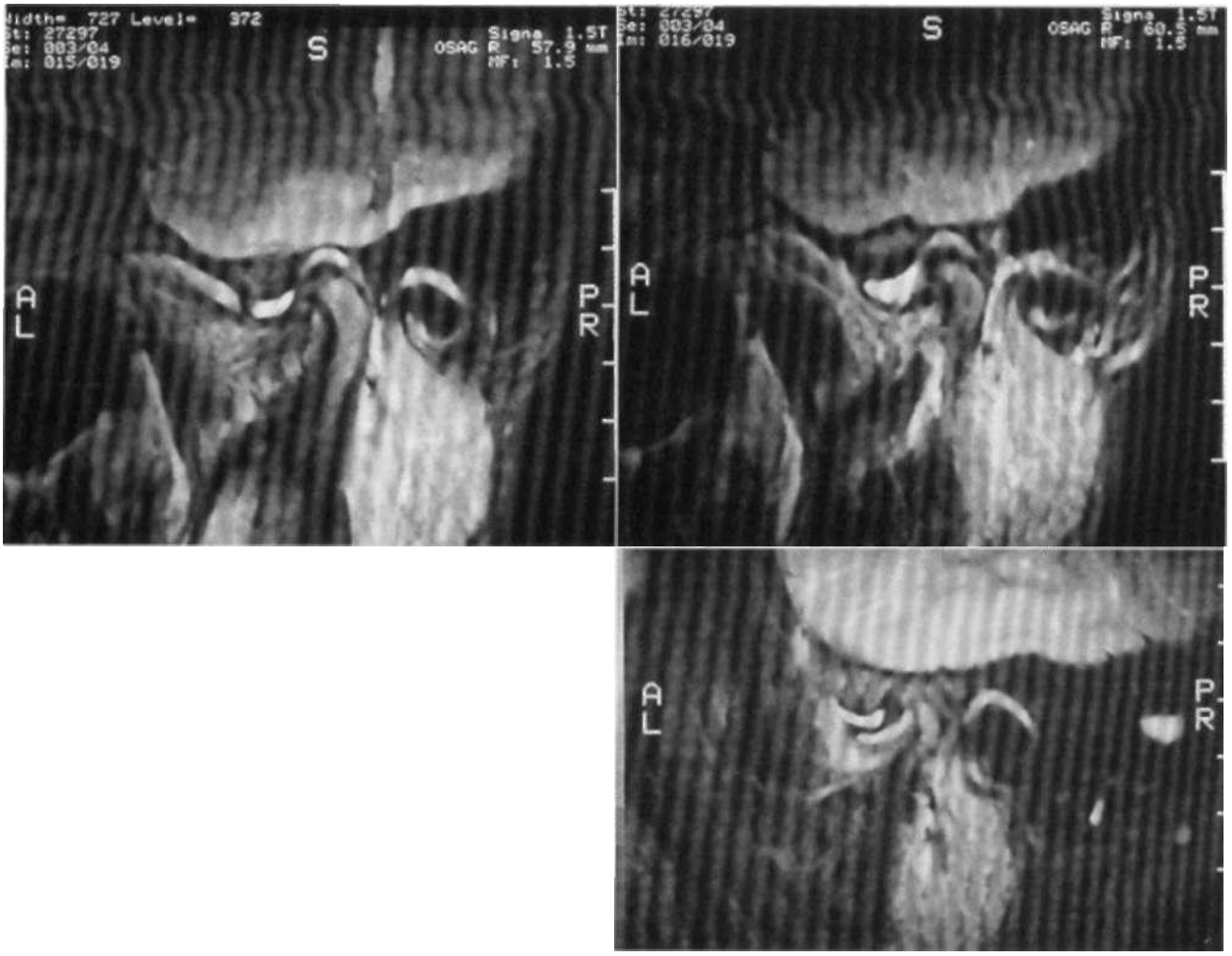


FIG.2.35

A, B, Postmeniscectomy joint effusion. **C,** T-2 weighted sogittal MRI of the temporomandibular joint showing a bright signal in the anterior and inferior joint space. Also, note the anterior displaced meniscus. Patient had recently undergone blunt symphyseal trauma, and arthroscopic examination confirmed a hemarthrosis within the joint,

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CHAPTER THREE

SURGICAL APPROACHES TO THE TEMPOROMANDIBULAR JOINT

Access to the temporomandibular joint is the *sine qua nan* of surgical success. Serious morbidity from facial nerve injury can overshadow the mechanical improvements in joint function and the amelioration of painful symptoms. Incisions were described by Humphrey in 1856 for condylectomy, Ricdel for meniscectomy in 1883, and Annandale for disk repositioning in 1887.

The main potential anatomic problems in temporomandibular joint surgery are the facial nerve and the terminal branches of the external carotid artery. Approaches to the joint include the following:

- Preauricular
- Endaural
- Postauricular
- Rhytidectomal
- Submandibular
- Intraoral

Ideally, the selected approach should accomplish the following:

- Maximize exposure for the specific procedure
- Avoid damage to the branches of the facial nerve
- Avoid damage to major vessels (e.g., internal maxillary artery, retromandibular vein)
- Avoid damage to the parotid gland
- Maximize use of natural skin creases for cosmetic wound closure

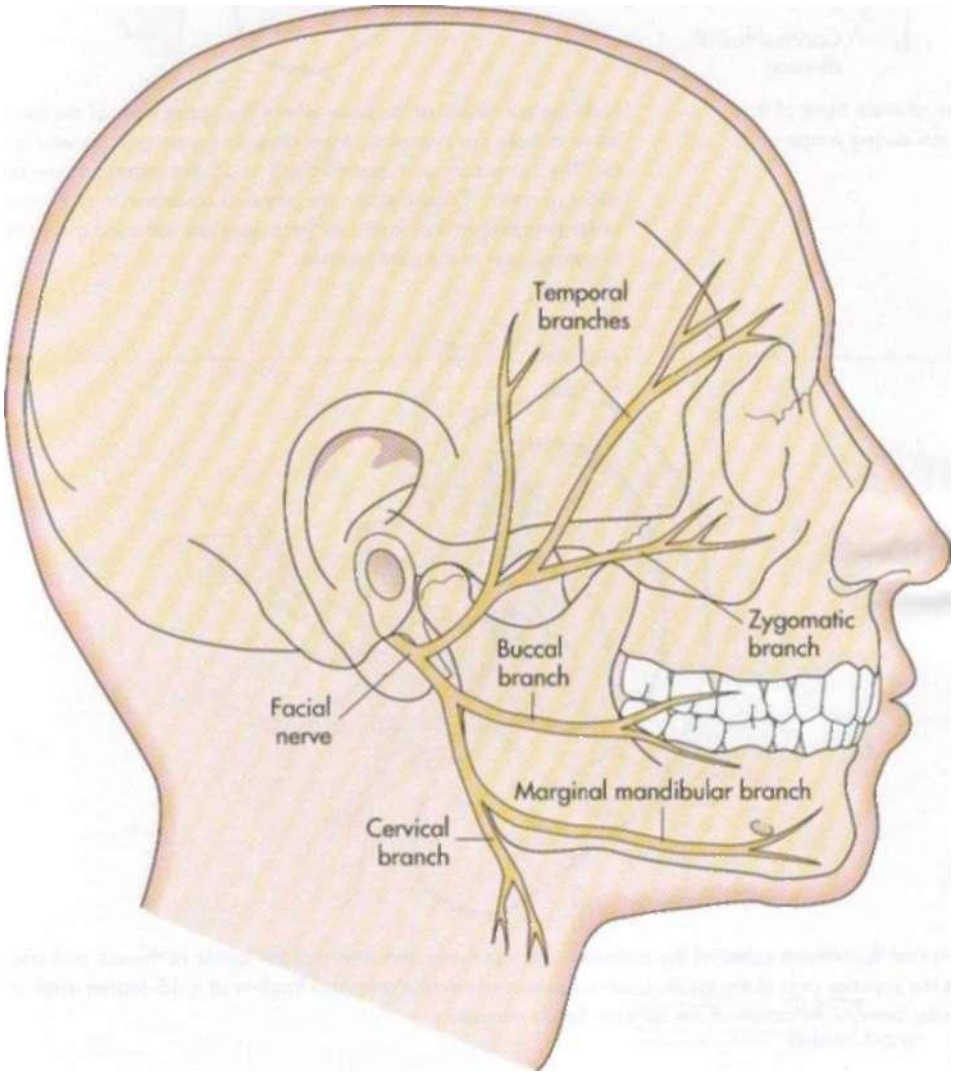
APPLIED ANATOMY

Facial Nerve

The main trunk of the facial nerve exits from the skull at the stylomastoid foramen. The suture line between the tympanic and mastoid portions of the mastoid bone is a reliable anatomic landmark because the main trunk of the facial nerve lies 6 to 8 mm inferior and anterior to this tympanomastoid suture. Approximately 1.3 cm of the facial nerve is visible until it divides into temporofacial and cervicofacial branches. In the classic article by Al-Kayat and Brantley (1980), the distance from the lowest point of the external bony auditory canal to the bifurcation was found to be 1.5 cm to 2.8 cm (mean, 2.3 cm), and the distance from the postglenoid tubercle to the bifurcation was 2.4 cm to 3.5 cm (mean, 3.0 cm). The most variable measurement was the point at which the upper trunk crosses the zygomatic arch. It ranged from 8 mm to 35 mm anterior to the most anterior portion of the bony external auditory canal (mean, 2.0 cm). By incising the superficial layer of the temporalis fascia and the periosteum over the arch inside the 8 mm bound-

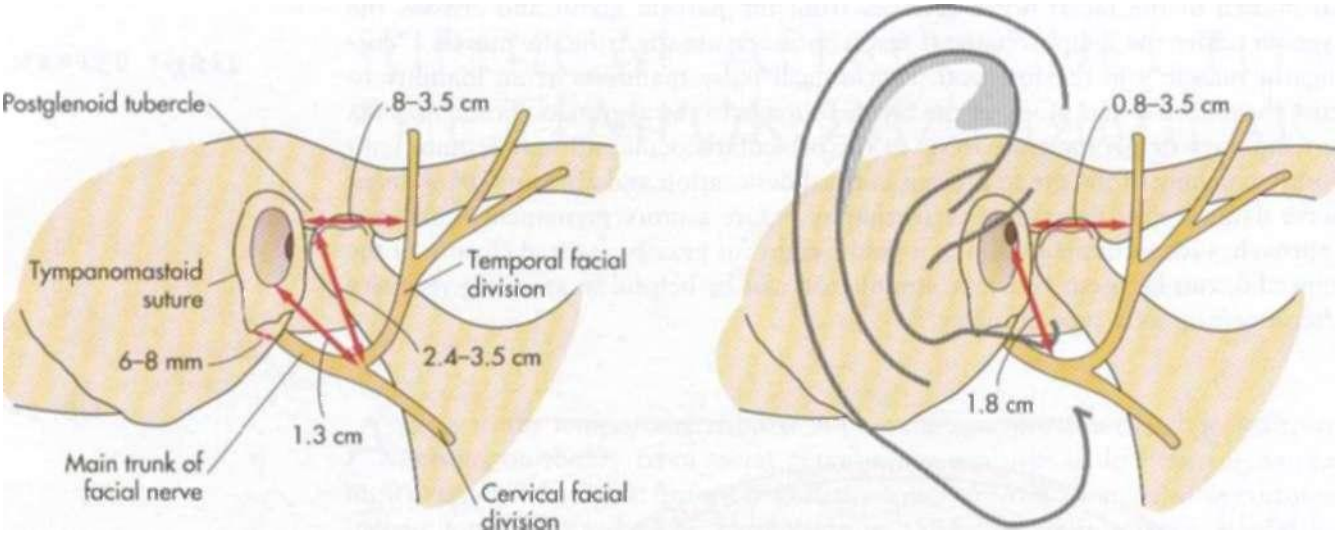
ary, surgeons can prevent damage to the branches of the upper trunk. The temporal branch of the facial nerve emerges from the parotid gland and crosses the zygoma under the temporoparietal fascia to innervate the frontalis muscle ("corrugaror muscle") in the forehead. Postsurgical palsy manifests as an inability to raise the eyebrow and ptosis of the brow. Damage to the zygomatic branch results in temporary or permanent paresis to the orbicularis oculi and may require temporary patching of the eye to prevent corneal desiccation and abrasion. Permanent nerve damage may necessitate tarsorrhaphy before a more permanent functional approach, such as implantation of a gold weight for gravity-assisted closure of the upper lid, can be used. Galvanic stimulation can be helpful in speeding recovery after a neuropraxia type of injury.

FIG. 3-1



Facial nerve emerging from stylomastoid foramen showing division into upper trunk with temporal and zygomatic branches and lower trunk with buccal, marginal, mandibular, and cervical branches.

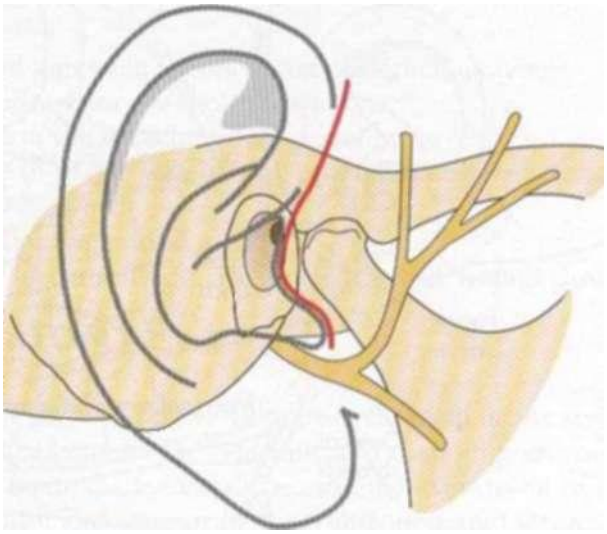
FIGS. 3.2, 3.3



Surgical landmarks for identifying location of main trunk of the facial nerve and the temporal-facial division during temporomandibular joint arlhroplastic dissection.

Note the variability at the point where the upper trunk of the facial nerve crosses the zygomatic trunk deep to the temporoparietal fascia. The nerve can cross point from 8 to 35 mm anterior lo the bony auditory canal. Consequently, the plane of dissection must be deep to the temporoparietal fascia as the tissues are retracted anteriorly to gain access to the joint capsule.

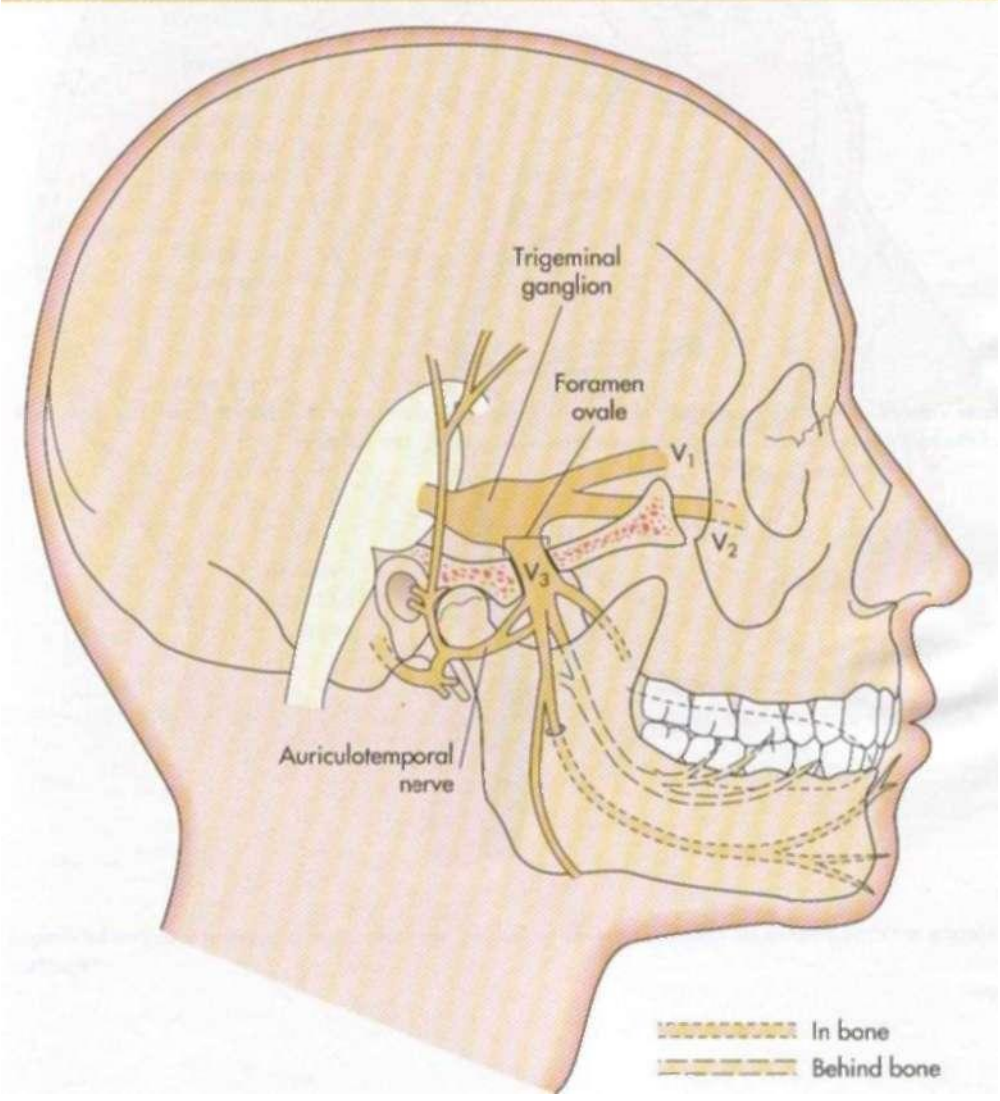
FIG. 3.4



Note that the inferior extent of the incision is the soft tissue attachment of the lobule of the ear and also that the superior arm of the incision can be extended into the temporal hairline at a 45-degree angle if greater anterior retraction of the surgical flap is necessary.

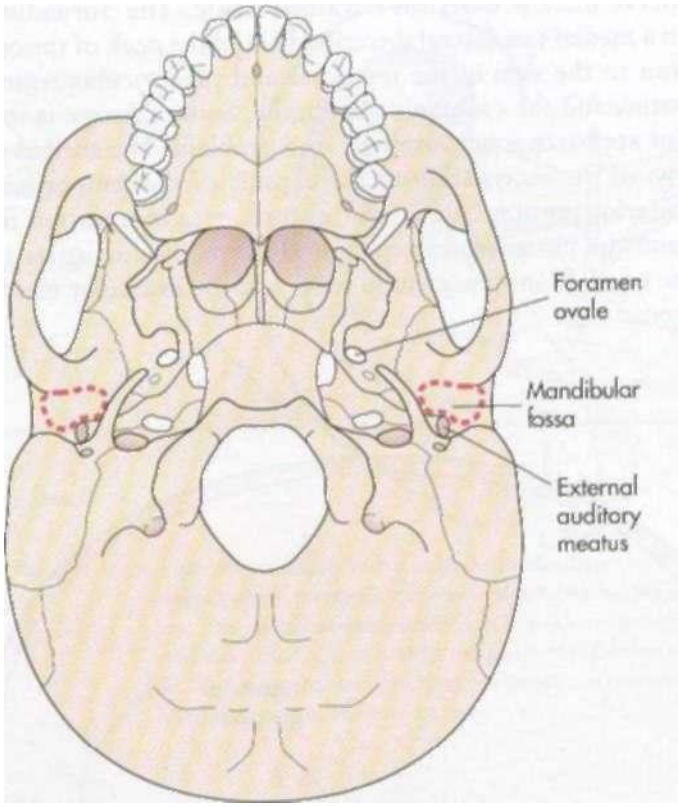
The auriculotemporal nerve is the first branch off the third division of the trigeminal nerve after it exits the foramen ovale. The auriculotemporal nerve courses from a medial to a lateral direction behind the neck of the condyle and supplies sensation to the skin in the temporal and preauricular region, the anterior external meatus, and the tympanic membrane. Some damage is inevitable during standard joint approaches but rarely poses a problem. The auriculotemporal nerve provides most of the innervation to the capsule of the temporomandibular joint itself. The anterior portion of the joint also receives innervation from the masseteric nerve and the posterior deep temporal nerve. The articular cartilage on the surface of the condyle and the glenoid fossa and the avascular meniscus itself have no innervation.

FIG. 3.5



Depiction of the auriculotemporal nerve emerging from the third division of the trigeminal nerve coursing behind the neck of the condyle. The nerve hnervates the majority of the capsule and meniscal-attachment tissues. The capsule is also innervated by the masseteric and posterior deep temporal nerves.

FIG. 3.6

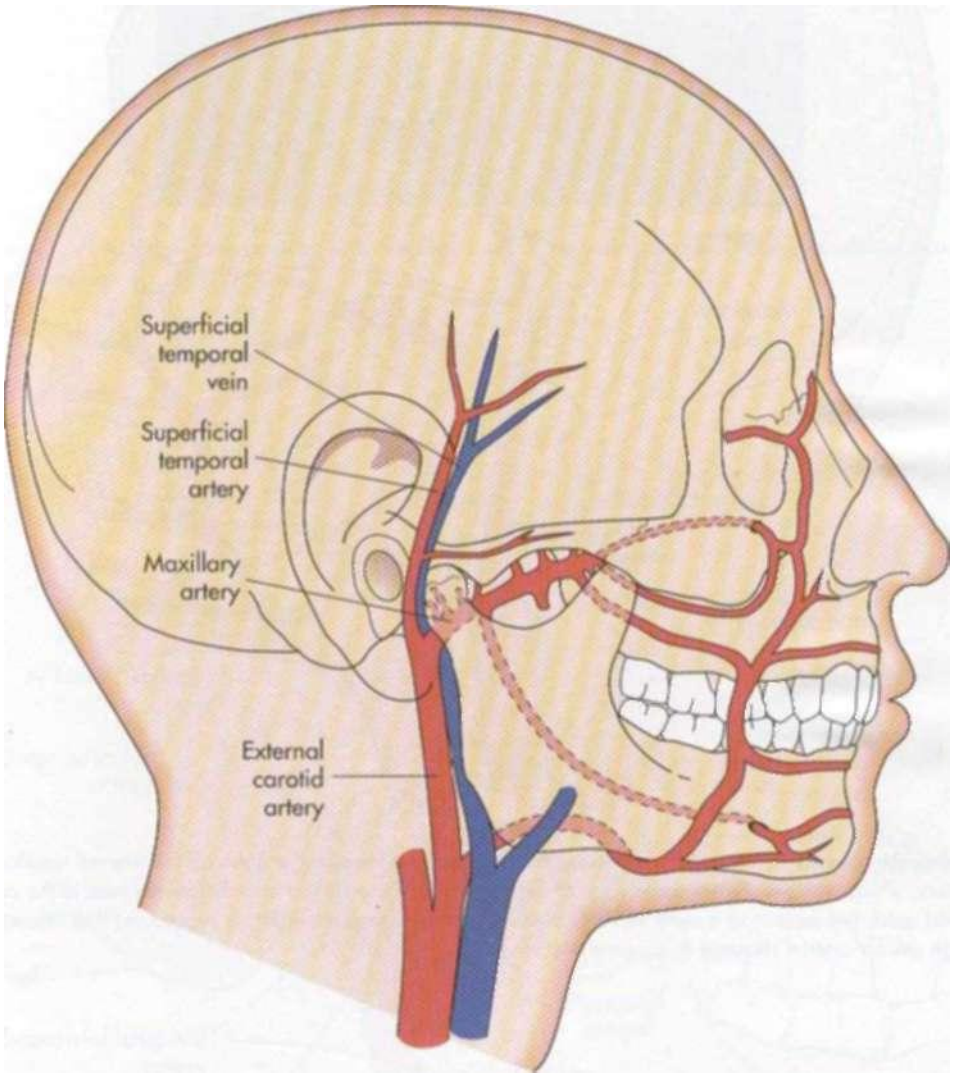


Base view of skull, showing position of foramen ovale in relation to the mandibular fossa. The main trunk of the, fnrinl nerve would rarely be encountered during open joint surgery.

VASCULAR ANATOMY

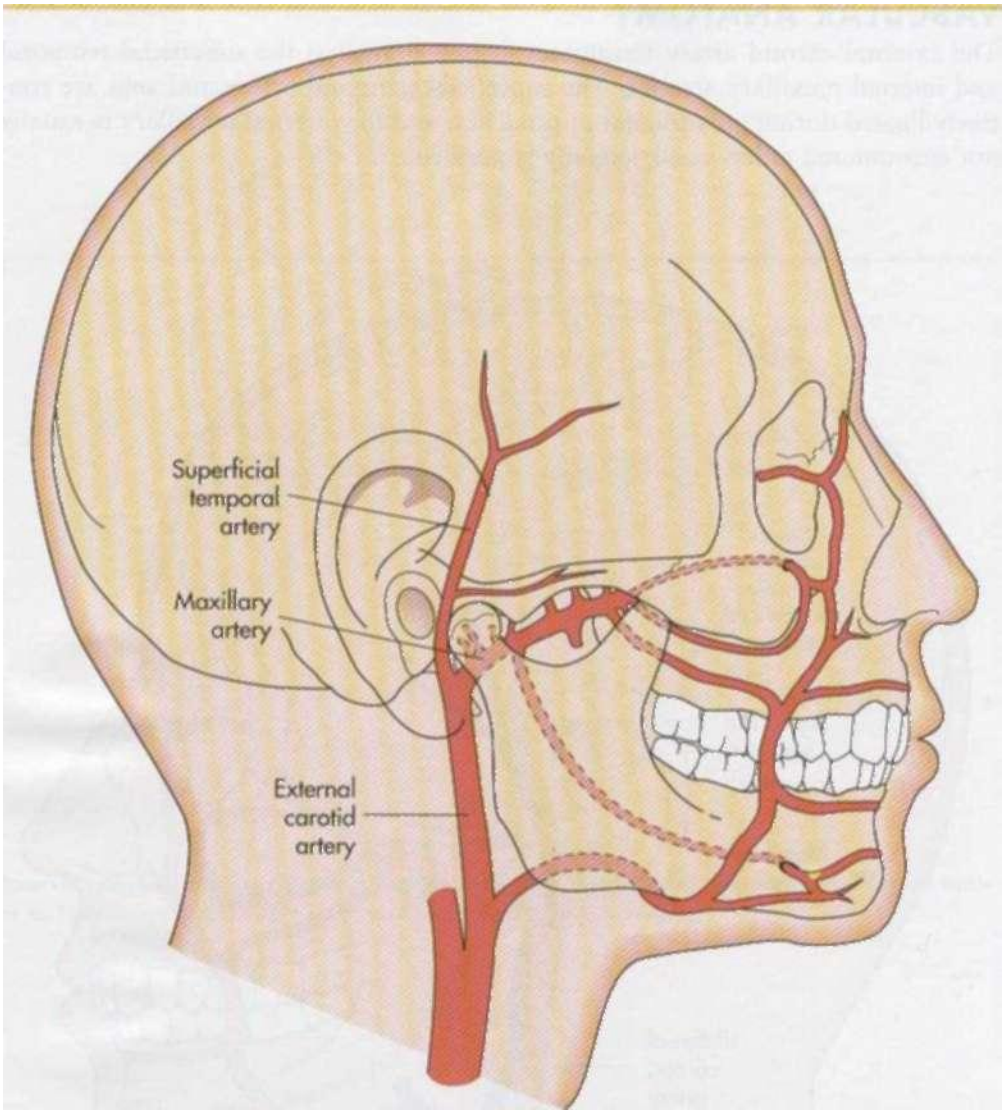
The external carotid artery terminates in two branches: the superficial temporal and internal maxillary arteries. The superficial temporal artery and vein are routinely ligated daring preauricular approaches, and the internal maxillary is usually not encountered unless condylectomy is performed.

FIG. 3.7



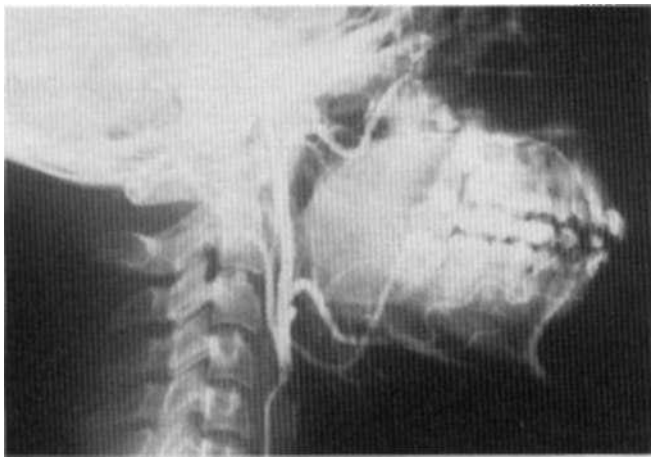
Superficial temporal artery and vein, which run just below the subcutaneous tissue anterior to the tragal cartilage.

FIG. 3.8



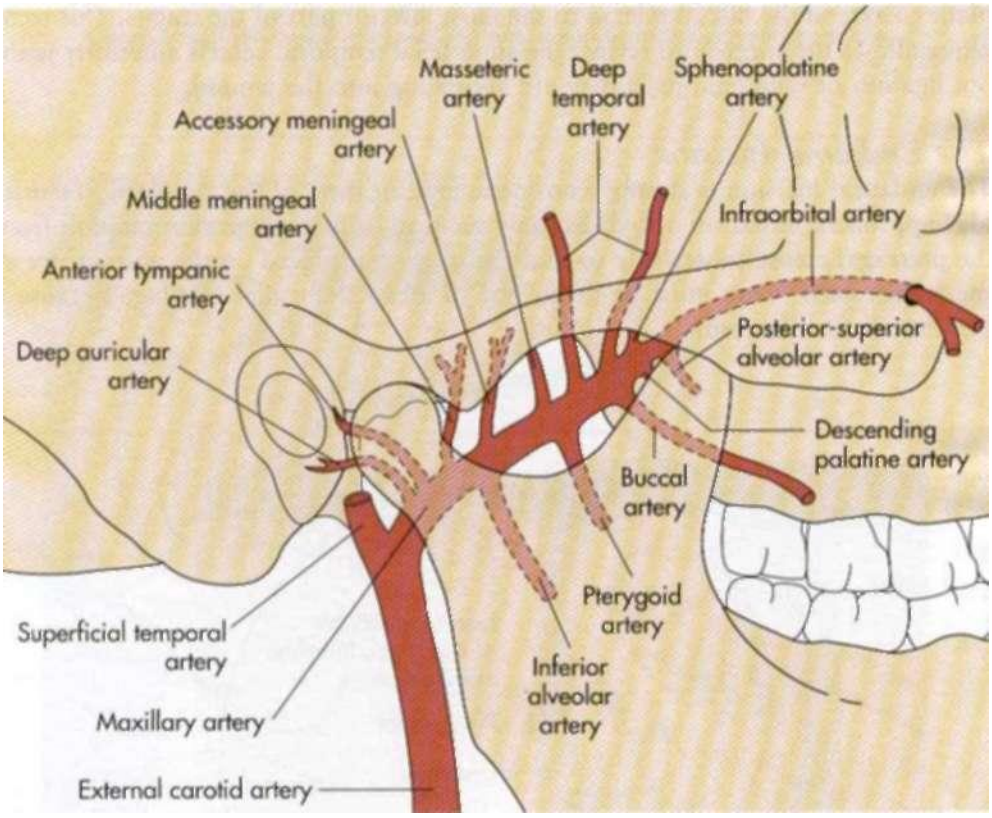
Before the external carotid artery terminates as the superficial temporal, it gives off the internal maxillary artery, which runs deeply below the neck of the condyle. It is usually just at or below the level of the sigmoid notch but can run in a more superior plane and must be protected during procedures that present a high risk for arterial damage (e.g., condylectomy).

FIG. 3.9



External carotid angiogram showing superficicl temporal artery with prominent facial and internal maxillary branches.

FIG. 3.10



Detailed view of the maxillary artery and its branches. The middle meningeal artery courses medially from the maxillary artery, and the masseteric artery runs laterally through the sigmoid notch. Both the maxillary ond the masseteric arteries can be damaged during extensive dissection.

Preauricular Approach

Extensive shaving at the site of surgery is unnecessary. A margin of 1 cm from the most superior aspect of the incision is adequate, and this should not require skin propping above the most superior point of the auricle. The shape of the incision is that of an inverted hockey stick, which follows the natural crease in front of the tragus. This should suffice for most arthroplastic procedures, but if greater access is required, the Al-Kayat and Bramley (1980) modification with temporal extension can be used. An incision is made through skin and subcutaneous tissue to the superficial temporal fascia. The superficial temporal artery and vein run just above the surface of the fascial layer, and the branches of the facial nerve run deep to it, just above the periosteum over the zygomatic arch. Above the zygomatic arch the superficial layer of the temporal fascia is incised in an oblique line running from the tragus to the superior end of the skin incision. This incision is parallel to the inverted hockey-stick incision. A mosquito hemostat is used to dissect bluntly along the external auditory canal in an anterior-medial direction to the level of the temporomandibular joint capsule. A #15 blade is used to make an incision along the root of the zygoma through the superficial temporal fascia and the periosteum. This is contiguous with the incision superior to the arch. With blunt hemostat dissection a plane is developed through this incision, just above the white, glistening temporomandibular joint capsule. While elevating this "pocket," the surgeon uses a blade to extend the fascial release to the most inferior part of the tragus. This technique allows the surgeon to retract the superficial temporal vessels anteriorly without ligation or with ligation if they are herniating into the wound.

The Endaural Incision

The endaural incision is simply a cosmetic modification of the standard preauricular approach. Based on a rhytidcctomy incision, it moves the skin incision from the pretragal crease posteriorly so that the incision is placed on the prominence of the tragus itself. Care must be taken not to incise the tragal cartilage because a perichondritis may result.

FIG. 3-11

Endaural and preauricular incisions. Note the optional temporal extension for more exaggerated anterior flap retraction.

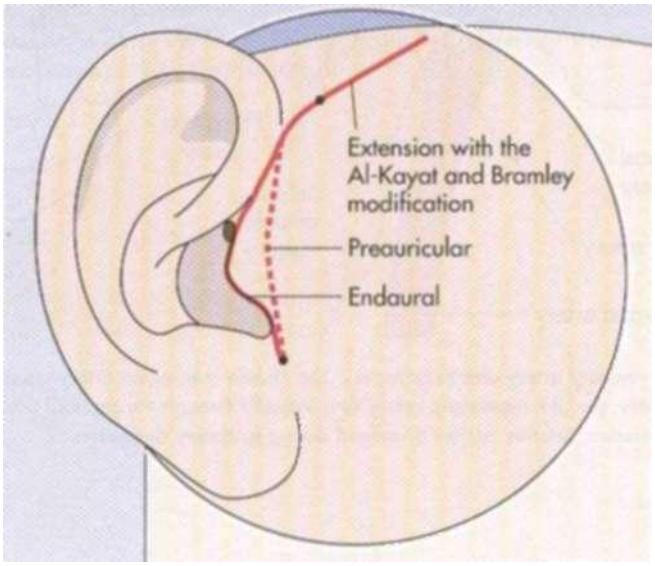
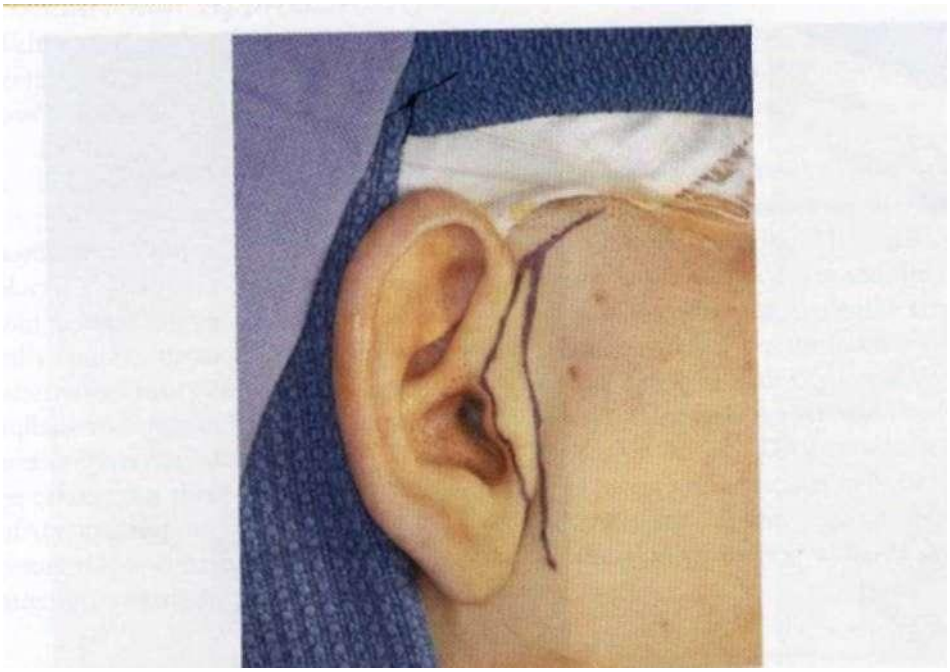
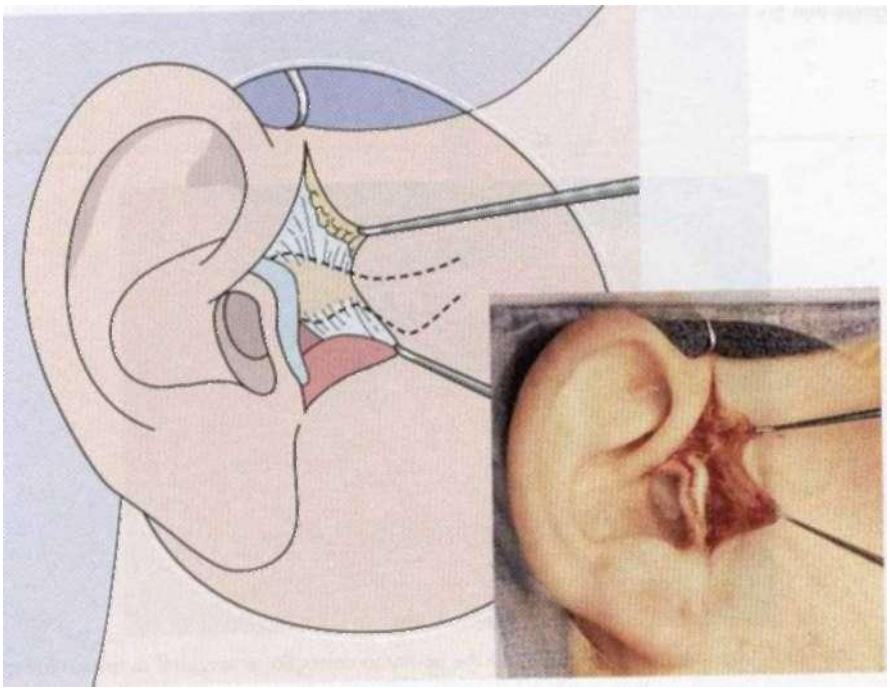


FIG. 3-12



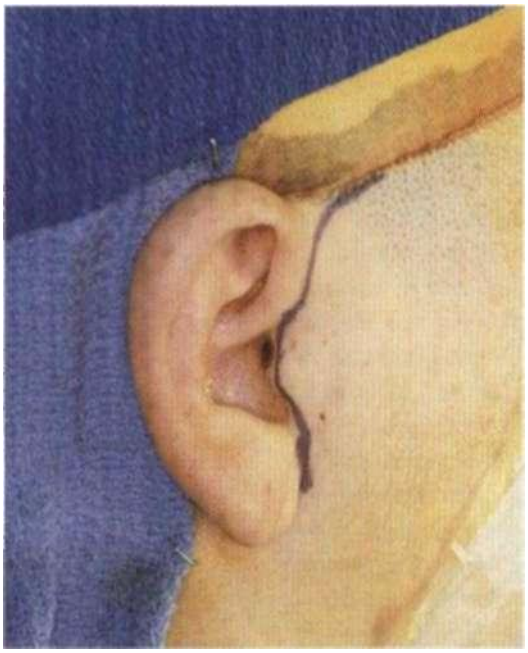
Comparison of standard preauricular and endaural rhytidectomy surgical approaches.

FIG. 3*13



Retraction of firs! level of dissection depicting skin and subcutaneous tissue in front of the tragal cartilage. The superficial temporal artery or vein (or both) run just under the subcutaneous tissue.

FIGS. 3.14, 3.15



Extent of endaural rhytidectomy incision. Note that the inferior boundary is the attachment of the lobule of the ear. The incision is carried carefully through the skin over the tragal cartilage at a 90-degree angle to the most convex part of the tragus itself. The incision is carried superiorly to the uppermost portion of the auricle and then extends in approximately a 45-degree angle into the temporal hairline for about 3 to 4 cm.



Standard preauricular incision showing cross-hatching from inlerrupled stitches,

FIG. 3.16



Endaural incisions 1 year after arthroplasty. Note the ability to camouflage temporal extension in hairline.

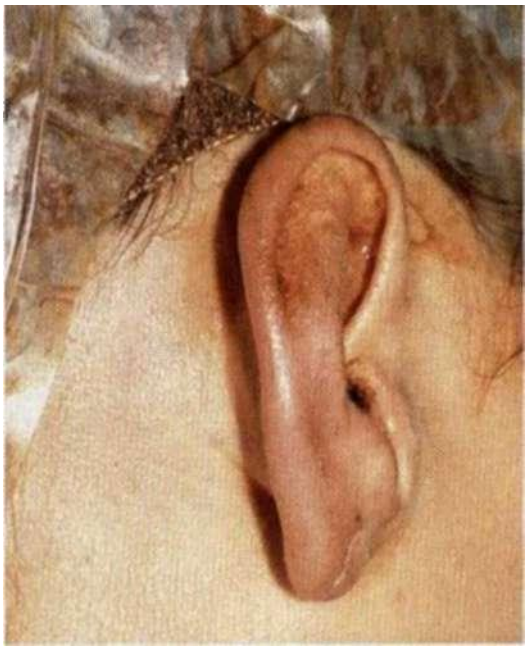
Postauricular Approach

Walters and Geist (1983) popularized a modified postauricular approach to the temporomandibular joint. Although rarely used, the approach does have the following advantages:

- Excellent exposure of the entire joint
- Ability to camouflage the scar in patients who have a tendency to form keloids

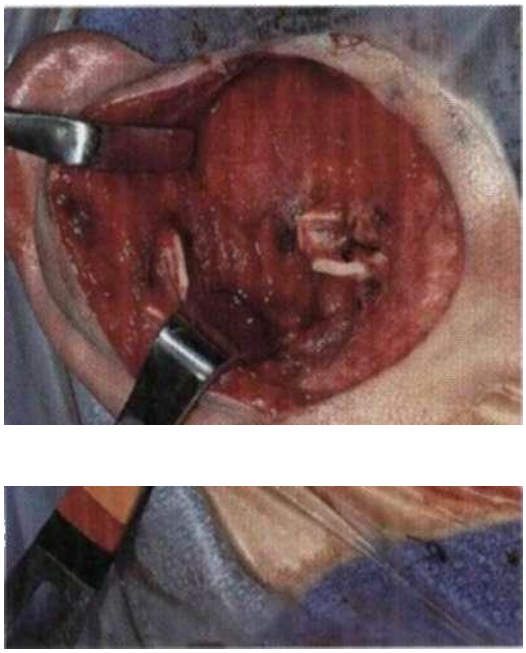
The main disadvantage is auricular stenosis, and the approach should not be used in the presence of joint infection or chronic otitis externa. The incision is placed 3 to 4 mm posterior to the auricular flexure and extended toward the mastoid fascia. Staying above the mastoid fascia (which is contiguous with the temporalis fascia), the incision exposes the superior and posterior circumference of the external auditory canal. Blunt dissection below the external auditory canal creates a plane running anteriorly to separate the pinna. A #10 blade is then used to transect the external auditory canal and retract the ear anteriorly. Dissection can then be carried out through the superficial temporalis fascia and periosteum at the root of the zygoma as previously described. Once the joint surgery is completed, a resorbable 4-0 running suture is used to close the skin of the ear canal only. No attempt is made to suture the cartilage itself.

FIG. 3.17

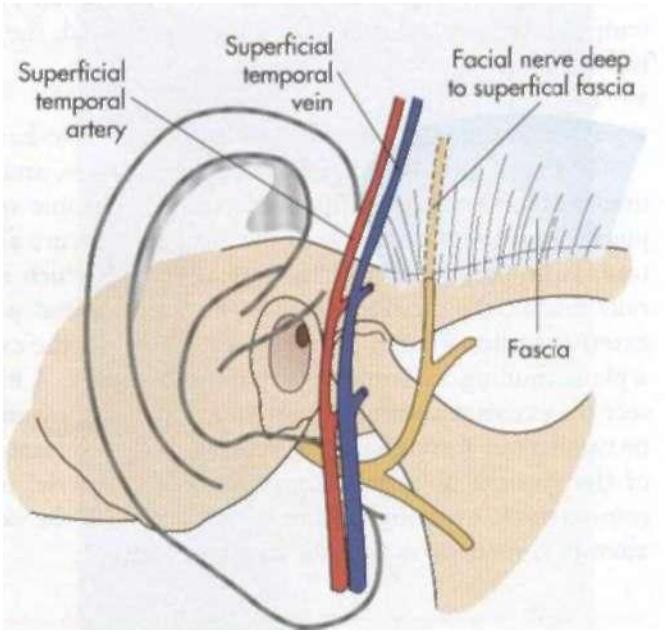


Postauricular approach to temporomandibular joint.

FIGS. 3.18, 3.19



Postauricular approach lo temporomandibular joint. The incision has been made through skin and subcutaneous tissue. The external auditory canal has been completely transected in a 360-degree fashion. A purse-string suture has been placed into the transected external canal lo prevent hemorrhage into the canal. Although this approach provides excellent visibility of the joint, the closure of the external canal can be problematic, and auricular stenosis can occur.



Relative position of the superficial temporal artery and veil and the temporal branch of the facial nerve. The vessels are superior to the superficial fascia, and the nerve is deep below the fascia.

FIG. 3.20

Sharp scissors being used to establish a plane deep below the superficial temporalis fascia. The fascia can be released superiorly and inferiorly lo create one contiguous plane, allowing for anterior traction as far forward as the articular eminence if necessary.

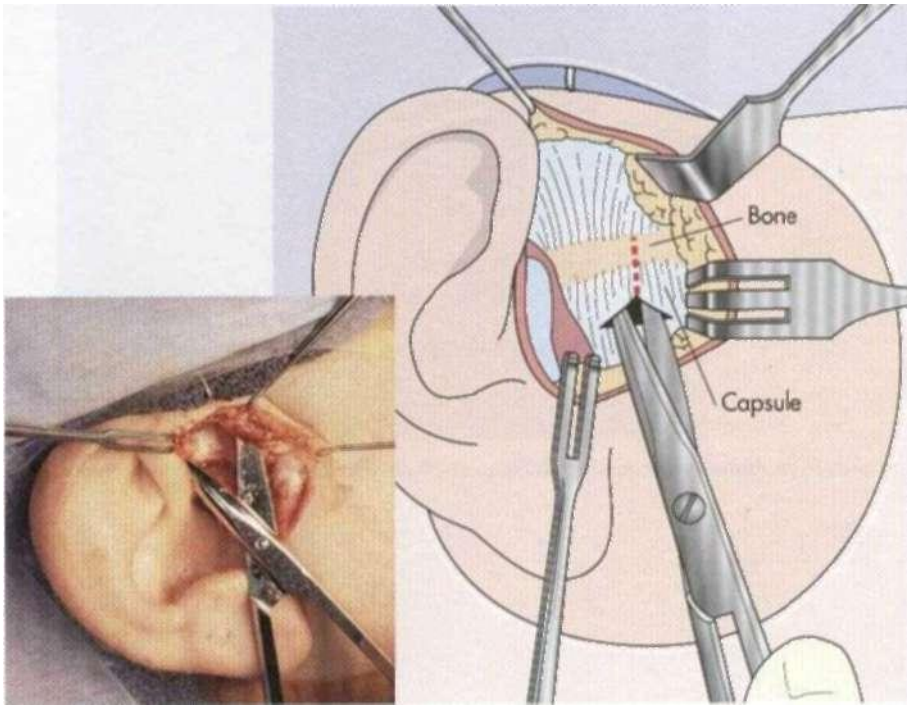


FIG. 3.21

A





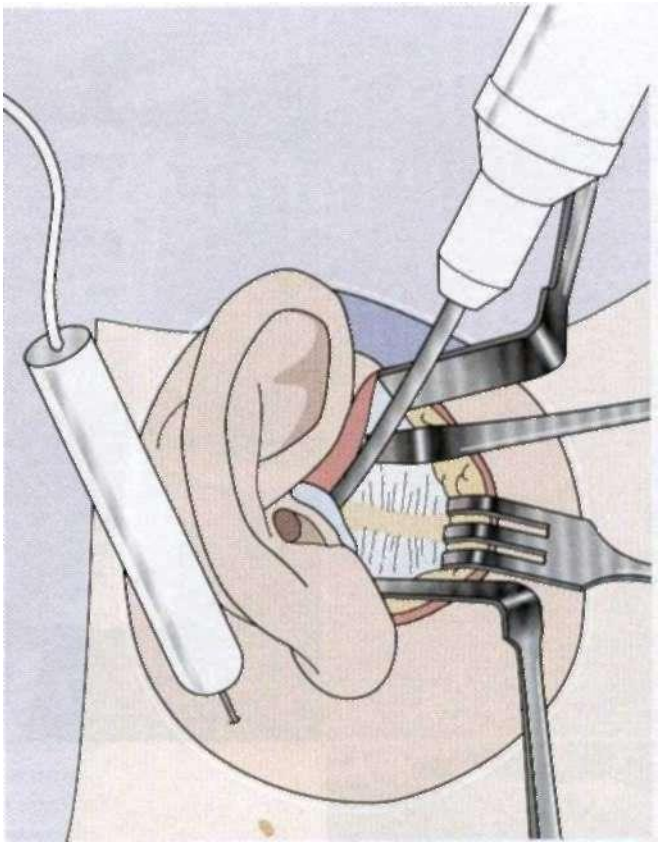
B

C



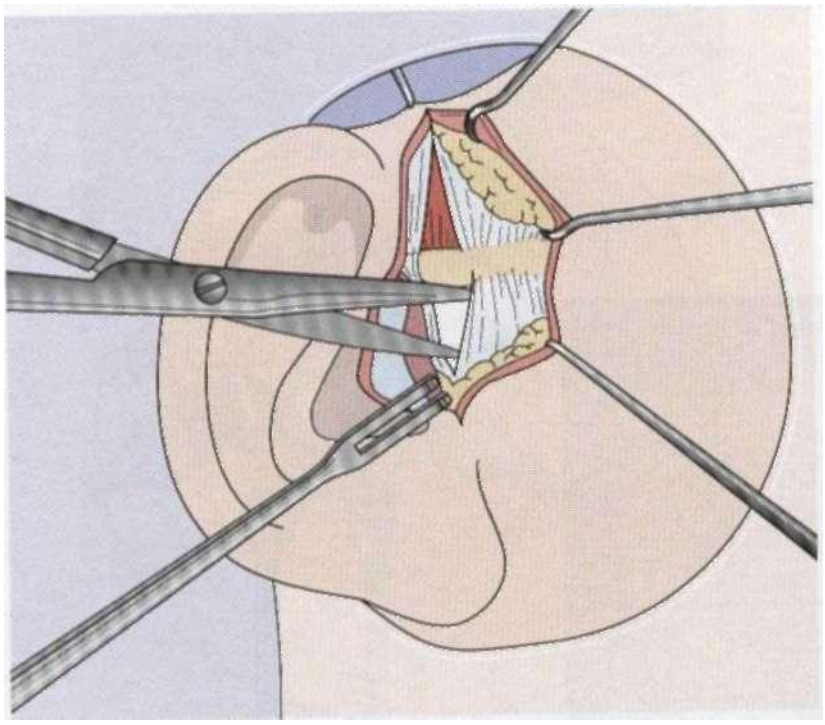
Because it is difficult to use nerve simulators to identify the frontal and zygomatic branches of the facial nerve, various methods have been employed. A, An auditory alarm in which electrodes are placed at the terminal branches of the facial nerve. Any direct pressure (e.g., retraction) during surgery triggers an audible alarm that alerts the surgeon to the proximity of the nerve branches. B, The alarm. C, Electrodes for facial nerve in position.

FIG. 3.22



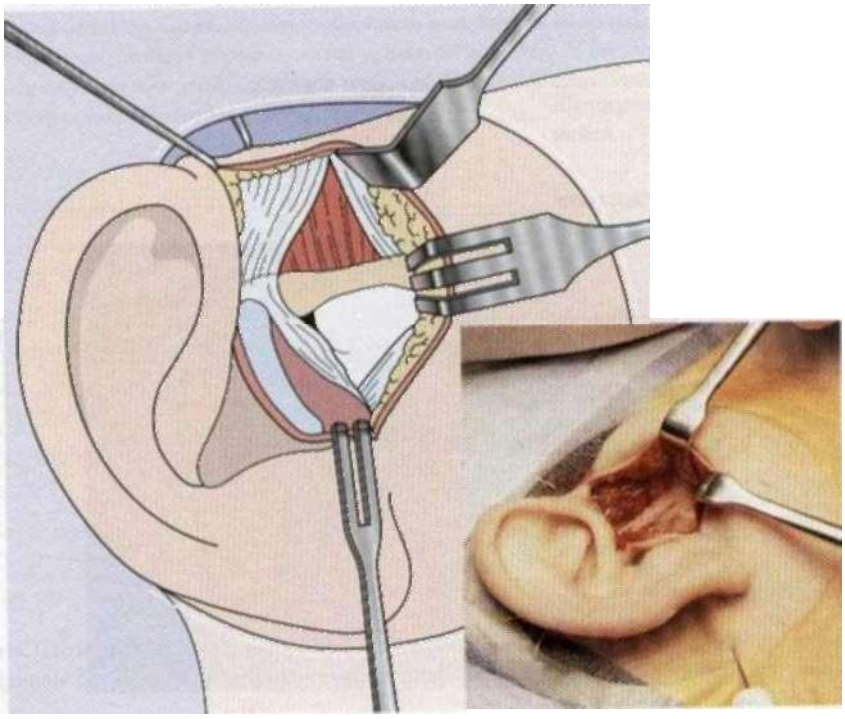
Nerve stimulator being used to help identify the upper trunk of the facial nerve. If the surgeon chooses to use the nerve stimulator, the patient must not receive any neuromuscular blocking agents intraoperatively.

FIG. 3.23



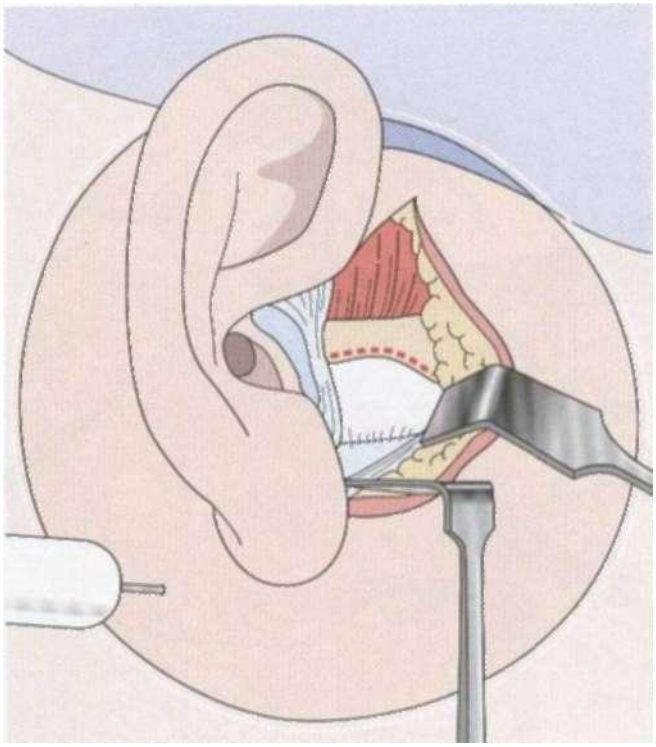
Metzenbaum scissors or a mosquilo hemostal can be used to dissect directly over the capsu until the only visible part is the gleaming white capsule itself.

FIG. 3.24



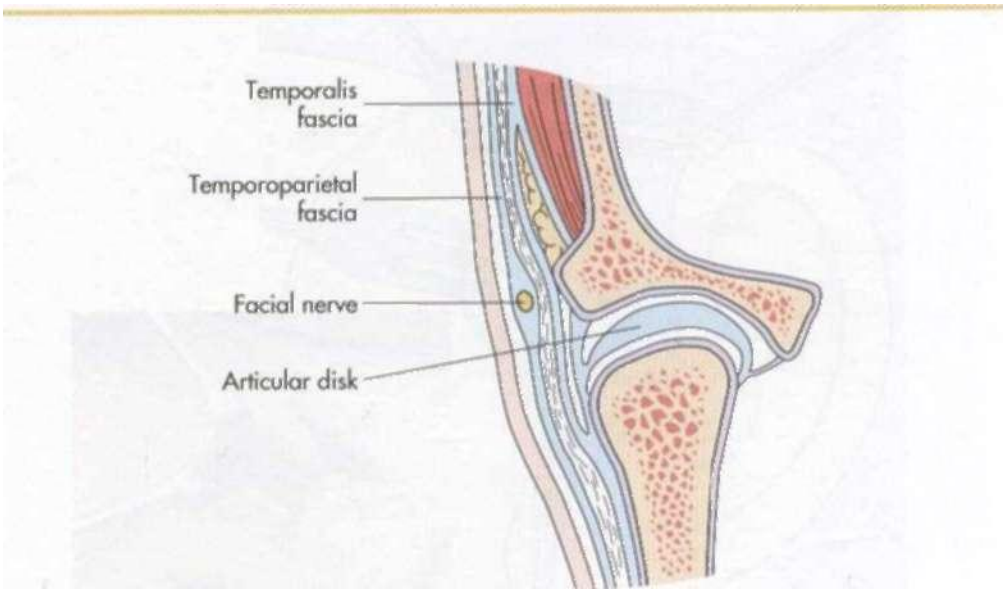
Joint dissection just before entry into the superior joint space. The surgeon should be able to appreciate the elliptical curve of the lateral edge of the glenoid fossa, as well as the anterior, lateral, and posterior surfaces of the joint capsule.

FIG. 3.25



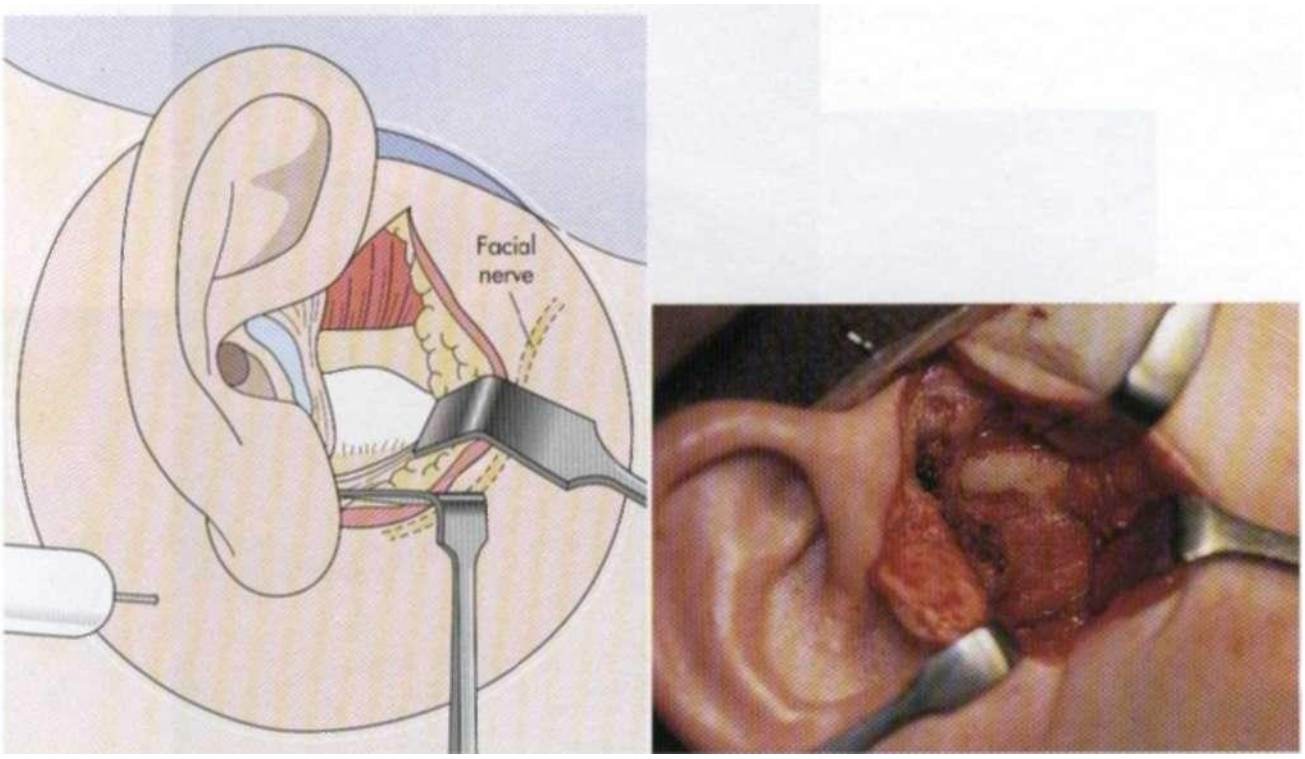
Dotted line incision for horizontal entry into the superior joint space. For greater access the incision can be converted lo a T incision by extending the horizontal incision interiorly lrom its midpoint.

FIG. 3.26



Coronal diagram of the intracapsular structures. Note the curvilinear shape of the meniscus. Care must be taken to enter the superior joint space from a 45-degree angle directed upward to avoid incising the disk itself.

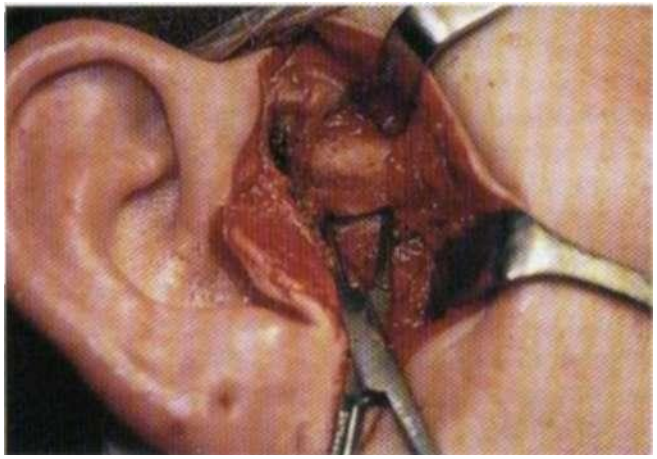
FIG. 3.27



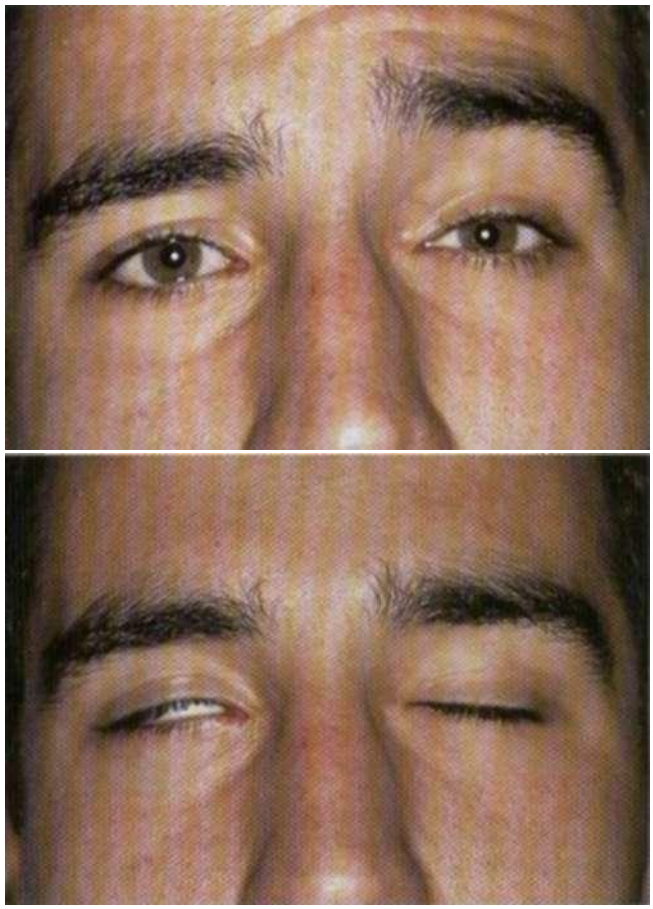
A B

A, Small, right-angle retractors positioned for anterior and inferior retraction to both improve visibility and protect the facial nerve branches. B, Dissection is carried down along the anterior slope of the tragal cartilage, with care taken not to remove the perichondrium from the tragal cartilage. The tragal cartilage then lakes a medial direction and descends into the retrocondylar space. The superficial temporal artery and vein will be encountered in this area and should be clamped and ligated. A curved hemostal is used to bluntly dissect under the superficial temporalis fascic and then the deep temporalis fasciae from the midpoint of the tragal cartilage superiorly to the uppermost boundary of the incision. The entire flap is retracted anteriorly with two small, right-angle retractors. This should allow visualization of the posterior edge of the temporomandibular joint capsule.

FIG. 3.28



After an incision is made in the superior joint space with a #15 blade, a small, curved hemostal is placed in the superior joint space, opened, and held in position. While the hemostal defines the anterior and posterior lateral walls, a #15 blade is used to extend ihe opening in both directions.



A, Paresis of the temporal branch on the facial nerve, causing weakness in the frontalis muscle. The patient is unable to raise the eyebrow after the procedure. B, Paresis in the zygomatic branch of the facial nerve The patient has weakness of the orbicularis oculi and is unable lo close the eye This can result in severe drying of the cornea, with desiccation and corneal abrasion.

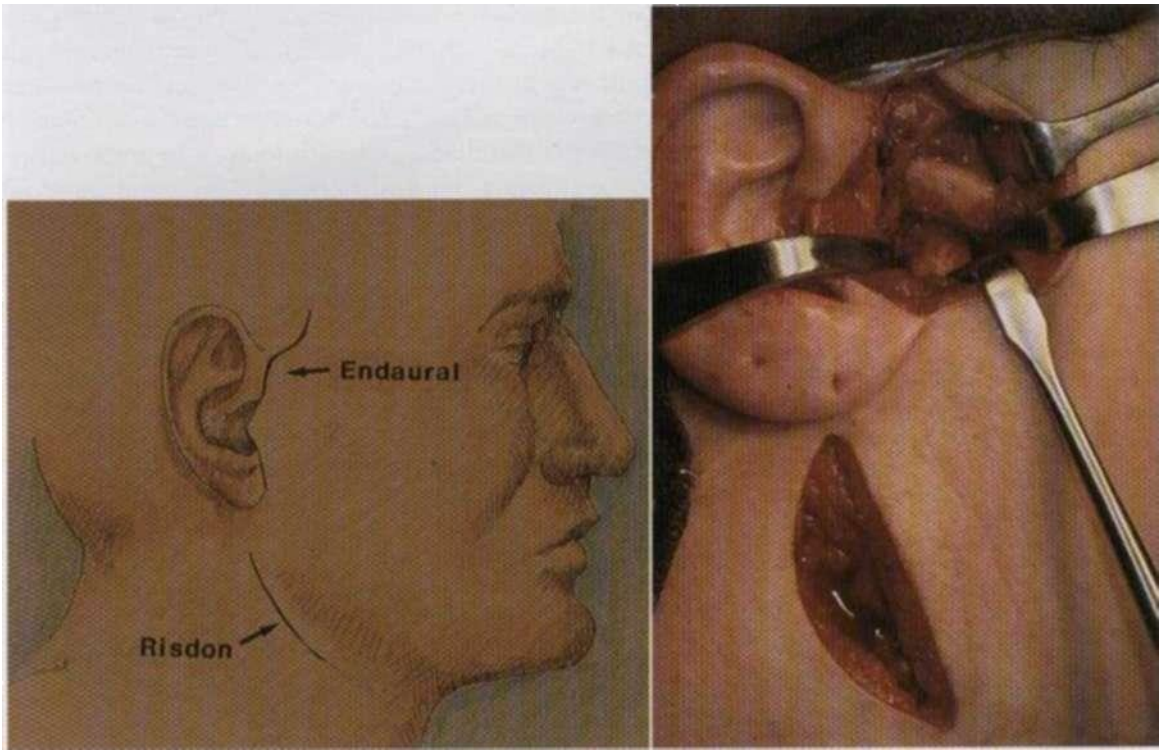
FIG. 3.29

Rhytidectomy Approach

Major tumor resections may require more extensive joint exposure, and several authors have reported on the use of the rhytidectomy incision. The endaural incision is extended in a curvilinear fashion around the mastoid tip, with an S-shaped extension ending in a submandibular incision. This allows access to the entire posterior border of the mandible and allows for identification of the main trunk of the facial nerve.

Submandibular (Retromandibular) Approach

For additional access to the temporomandibular joint for open fracture reduction, costochondral grafting, total alloplastic joint reconstruction, or tumor resection, a submandibular approach is necessary. When combining both incisions, the surgeon must leave an intervening bridge of tissue that extends inferiorly at least 3 cm from the lowest point of the bony external auditory canal. The classic Risdon submandibular approach was used mainly for open fracture reduction at the angle and body of the mandible. The approach to the joint is actually by way of a retromandibular incision, which allows superior retraction for placement of rigid fixa-



A, The endaural rhylidectomy type of incision with tempora extension and posterior mandibular incision for approaching the ramus of the mandible during temporomandibular joint surgery. Note that it is in fact a modified Risdon incision, with the superior extension being more retromandibular. B, Endaural and modified Risdon incisions for total joint reconstruction.

FIG. 3.30

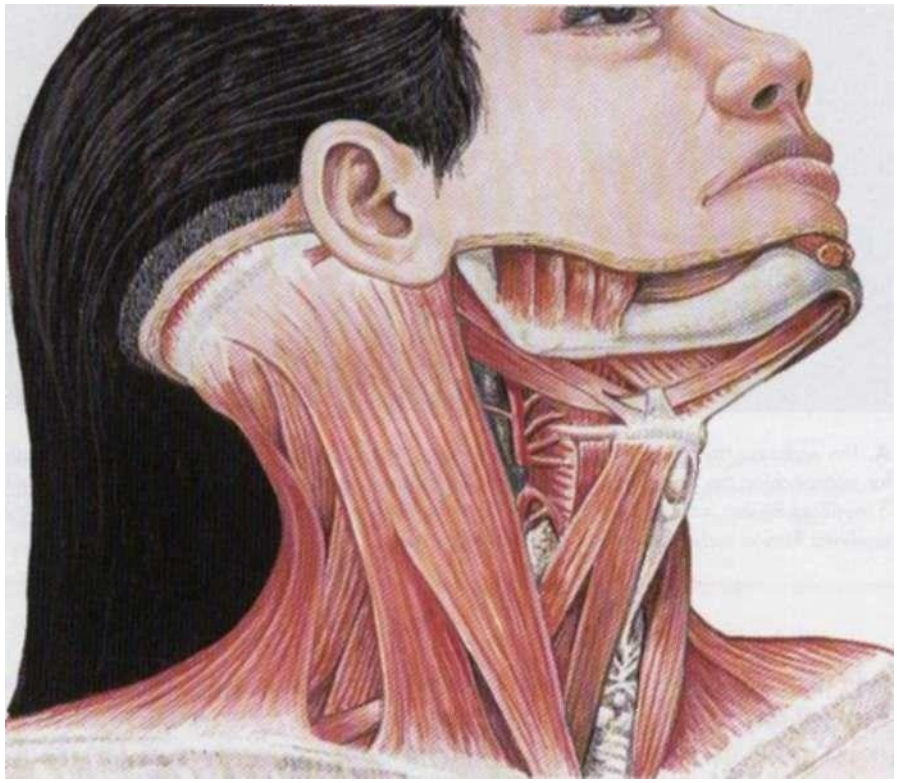
tion plates or screws for rib grafts or alloplastic implants. The incision is made on a curvilinear line approximately 5 cm long and 2 cm distal to the most inferior point of the mandibular angle, where its midpoint is situated. The main structures to be avoided are the marginal mandibular branch of the facial nerve and the retromandibular vein. The marginal mandibular branch of the facial nerve, posterior to the facial artery, passed above the inferior border of the mandible in 81% of dissections (Dingman, Grabb, 1962). It ran superficial to the facial vein in all the cadavers studied. It can, however, run as much as 3 cm below the inferior border of the mandible, deep to the platysma muscle. The dissection is carried down through skin, subcutaneous tissue, and platysma. A nerve stimulator is used to identify the mandibular branch, and it is retracted superiorly.

Injury to the marginal mandibular nerve results in temporary or permanent deinnervation of the depressor anguli oris muscle. The patient is unable to depress the lower lip and show the mandibular anterior teeth. On the side of the injury the affected side of the lip may appear to be pulled over the incisal edges of the teeth, as the normal side shows an exaggerated inferolateral pull. The retromandibular vein (posterior facial vein) lies just behind the posterior border of the ramus lateral

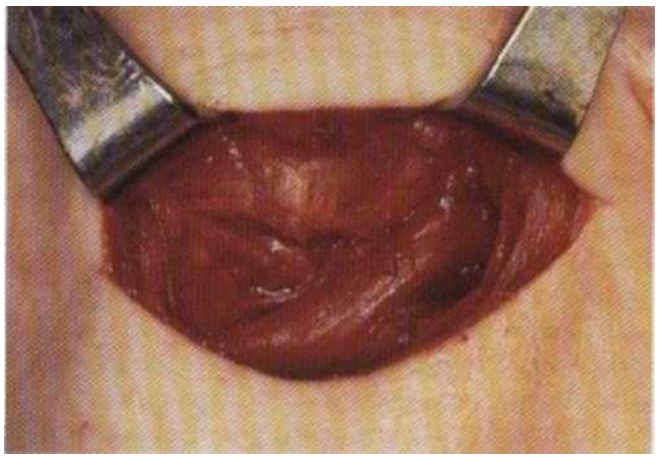
to the external carotid. Blunt dissection is used to define a plane between the sternocleidomastoid muscle and the capsule of the submandibular gland. Blunt finger dissection and retraction should be used to retract the anterior border of the sternocleidomastoid posteriorly and the capsule of the submandibular gland anteriorly to visualize the aponeurosis of the masseter and the medial pterygoid along the inferior border of the ramus. A #15 blade is then used to make an incision through the aponeurosis. It is important not to incise through the body of the masseter muscle itself to prevent unnecessary hemorrhage. The masseter muscle can then be stripped off the lateral surface of the mandible, and with long right-angle retractors, the surgeon can visualize superiorly as far as the condylar neck and coronoid notch from this posterior-mandibular approach.

FIG. 3.31

A, Masseter insertion showing extent of dissection necessary to completely free masseter from lateral border of the ramus. B, Posterior mandibular incision showing insertion of masseler along the inferior border. Note the posterior belly of the digastric muscle running at a 45-degree angle relative to the inferior



A

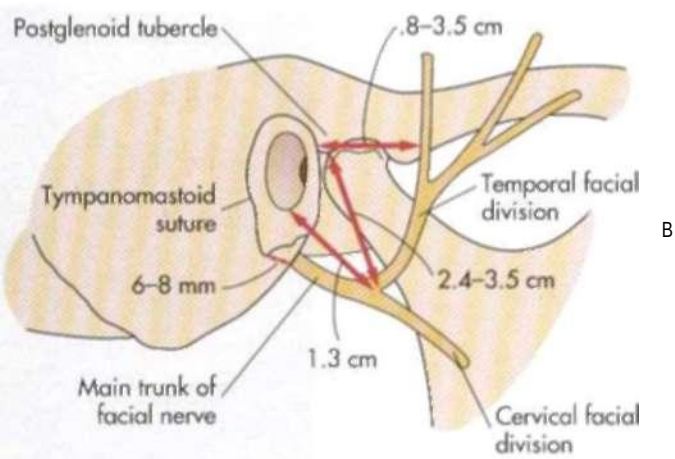


B

FIG. 3.32

A

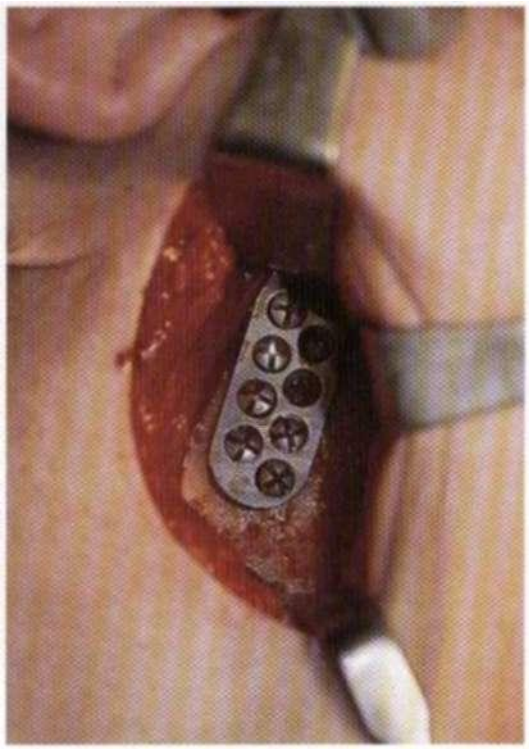




B

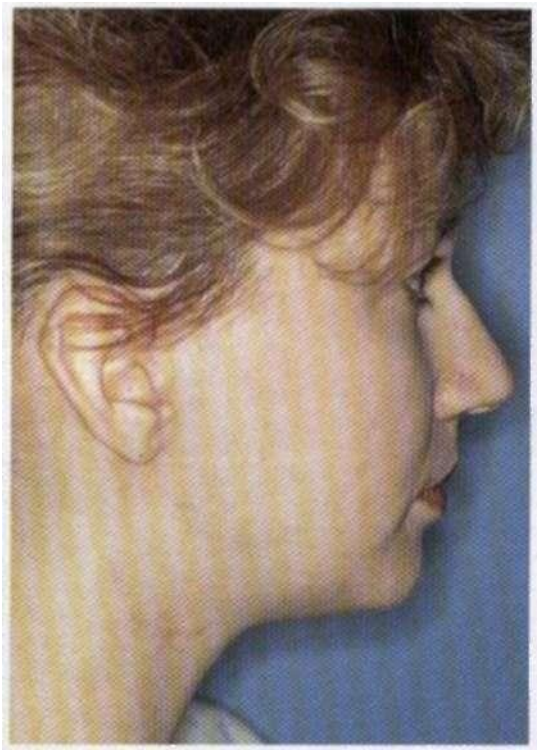
A, Posterior mandibular incision with separation of the aponeurosis between the masseter and medial pterygoid muscles. Note the tendons of the masseter muscle inserting directly into the bone at the angle of the mandible. B, Main trunk of the facial nerve after its exit from the stylomastoid foramen. Note that the main trunk divides into the upper and lower trunks along the inferior third of the posterior ramus. This necessitates the separate endaural and posterio mandibular incisions to allow that facial nerve to run through the bridge of the intervening tissue.

FIG. 3.33



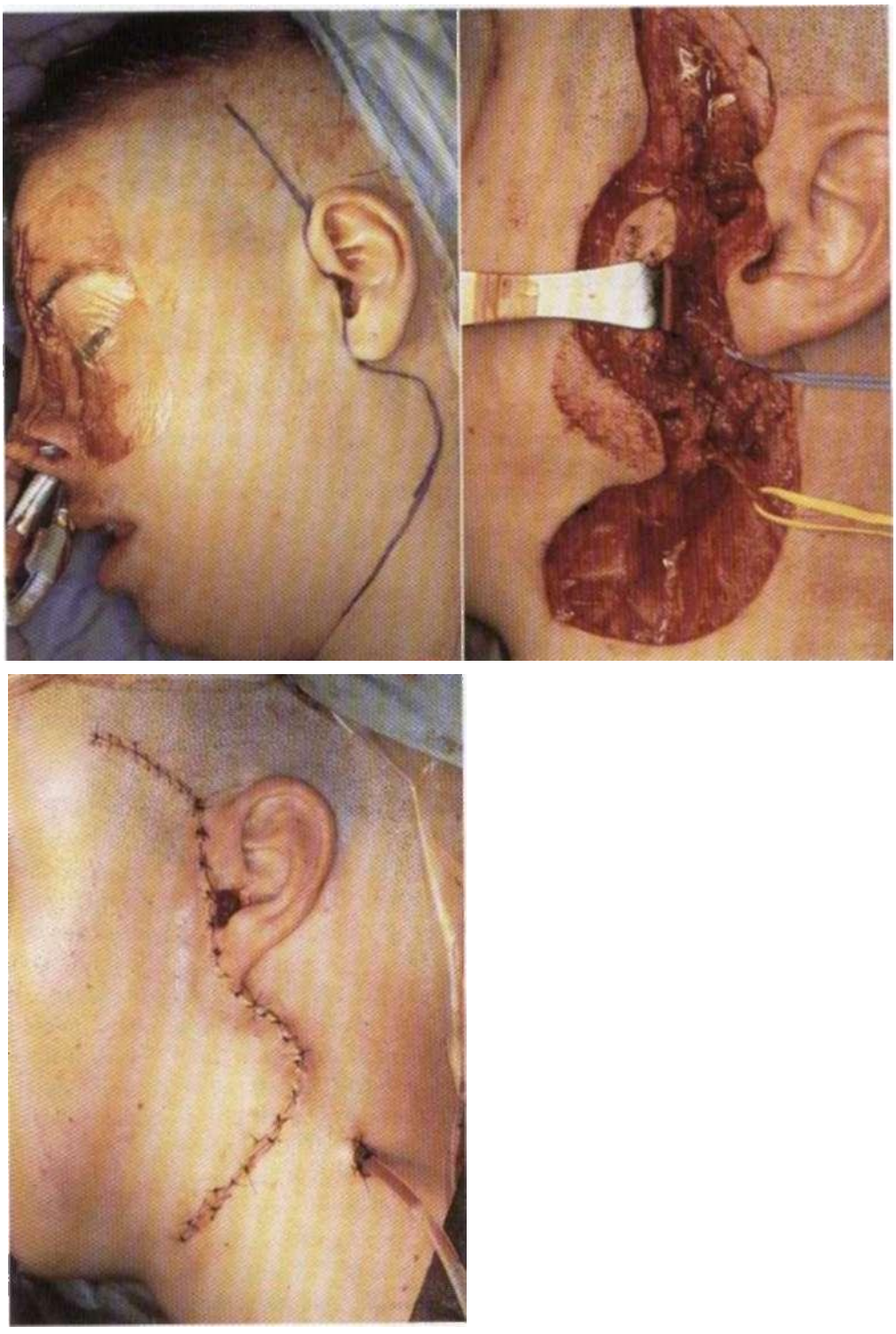
Example of posterior mandibular incision with excellent view of the lateral ramus. This approach con be helpful in placement of fixation for costochondral grafting and alloplastic joint implants and can provide access to low condylar neck fractures.

FIG. 3-34



A 30-year-old woman after open reduction of complicated condylar fracture via endaural and posterior mandibular incisions. Note the appearance of well-healed incisions.

FIG. 3.35



Combination of parotidectomy and extended preauricular incision with temporal extension for wide exposure of temporal fossa, zygomatic arch, and posterior mandible. Incision allows identification and preservation of facial nerve.

SURGERY FOR INTERNAL DERANGEMENTS

CHAPTER FOUR

Meniscal surgery for internal derangement is reserved for patients for whom nonsurgical conservative methods and arthroscopic techniques fail to control pain and increase functional range of motion. Because the temporomandibular joint is a ginglymoarthrodial joint with unique biomechanical demands; the mechanics of the disk-condyle complex may be extremely difficult to replicate with any surgical technique.

Meniscal salvage procedures are usually confined to patients in Wilkes stages II and III but can occasionally be effective in stage IV as well. In stage V disease the success rare of meniscal repair is clearly lower than in the earlier stages.

Open joint surgery ranges from meniscal repositioning to meniscectomy with or without replacement. Currently acceptable open joint procedures include the following: (I) meniscoplasty with or without arthroplasty, (2) meniscectomy, (3) meniscectomy with temporary silicone implant, (4) meniscectomy with autogenous or allogeneic graft, (5) meniscectomy with condyloplasty or eminoplasty, (6) repair of perforated posterior attachment with meniscal recontouring and repositioning, (7) meniscectomy with temporalis muscle flaps, and (8) modified mandibular condylotomy.

The main goal of all these procedures is to decrease pain and increase the range of motion. A reasonable goal is an interincisal opening of 35 mm with lateral excursions of 4 to 6 mm. Desirable functional outcomes would enable the patient to masticate a normal or nearly normal diet with a stable occlusion. In addition, open arthroplastic procedures can be expected to significantly reduce functionally induced pain.

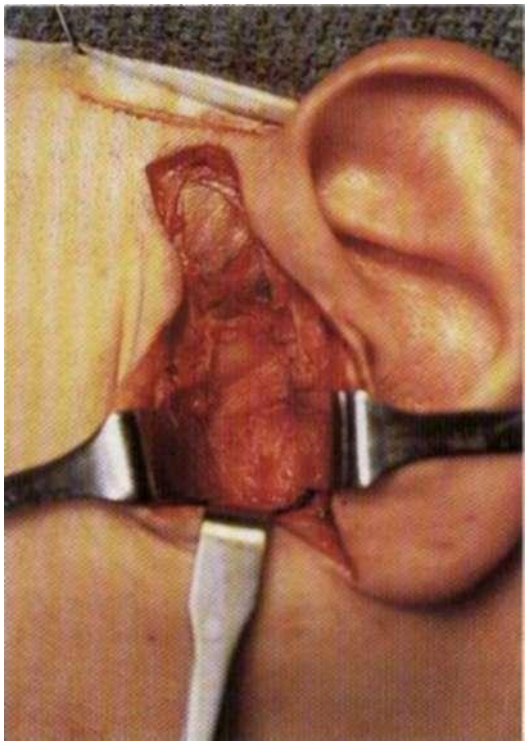
As previously discussed, the joint is exposed through an endaural incision. The surgeon may find it helpful to palpate the lateral pole of the condyle continually while the other hand uses a sterile urology drape as an intraoral manipulator. This allows the surgeon to constantly move the mandible to ascertain the exact position of the lateral pole and the palpable capsular depression between the glenoid fossa and the lateral pole. Once the capsule itself is isolated, a small amount of local anesthetic (1 ml) can be used to insufflate the joint space. The #15 blade is then used to make a small opening through the lateral capsule into the superior joint space. The blade is angled superiorly at approximately 45 degrees to prevent any iatrogenic damage to the disk as it courses over the lateral pole to attach to the capsule. An assistant may depress the posterior molars inferiorly to increase the joint space during this maneuver. The small hemostat may be used to widen the opening into the superior joint space. The egress of synovial fluid should confirm immediately that the surgeon is in the superior joint space.

The #15 blade is again used to open up the incision from a posterior and an anterior point to visualize the entire superior surface of the disk and the anterior and posterior recesses of the joint space. A small freer elevator can be used to sweep gently across the top of the disk to break any adhesions at this point. In joints on which

TABLE **4.1** ***Wilkes's Staging of Internal Derangement of the TMJ***

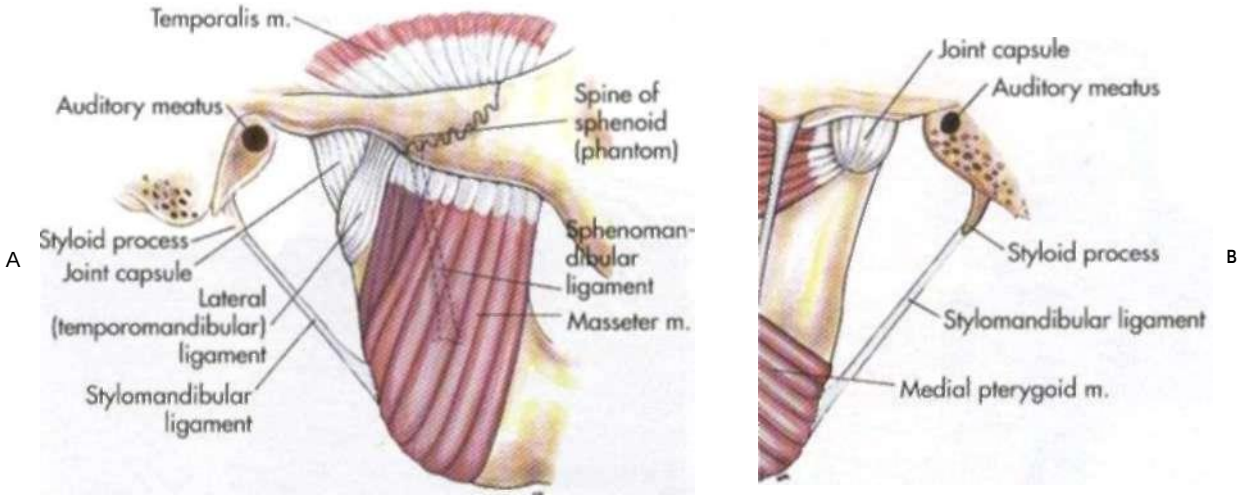
STAGE	CHARACTERISTICS	IMAGING
I. Early	Painless clicking No restricted motion	Slightly forward disk Normal osseous contours
II. Early/ Intermediate	Occasional painful clicking Intermittent locking Headaches	Slightly forward disk Early disk deformity Normal osseous contours
III. Intermediate	Frequent pain Joint tenderness, Headaches, locking Restricted motion Painful chewing	Anterior disk displacement Moderate to marked disk thickening Normal osseous contours
IV. Intermediate/ Late	Chronic pain, headache Restricted motion	Anterior disk displacement Marked disk thickening Abnormal bone contours
V. Late	Variable pain, joint crepitus Pain	Anterior disk displacement with disk perforation and gross deformity Degenerative osseous changes

FIG. 4.1



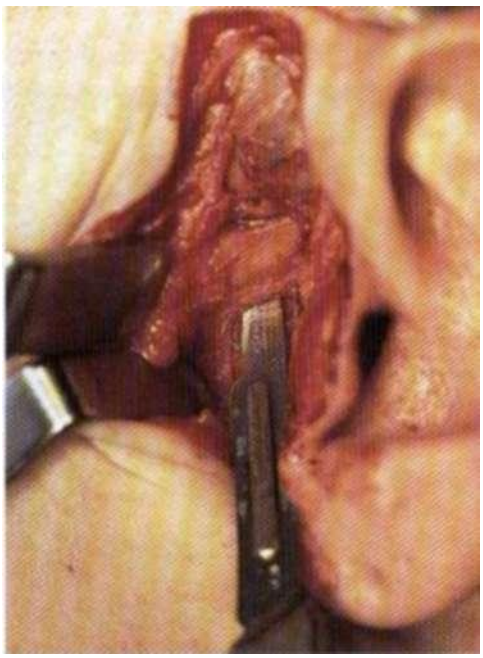
Capsule of left temporomandibular joint. The surgeon can easily palpate the lateral pole of the condyle by feeling for the depression between the lateral edge of the glenoid fossa and the condyle itself.

FIG. 4.2

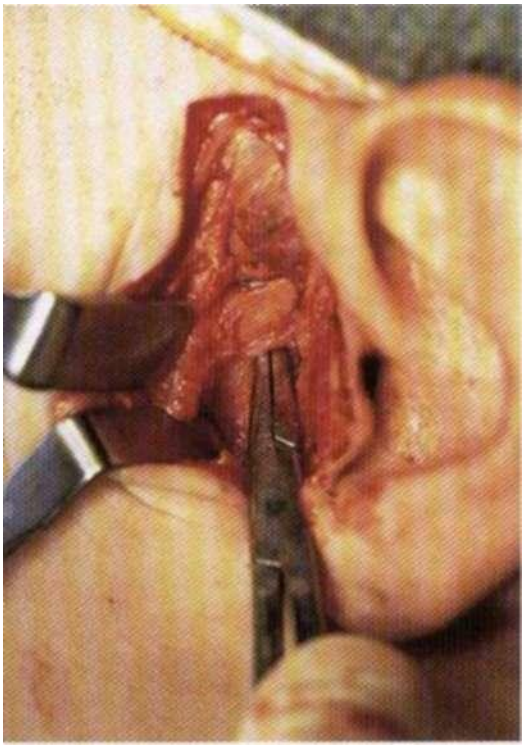


Note the extent of the capsule from both medial (A) and lateral (B) views. On the lateral view the temporomandibular ligament extends across the inferior insertion of the capsule. The surgeon should attempt to place an index finger over the joint space while the patient is anesthetized to move the condyle forward in order to palpate the lateral pole and judge the approximate location of the space between the lateral pole and the lateral rim of the glenoid fossa.

FIG. 4.3



No.15 Blade entering superior joint space at approximately 45-degree angle to prevent meniscal laceration.



Small, curved hemostal placed into superior joint space until synovial fluid is visualized.



Open view of superior joint space showing normal dimensions of the anterior recess with the anterior capsular wall attached to the anterior slope of articular eminence.

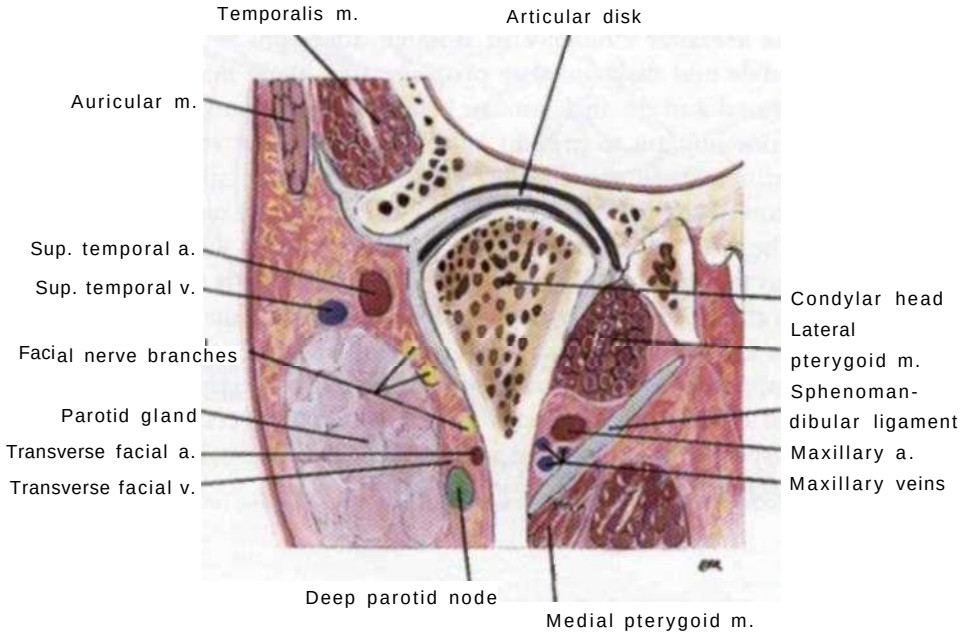
FIGS. 4.4, 4.5

no previous surgery has been performed, this procedure is relatively easy. In joints that have undergone multiple operations, however, this can be a complicated dissection, especially with the presence of fibrous ankylosis.

After obtaining adequate visualization of the joint space, the surgeon must immediately evaluate the disk position before the mechanics of the surgery falsely alter it. This is also the opportunity to determine whether the disk or the posterior attachment is perforated. The surrounding tissues can be examined for synovitis, fibrillations of the articular cartilage, and any evidence of osteoarthrosis of the bony surfaces. Removal of the lateral third of the articular eminence with a small osteotome is sometimes helpful to improve visualization within the anterior joint space. This maneuver also increases the lateral joint space and allows for freer movement of the disk. At this point, adhesions in the superior joint space can be removed and the joint can be manipulated to assess the mechanics of the condyle-disk complex.

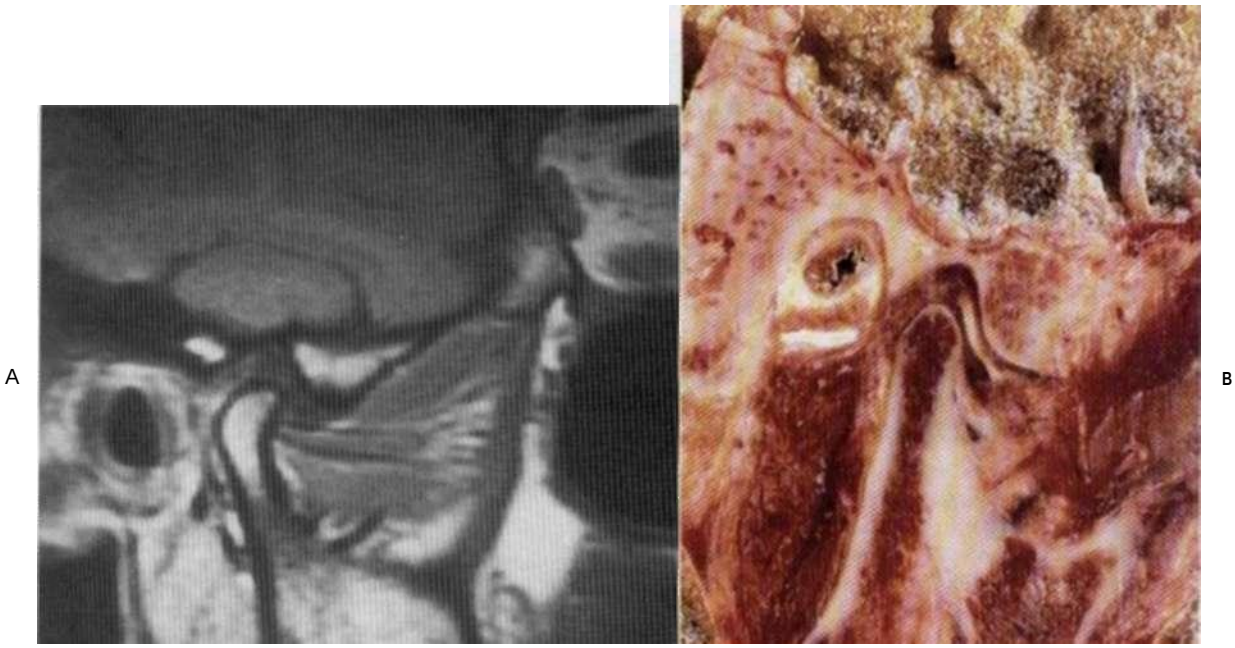
The surgeon should observe closely for folding of the meniscus during opening and closing or obstructions to normal disk movement from the articular eminence. The surgeon must assess the disk in its total medial-lateral dimension and ensure that no adhesions are present on the medial surface that would make it difficult to

FIG. 4.6



Sagittal view of joint showing disk attachment lo the lateral capsule. Care must be taken when entering the superior or inferior joint space so as not to cause iatrogenic injury to the disk, which could cause a reparable disk to become irreparable.

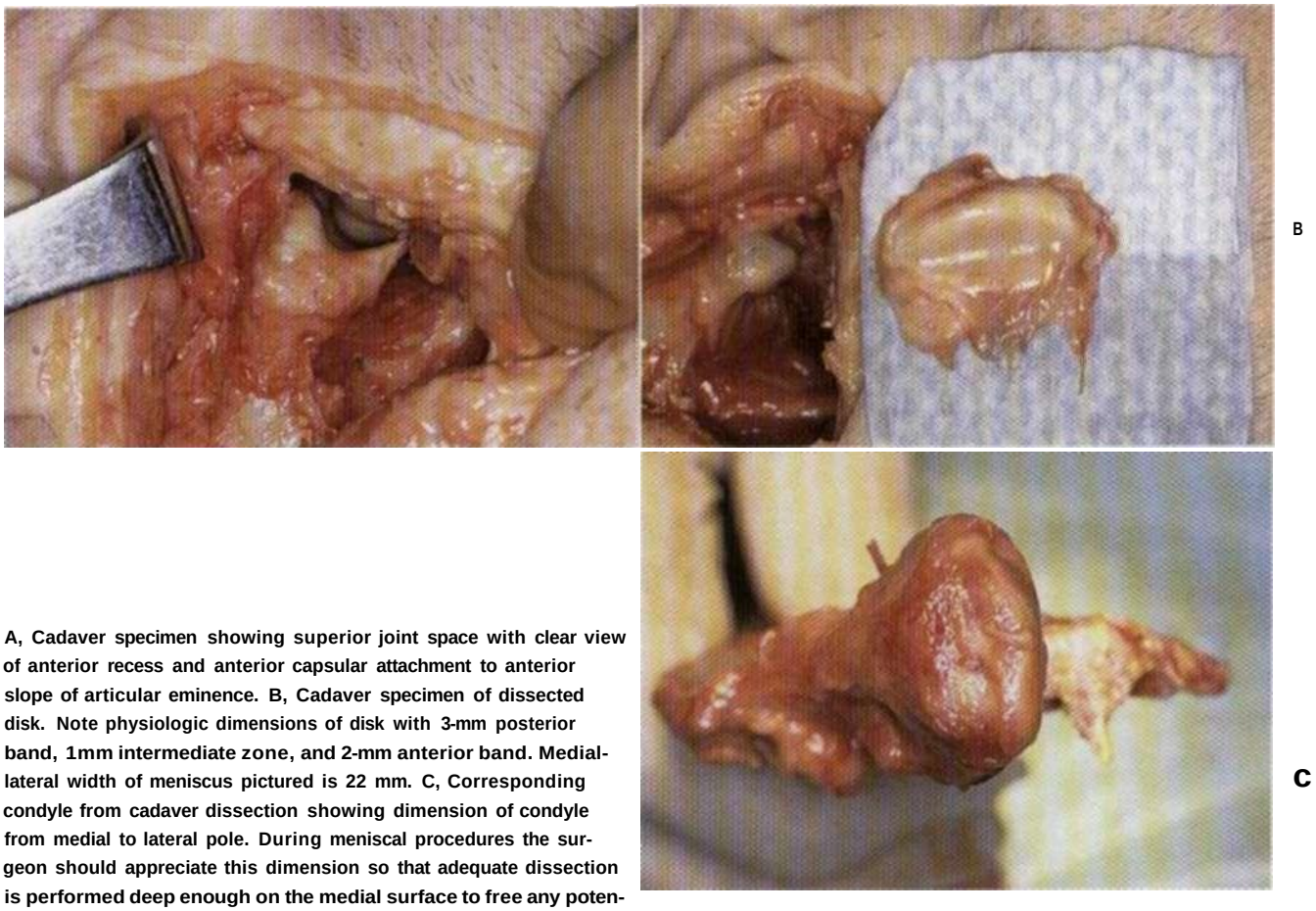
FIG. 4.7



A, MRI showing separate and distinct heads of lateral pterygoid with fat plane separation. B, Cryoseclion depicting clear separation of lateral pterygoid heads showing inferior belly extending through anterior wall of capsule directly into fovea of the condyle.

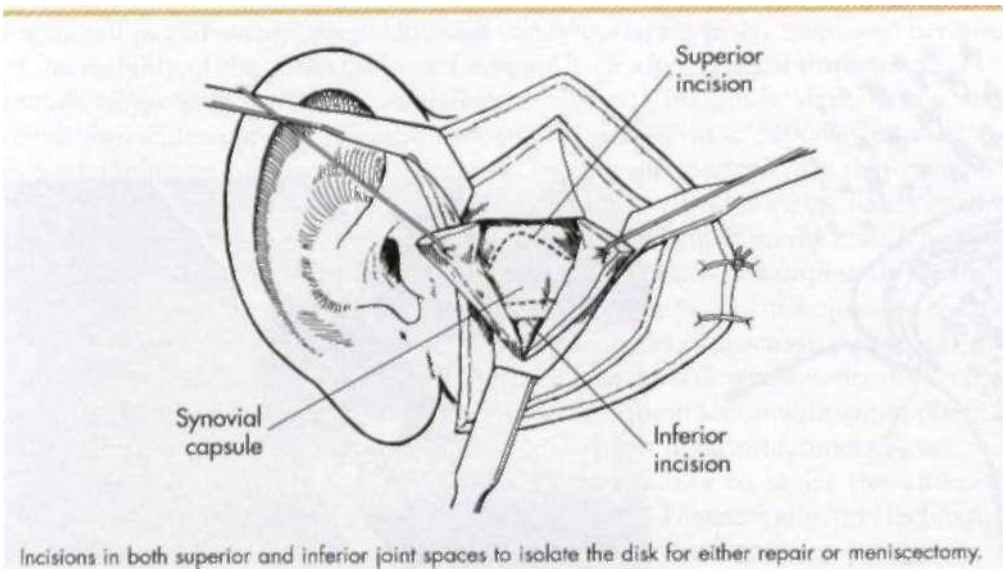
position the disk posteriorly and laterally. In rare cases, this exposure into the superior joint space may be all that is necessary if the main problem was adhesion of the disk to the articular eminence or isolated adhesions in the superior joint space. If the condyle and disk function properly after these maneuvers, the joint space can be irrigated and the incision can be closed. Some surgeons prefer to use a temporary silicone implant to prevent adhesions of the disk to the glenoid fossa and articular eminence. In most cases, the inferior joint space must also be explored. Palpation of the neck of the condyle just above the insertion of the capsule is critical. The #15 blade is again used to make a small incision through the capsule inferior to the disk itself. A small periosteal elevator is used to widen this incision and then the freer elevator is used to free the lateral meniscal attachment. The same elevator is then used to sweep over the top of the condyle to free the disk from an inferior approach. Prevention of any direct trauma to the fibrocartilage on the condylar head is always important during these maneuvers. The approach to the inferior joint space can be widened anteriorly and posteriorly with a small Iris or Metzenbaum scissors.

FIG. 4.8

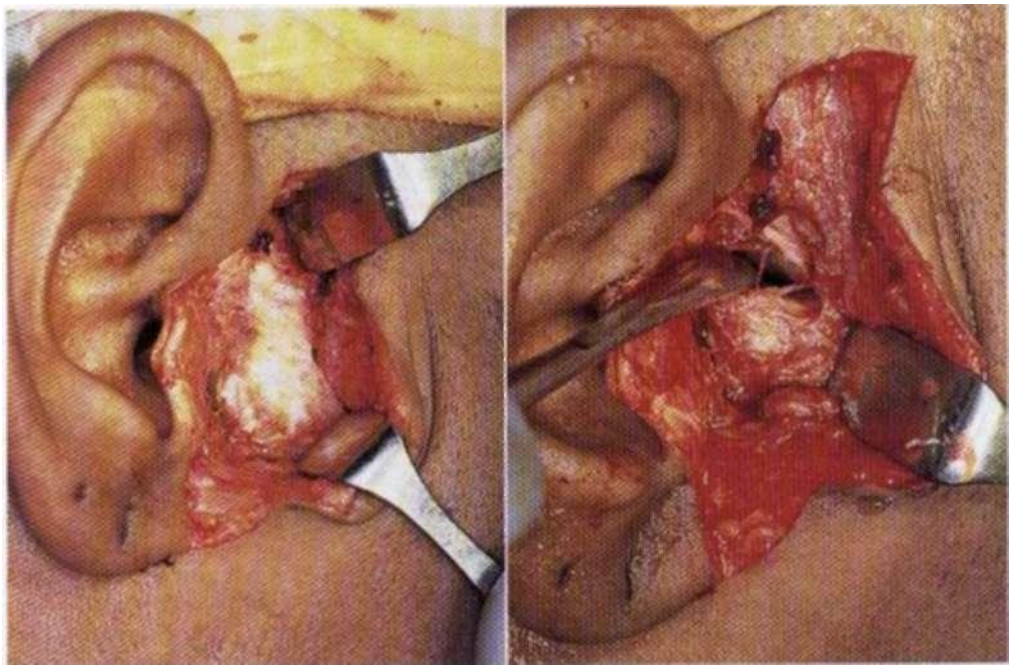


A, Cadaver specimen showing superior joint space with clear view of anterior recess and anterior capsular attachment to anterior slope of articular eminence. B, Cadaver specimen of dissected disk. Note physiologic dimensions of disk with 3-mm posterior band, 1mm intermediate zone, and 2-mm anterior band. Medial-lateral width of meniscus pictured is 22 mm. C, Corresponding condyle from cadaver dissection showing dimension of condyle from medial to lateral pole. During meniscal procedures the surgeon should appreciate this dimension so that adequate dissection is performed deep enough on the medial surface to free any potential adhesions.

FIG. 4.9



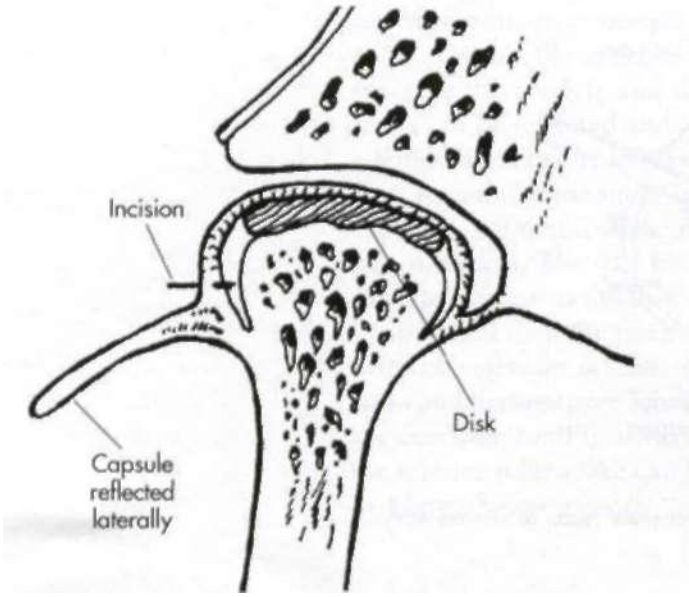
Incisions in both superior and inferior joint spaces to isolate the disk for either repair or meniscectomy.



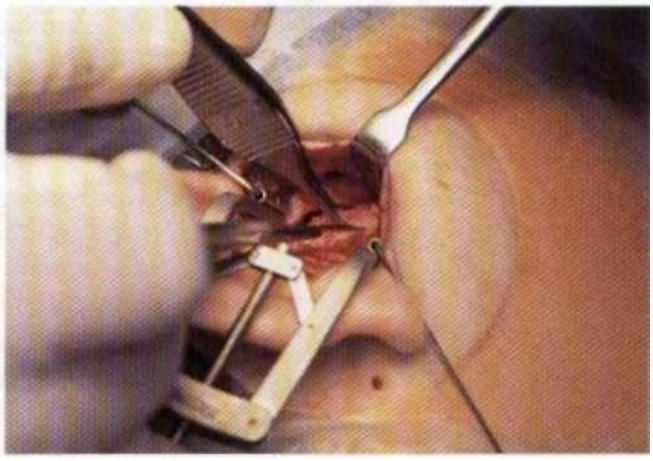
A B

A, Endaural approach to temporomandibular joint showing intact capsule of temporomandibular joint. B, Exposure into superior joint space showing marked adhesions from superior surface of the articular disk to the glenoid fossa.

FIGS. 4.11, 4.12

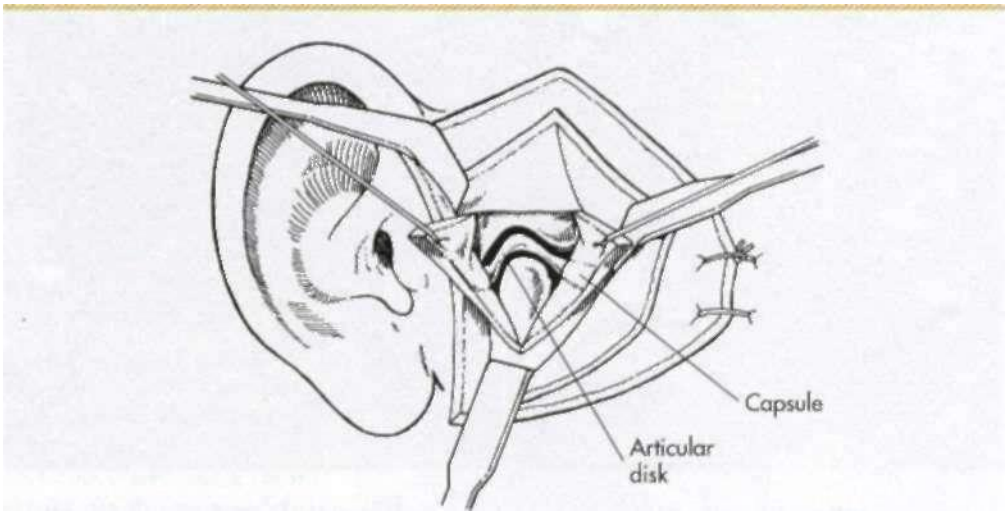


Incision inlo inferior joint space is made on the neck of the condyle, just above the inferior attachment of the lateral capsule. The incision is made with a #15 blade to avoid cutting the disk and to allow the hemostat to pass up and over the condyle. Care is taken not to damage the fibrocartilage covering on the condyle.



Blade is being used to enter the inferior joint space by cutting through the lateral capsular attachment inferior to the disk itself, Note that the disk is being held with a tissue forceps to retract it superiorly and prevent potential damage,

FIG. 4.13



An open point with entrance into both inferior and superior joint spaces. At this point the disk can be inspected for any gross perforations that would preclude disk repair.

The condyle is now examined from the inferior approach for the presence of degeneration and osteophytes. Although condyloplasty is rarely employed because of the inability of the condylar bone to repair itself after surgical trauma, the contouring of gross deformities is sometimes necessary. This can be done with a diamond bur under copious irrigation. A small freer elevator can also be used to explore the inferior surface of the disk to diagnose any perforations that may not have been visible from the superior joint space. A decision must be made at this point regarding the type of procedure that will be performed on the disk. The surgical options are as follows: (1) disk plication—surgical repositioning of the disk by suturing it to retrodiskal and lateral capsular tissues, (2) diskopexey—a disk "tie-down" that anchors the disk to a condylar or fossa purchase point, and (3) lysis of adhesions in both superior and inferior joint spaces without any disk repositioning. (The last procedure can be performed in conjunction with eminoplasty.)

In the disk repositioning procedures the surgeon must sometimes release the disk anteriorly by using a #15 blade or electrocautery to incise the anterior attachment in the area of the anterior capsular wall. Theoretically, this technique lessens the anterior and medial pull of the lateral pterygoid muscle.

FIGS. 4.14, 4.15



MRI displaying anterior disk displacement with reduction. At this stage the disk still appears to have normal anatomic dimensions, and if the symptoms were not amenable to nonsurgical or arthroscopic therapy, this would be an indication for disk repositioning.

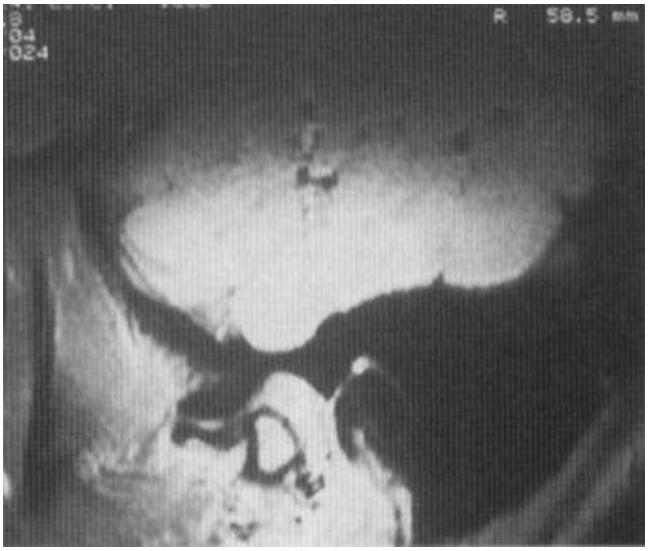


MRI showing anterior displacement of meniscus with landmark junction of the posterior attachment and posterior band at approximately the 3 o'clock position in relation to the condyle. Condyle shows minimal early sclerosis of the anterior-superior slope.

FIGS. 4.16, 4.17



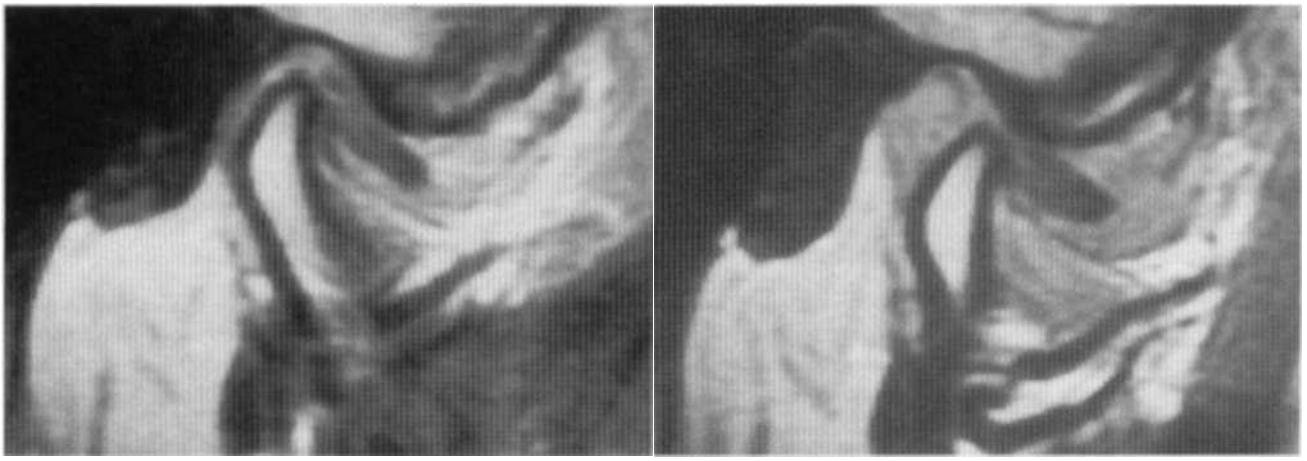
Cryosection showing normal physiologic position of meniscus with relationship to anterior-superior slope of condyle and articular eminence. Note that the junction of the posterior attachment and the posterior band of the disk is approximately at lhel2 o'clock position on the condylar head. Also note the normal dimensions of the functioning disk, which are approximately 3 mm x I mm x 2 mm.



MRI sagittal view of anterior disk displacement without reduction Relatively normal shape of disk indicates possibility of disk repairability.

FIG. 4.18

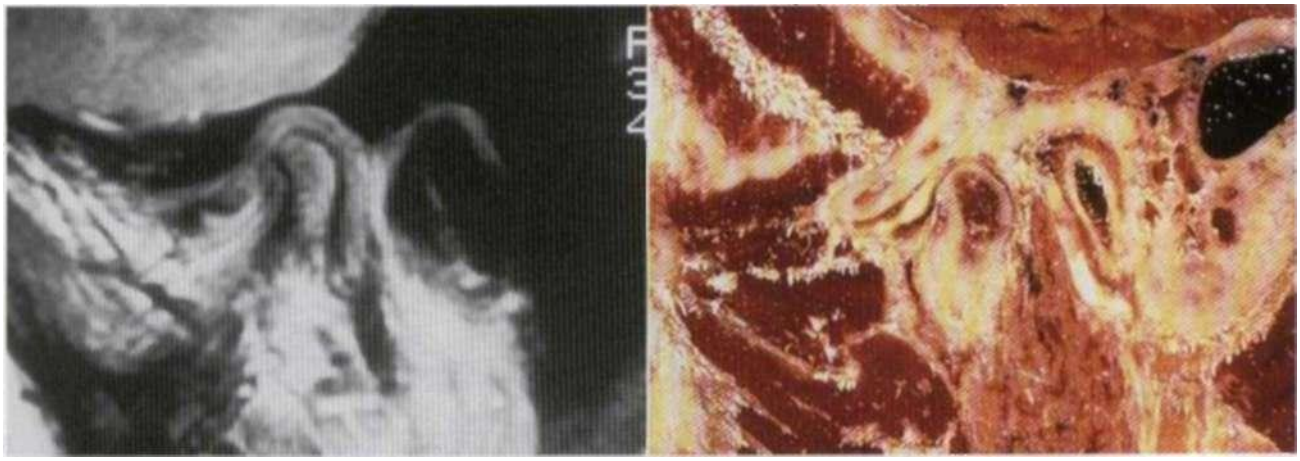
A



B

MRI of open and closed view of late stage anterior disk displacement without reduction. Note gross distortion in shape of diskal tissues. To reposition this type of a deformed disk, the surgeon must reconlour the disk and perform an errinoplasty to allow for unobstructed condyle-disk motion.

A



B

A, MRI depicting anteriorly displaced disk with foreshortening of the anterior-posterior length and thickening of the posterior band. **B,** These changes are also depicted in the cryosection, which shows some secondary sclerosis of the anterior-superior slope of the condylar head with thickening at the most anterior aspect of the condylar head.

FIG. 4.19

DISK PLICATION

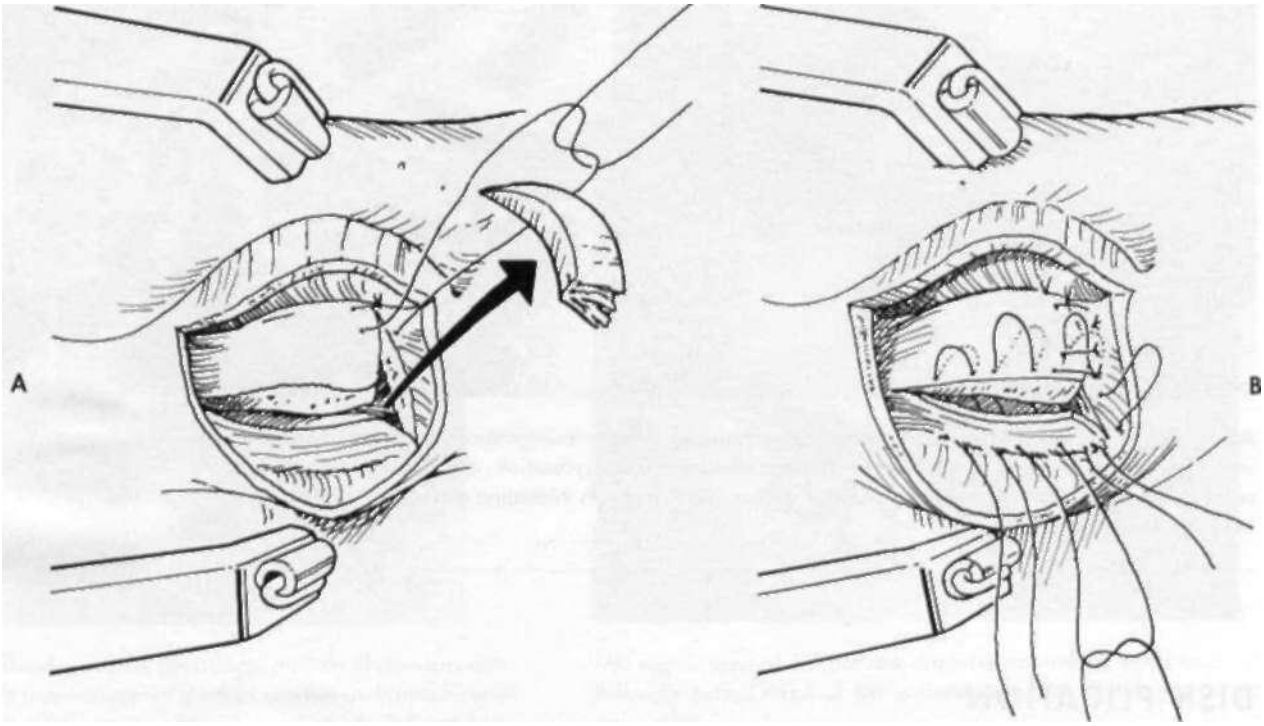
Disk plication can be either a complete or a partial procedure. In the complete disk plication a full wedge of retrodiskal tissues is removed and the disk is repositioned by suturing the remaining retrodiskal tissue directly to the posterior ligament.

In a partial plication a small, pie-shaped wedge of tissue is removed to facilitate repositioning in a simultaneous posterior and lateral plane. Separation of the condyle from the fossa allows better visibility and increased working space for surgical instruments. A Wilkes retractor is used by placing Kirschner wires in the zygomatic arch and the neck of the condyle. The retractor can then fit over the cut ends of the Kirschner wires and retract the condyle inferiorly and anteriorly.

In the plication procedure, specially modified right-angle vascular clamps are used to clamp the anterior and posterior attachments at the level of the wedge resection. This provides both hemostasis and control of the soft tissue edges. The repair is performed with multiple resorbable 4-0 sutures on a small curved needle. It is helpful to pass all the sutures first rather than tying them down sequentially, which can limit subsequent suture placement. The goal is to replicate as closely as possible the normal position of the disk. In most cases, this means that the junction of the posterior attachment and posterior band of the disk are at approximately the 12 o'clock position with reference to the condylar curve. After the repair, many surgeons find it helpful to simulate a range of motion with the condyle to ensure the absense of mechanical obstruction, catching, or locking.

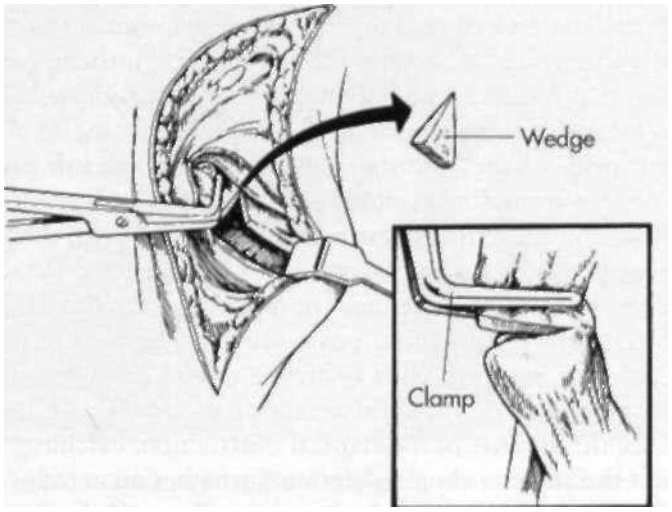
At this point the surgeon should determine whether an anterior release should be performed with electrocautery, laser, or small surgical scissors. When the condyle is secured in a satisfactory position, the surgeon can decide whether an eminoplasty should be performed to increase the superior joint space if mechanical obstruction is still present.

FIG. 4.20



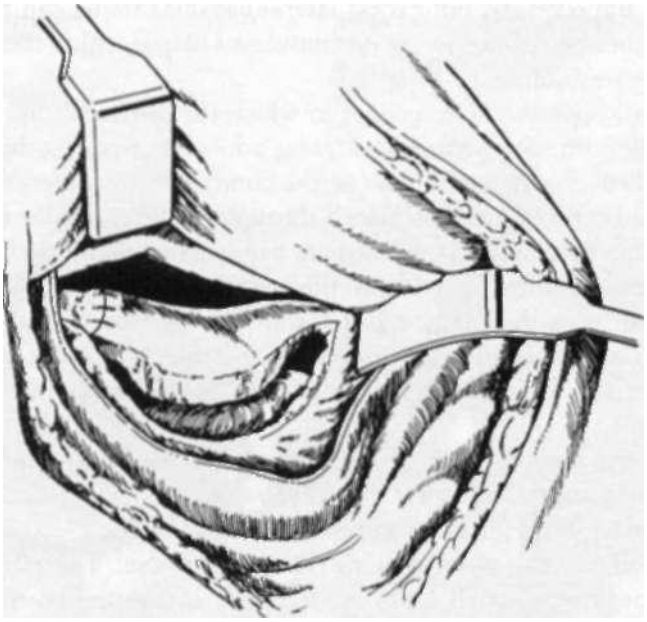
Meniscalplasty depicting a wedge resection for posterior and lateral repositioning of an anferior-medially displaced meniscus. The dimensions of the wedge can be altered to control the separate vectors of posterior and lateral movement of the disk.

FIG. 4.21



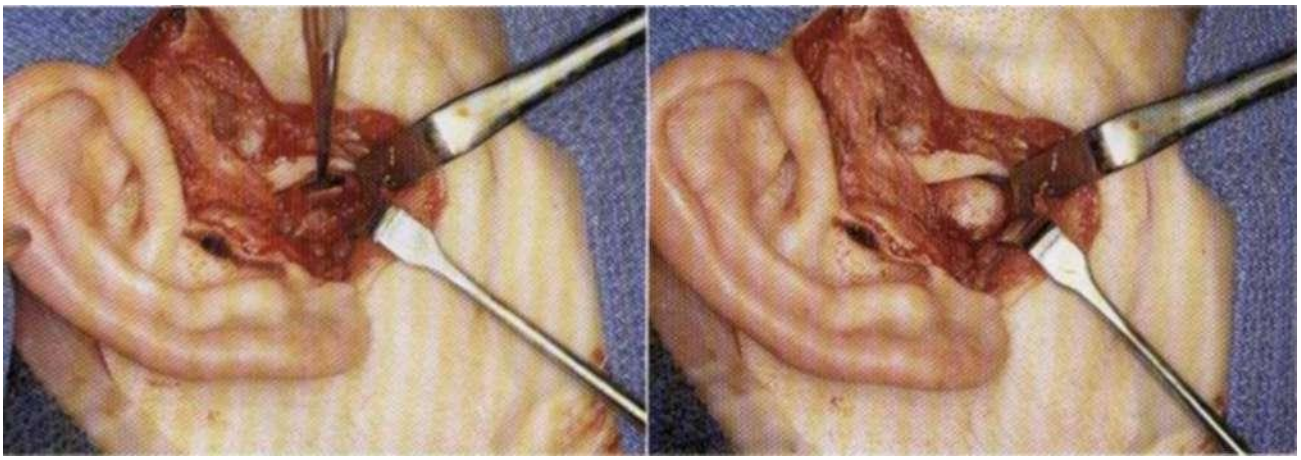
Triangular wedge resection in the posterior attachment to bring the displaced disk both posterior and laterally when it is plicated. Note the use of a right-angle tissue clamp on the posterior attachment to control bleeding during the repair.

FIG. 4.22



Once ihe disk is repositioned posterior-lalerolly, the lateral repair can proceed. A curved scissors or electrocautery is used to release the anterior attachment near the anterior capsular wall for a tension-free repositioning of the disk. Simple interrupted or horizontal mattress 4-0 sutures are used to reposition the disk posteriorly and laterally.

FIG. 4.23



A, Anlerior-medially displaced meniscus being grasped with tissue forceps. **B,** Meniscal repositioning posterior-lalerally after anterior release.

In the partial-thickness technique a complete resection of the posterior attachment is usually unnecessary, but excess lateral capsular tissue can be excised with scissors, and a small wedge of tissue is removed to help position the disk in a more lateral-posterior position.

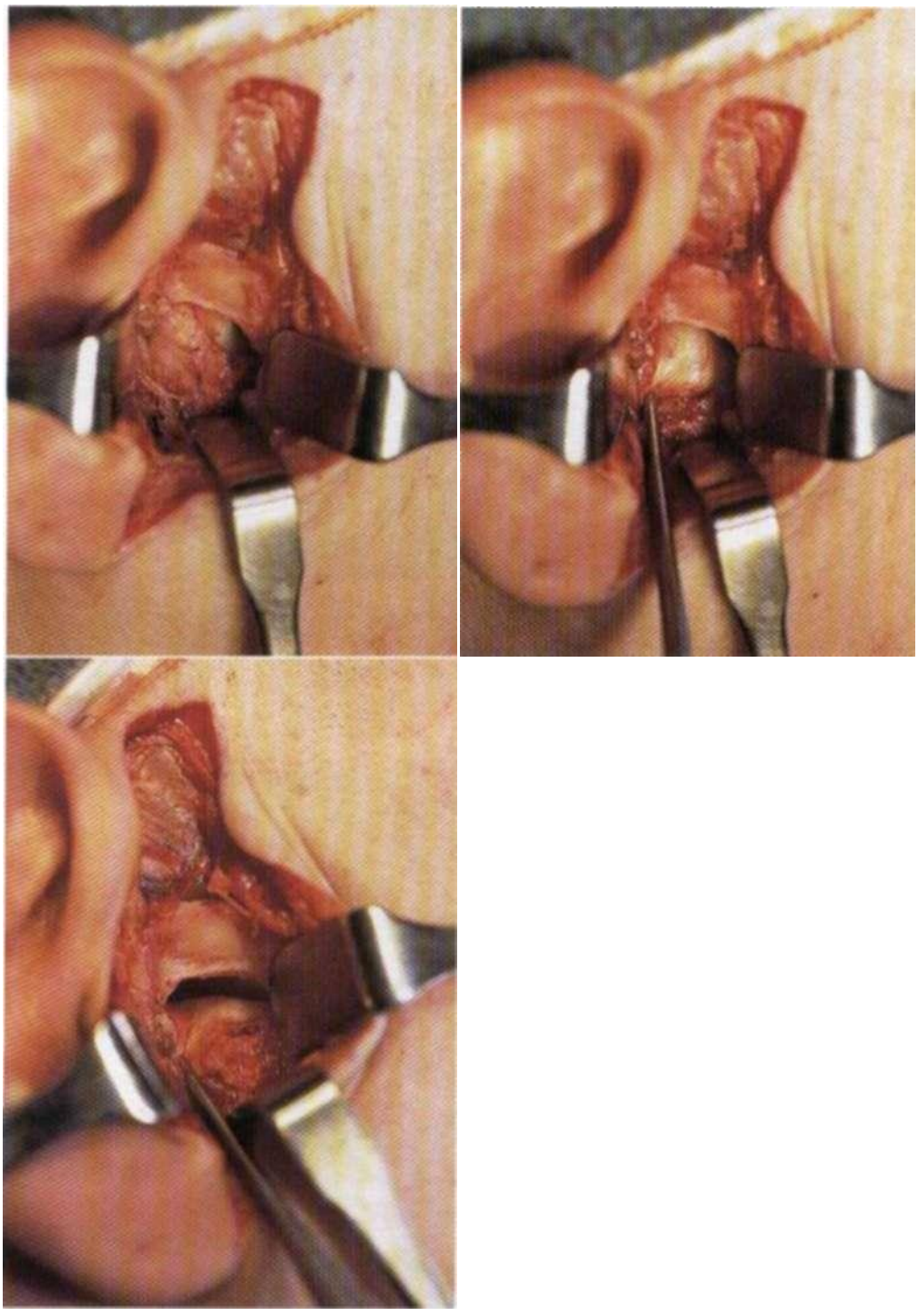
Condylar diskopexey is a procedure in which the displaced disk is freed by the surgeon entering both joint spaces and lysing adhesions first. At this point a small hole is placed through the lateral pole of the condyle from posterior to anterior. A nonresorbable 2-0 or 3-0 suture is placed through the hole and through the disk at the junction of the anterior and intermediate bands. Four to five additional 4-0 nonresorbable sutures are then placed from the lateral surface of the disk to the lateral capsular attachment on the condyle. If deformity of the disk precludes repositioning it into a more normal position, recontouring the thickened disk with a scalpel is sometimes necessary. This recontouring can also be performed with the operating microscope.

Some surgeons favor the use of a temporal diskopexey for stage III and stage IV internal derangements when the disk is too deformed to function in a condyle-disk unit. In this case the disk is secured to the roof of the glenoid fossa by placing two bur holes in the posterolateral lip of the fossa. The patient should be assessed preoperatively with MRI studies and intraopcratively to judge the repairability of the disk. Although attempts to salvage late-stage meniscal displacements are becoming more popular, the success of the disk repair depends on the degree of deformity and the extent of degenerative changes at the time of the arthroplasty. In some cases of disk deformity, a simultaneous eminoplasty to increase the superior joint space may be appropriate. After the plication is completed, the mandible is manipulated to assess the area on the eminence where the disk impinges. The condyle is then separated from the fossa, and a large diamond bur is used to contour the eminence to allow unobstructed passage of the condyle-disk complex. Care is taken to avoid removing the fibrocartilage in the fossa itself during this maneuver. Some surgeons recommend use of a temporary silicone implant after this procedure to prevent the disk from adhering to the surface of the recontoured articular eminence.

Text continued on p 74

FIG. 4.24

A



C

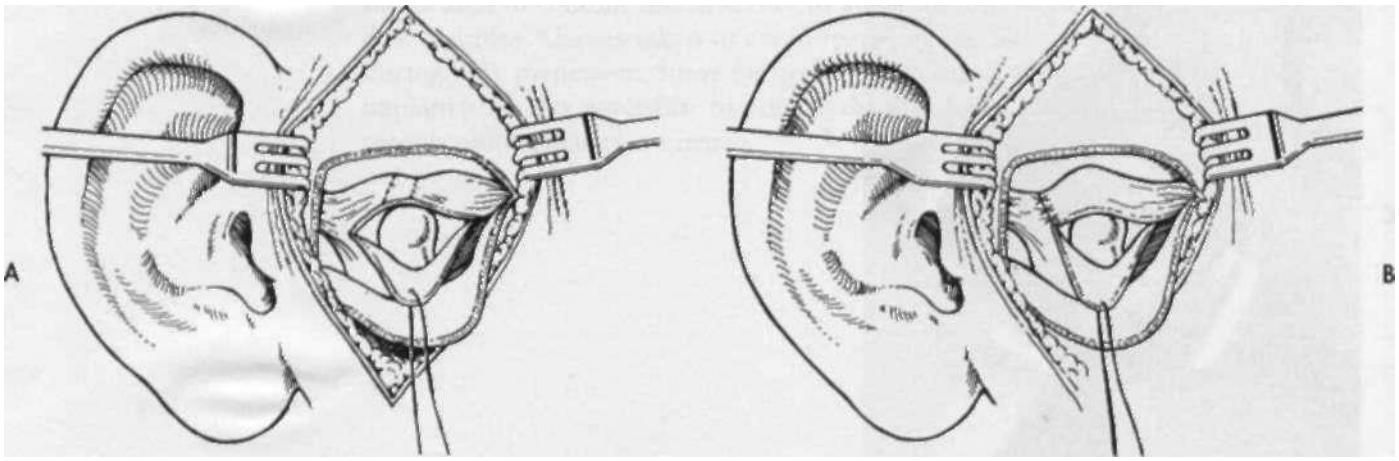
A, Superior joint space, left joint, showing anterior-medially displaced disk. **B,** Tissue forceps pulling displaced disk in exaggerated lateral position. **C,** Tissue forceps holding repositioned meniscus in lateral-posterior position, which allows unrestricted motion of condyle without clicking or locking.

FIG. 4.25



Cryosection showing dimensions of healthy posterior attachment. Although it is possible to perform wedge resection of this tissue with primary approximation, this can present a difficult challenge in late-stage displacements with atrophic and markedly thinned posterior attachments.

FIG. 4.26



A, Resection of posterior attachment for meniscal repositioning. Note that both edges of resection must be in vascular tissue to ensure healing. **B,** Repositioned meniscal tissue.

FIG. 4.27



A, Note repositioned meniscus in closed position. Suture line is visible along lateral capsular attachment. It is preferable to keep the suture knots away From any area that would possibly be in contact during joint loading. **B,** Note the condyle is maneuvered alter the disk repair is completed to ensure smooth condyle-disk function during the expected range of motion. No excessive pull should occur on the suture line at the terminal opening point.

FIG. 4.28



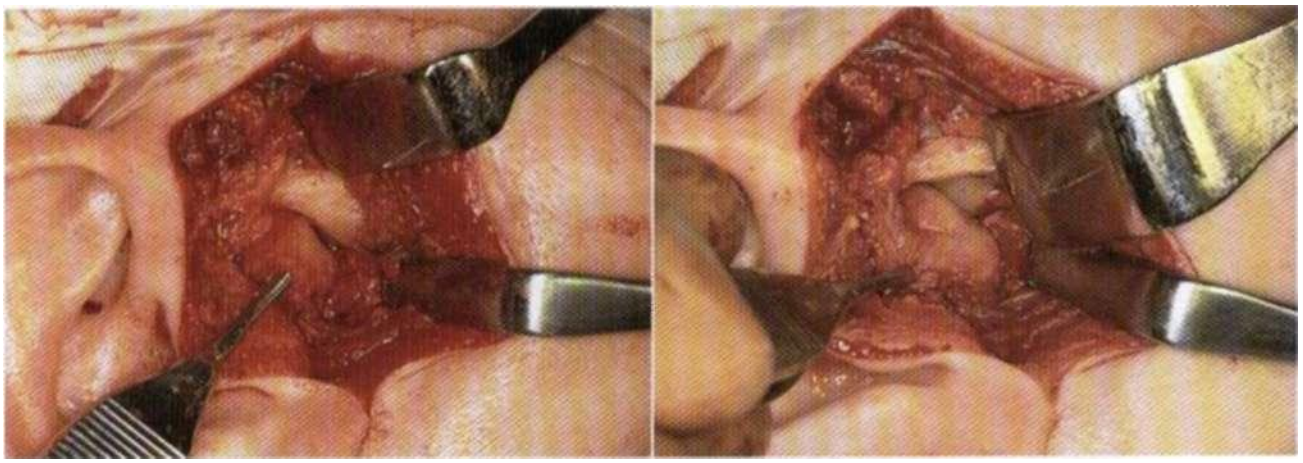
Cryosection of normal temporomandibular joint anatomy showing relationship of condyle to the posterior slope of the articular eminence. It may be necessary to perform an eminoplasty in conjunction with the diskal repair to increase the joint space and prevent future impingement of the disk against the eminence. Condyloplasty and "condylar shaves" to increase the joint space are not recommended because once the fibrocartilage is destroyed, accelerated degenerative changes are likely to occur in the condyle.

FIG. 4.29



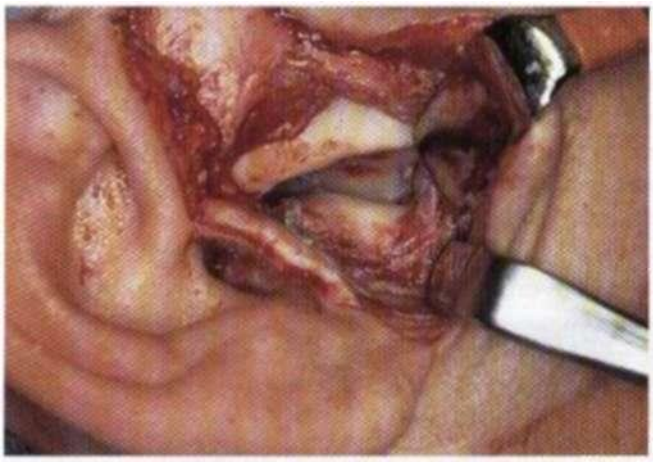
A, A case in which eminoplasty was used as an isolated procedure for treatment of chronic closed lock. **B,** Note increased joint space with condyle in closed position.

FIG. 4.30

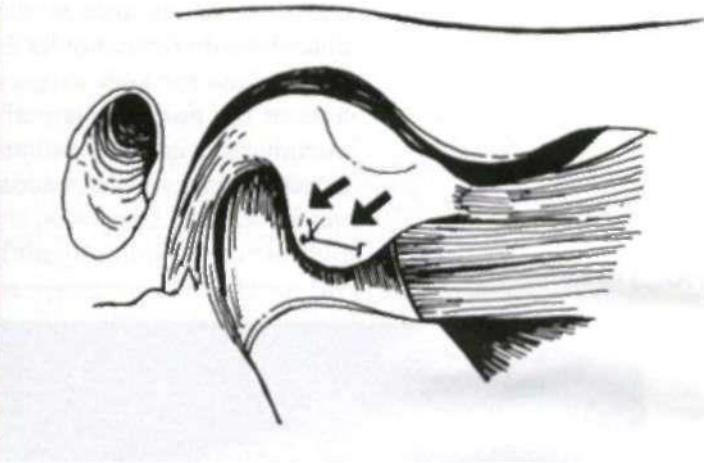


A, Tissue forceps being used to reposition a displaced meniscus in a more physiologic position. **B,** Final position of meniscus after anterior release and eminoplasty.

FIGS. 4.31, 4.32

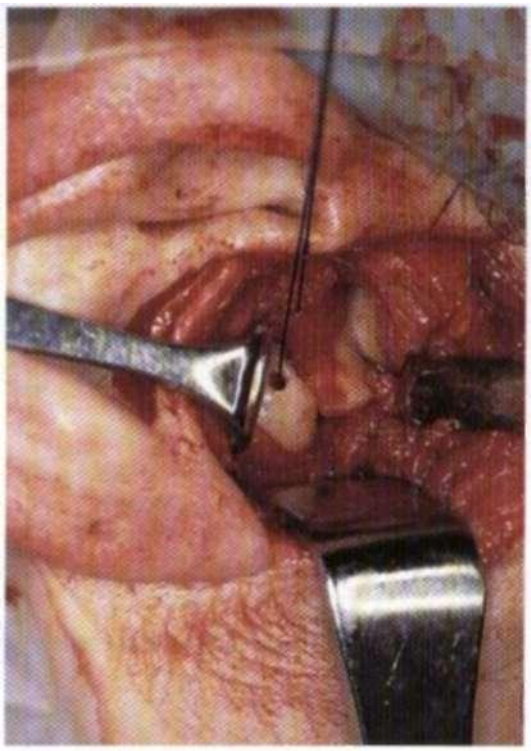


Status postdisk repositioning and eminoplasty. The disk was repositioned with eight 4-0 vicryl sutures. All the knots were buried on the deep surface of the posterior attachment, and the repair line is visible as a crease just distal to the posterior band of the disk. Again, note the increased joint space in the anterior-superior joint space.



Condylar diskopexy. Sagittal view of meniscal repositioning with the lateral attachment secured to the lateral pole of the condyle with 2-0 permanent monofilament suture,

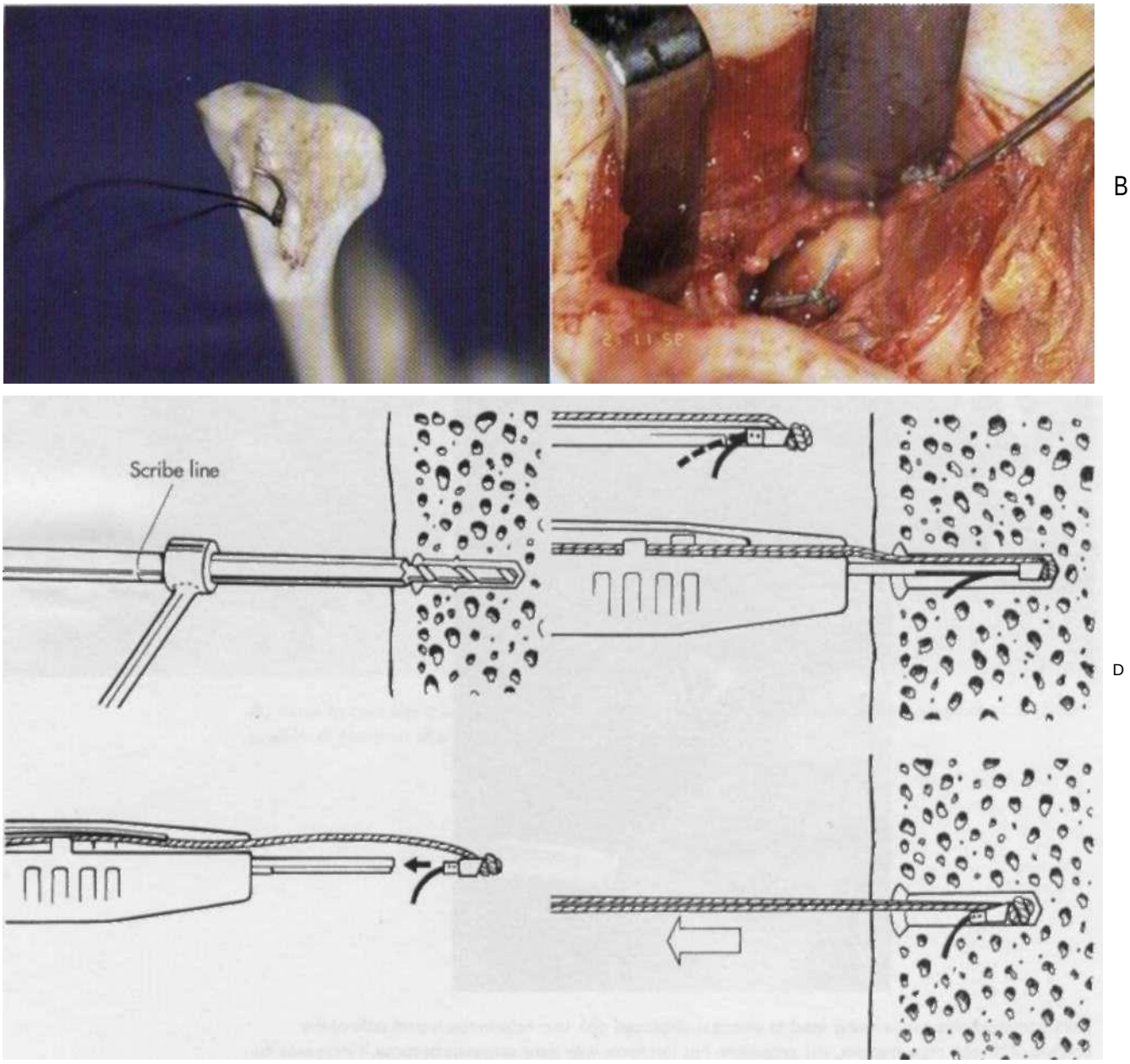
FIG. 4.33



Note nonresorbable suture being used to secure a displaced disk to a hole in the lateral pole of the condyle. Although once popular, this procedure has lost favor with most surgeons because it increases the potential for adhesions between the disk and it also limits independent condylar movement during condylar translation.

Another technique for securing the disk in a more physiologic position is the use of the Mitek anchor. This bone-anchoring system allows a metal insert to be placed inside the condylar head with a suture attached to it. This system is commonly used for knee surgery. In this technique the Mitek drill is used to create a hole in the posterior-lateral surface of the condylar neck. The Mitek bone-cleat introducer is inserted and pushed into the bone, where two small coils unlock and attach the cleat to the inner surface of the cortical bone. The nonresorbable woven

FIG. 4.34

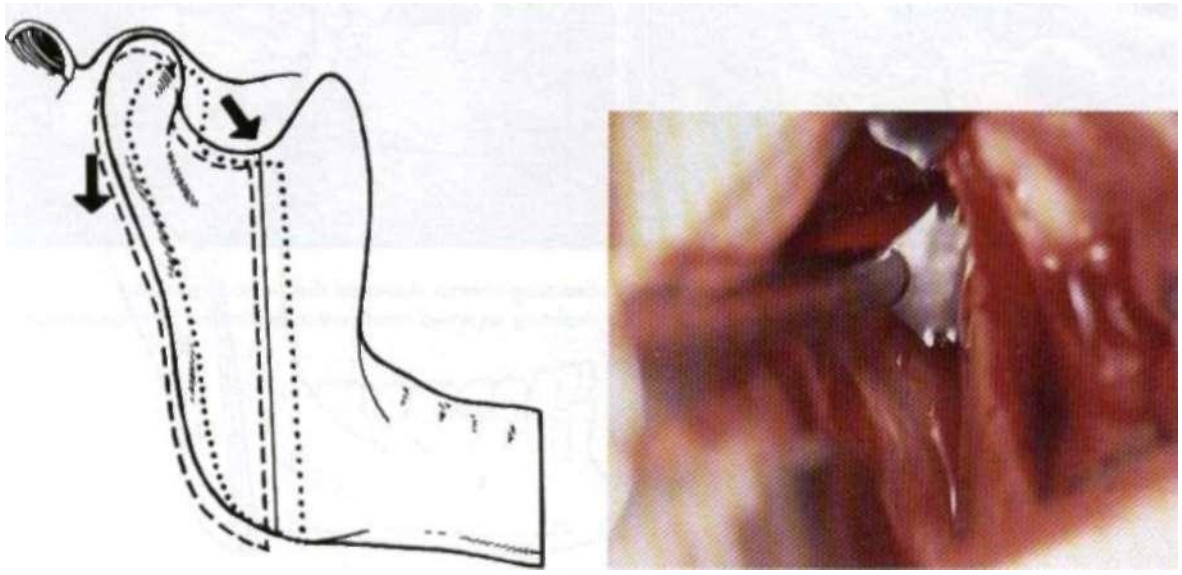


A, Condylar specimen cur away to show insertion of the Mitek cleat into the head of the condyle from a posterior-lateral approach. **B,** Repositioned disk held in position by Mitek cleat. **C, D,** Insertion of Mitek cleat into condylar head for meniscal anchoring procedure.

Suture is then passed with a fine needle through the free edge of the disk, and the disk is tied down to the condylar neck. Although this is an effective way to secure the disk and prevent postsurgical relapse, the Muck cleat will interfere with future magnetic resonance imaging studies.

Another method for treating internal derangements, which Hall has recently popularized, is the modified condylotomy. This procedure can he used for internal derangements instead of conventional intracapsular disk-repositioning techniques. In essence, an intraoral vertical subsigmoid osteotomy is performed. A large pineapple buf is used to contour the lingual cortical bone of the proximal segment. Even though there is incomplete stripping of the medial pterygoid muscle, inferior and anterior repositioning of the proximal segment occurs. This allows the condyle to reposition itself in a more normal relationship with the displaced disk. This condylar movement is secondary to a shortening of the lateral pterygoid muscle, and the condylar repositioning essentially reduces the impingement on the rctrodiskal tissues. A short period of intermaxillary fixation is followed by functional training with interarch elastics.

FIG. 4-35

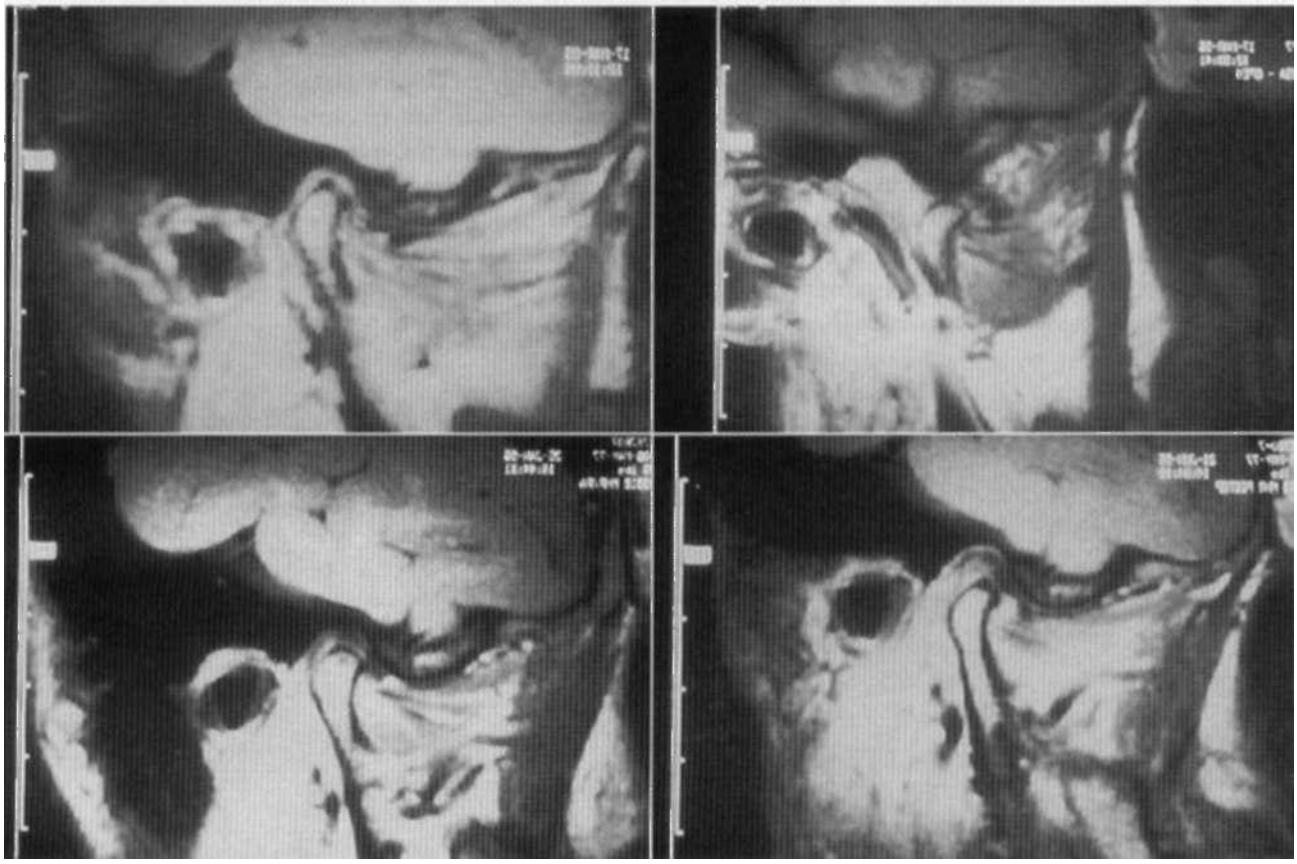


A B

A, Modified condylotomy as described by Hall. Note anterior-inferior positioning of the condyle status postosleotomy. **B,** Intraoral view of right-angle reciprocating saw being used to perform osteotomy cut from base of sigmoid notch to the inferior border or the modified condylotomy procedure.

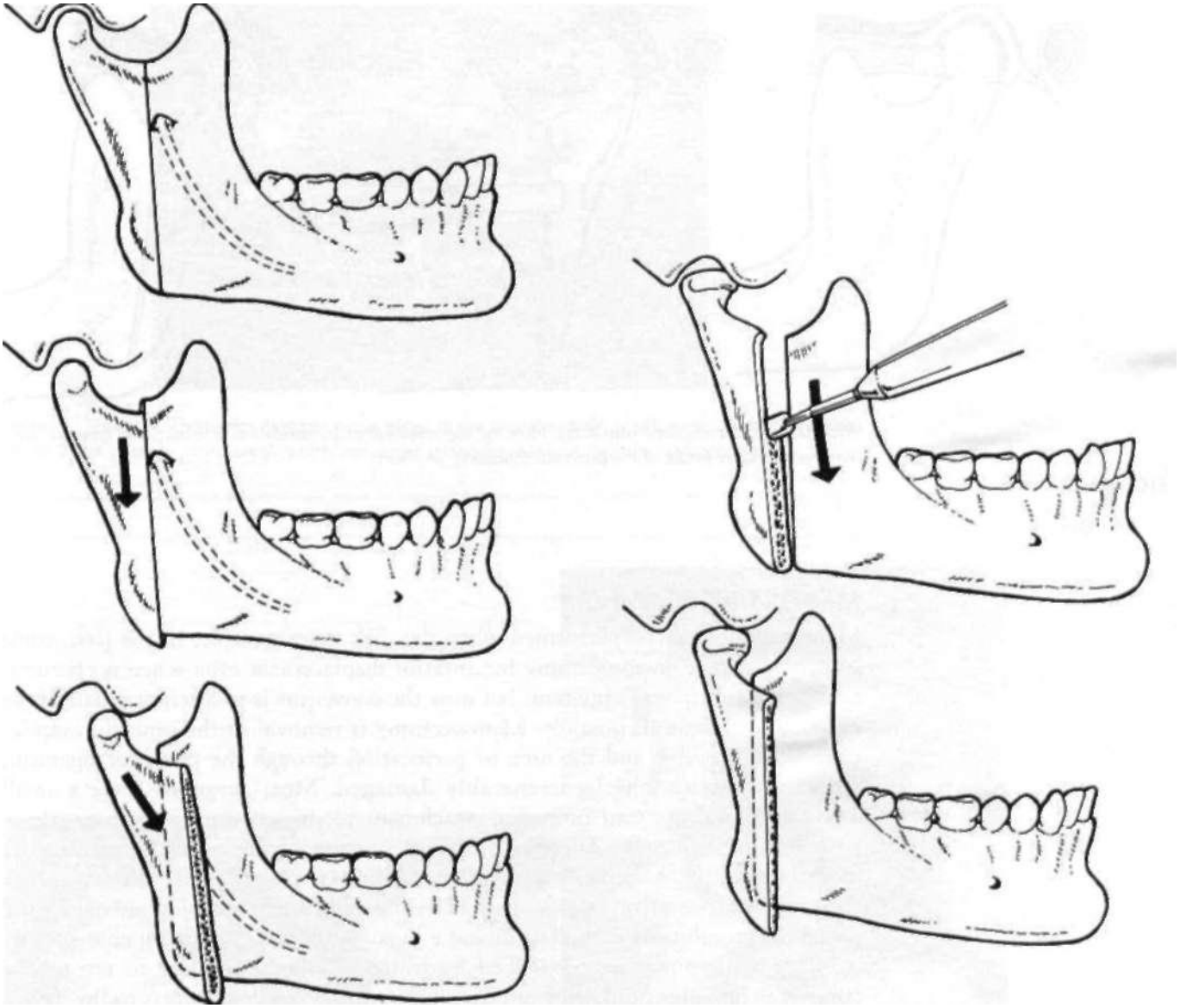
Continued

FIG. 4.35, CONT'D

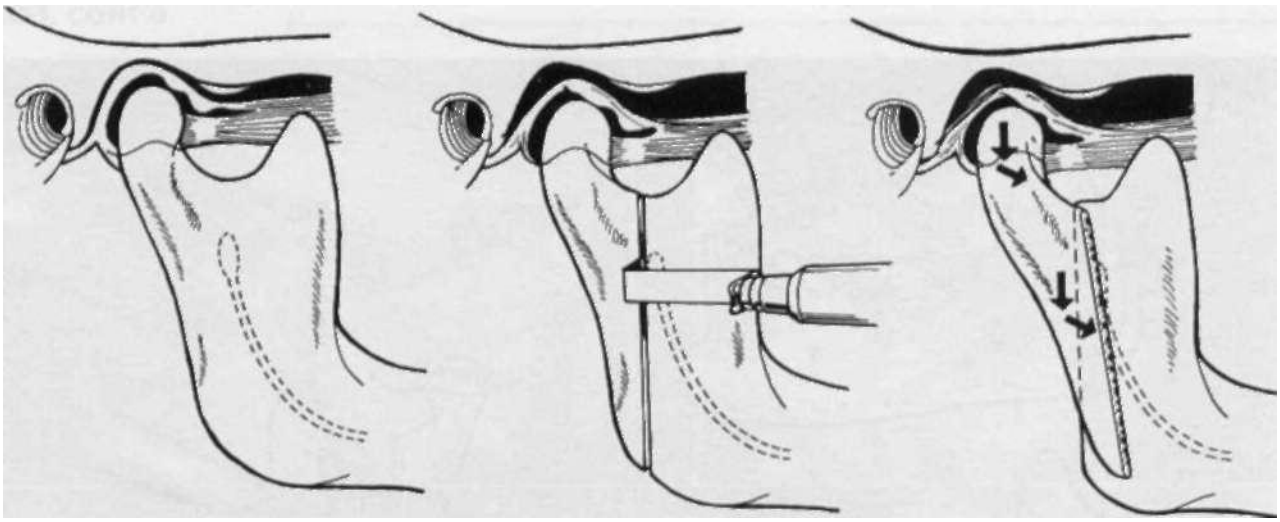


C, D, Preoperative open and closed MRIs depicting anterior displaced disk without reduction.
E, F, Postoperative open and closed MRIs depicting improved condyle-disk relationship after condylotomy.

FIG. 4.36



Intraoral subsigmoid osteotomy. After the osteotomy has been completed, a large pineapple bur is used to contour the lingual cortical surface of the proximal fragment tc optimize the bony adaptation of the proximal and distal osteotomy segments.



Intraoral vertical subigmoid osteotomy. Note the improvement in the condyle-disk relationship ofler the anterior-inferior displacement of the proximal osteotomy segment.

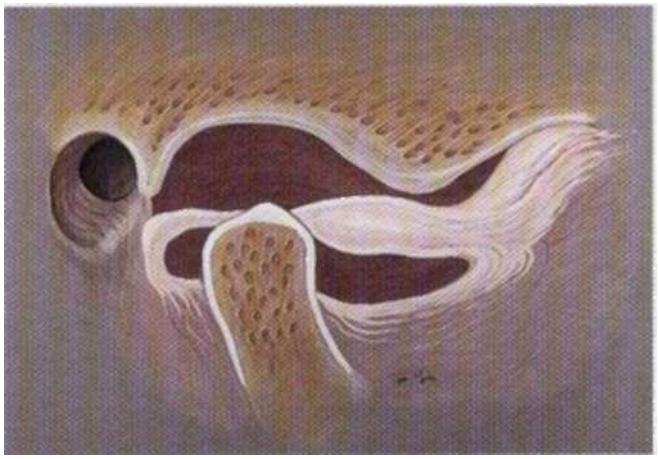
FIG. 4.37

MENISCECTOMY

Meniscectomy can be performed when the disk is irreparable. In the past, some surgeons favored meniscectomy for anterior displacement even when no perforation or deformity was apparent, but now the consensus is to attempt repair of the native tissues if at all possible. Meniscectomy is removal of the central avascular portion of the disk and the area of perforation through the posterior ligament, where the tissues may be irreparably damaged. Most surgeons leave a small amount of anterior and posterior attachment to prevent excessive hemorrhage with resultant fibrosis. The most difficult portion of the disk to remove is its medial extension. A specially designed, curved TMJ scissors can be used to cut the anterior and posterior attachments. The bleeding can then be controlled with packs of thrombin-soaked sponges and a local anesthesia containing epinephrine.

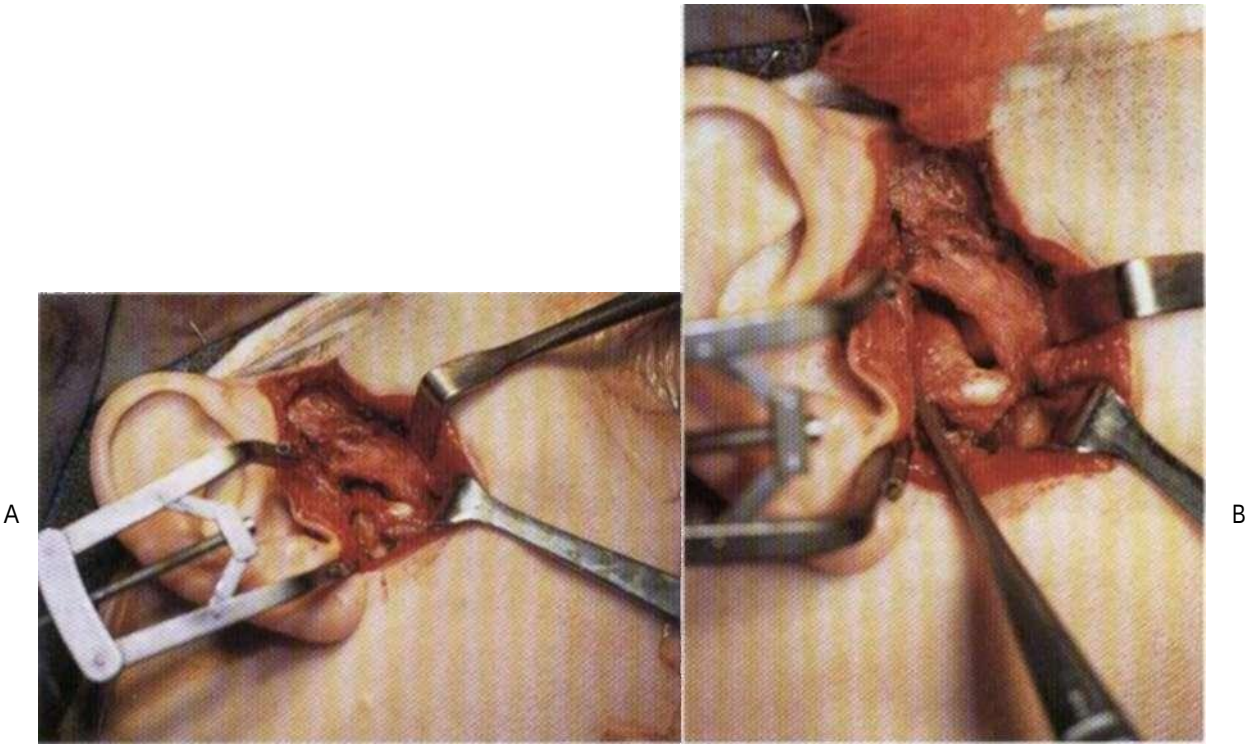
The final step is accomplished by using a Wilkes retractor to retract the condyle in an anterior-inferior direction. This allows maximal access to the medial recess. Either the curved TMJ scissors or a #15 blade is used to separate the disk from its medial attachment. The surgeon must be careful not to cut through the medial capsular wall and damage the internal maxillary artery. Once the disk is removed, the joint space can again be packed with thrombin-soaked sponges until hemostasis is obtained. One of the most common reasons for meniscectomy is perforation of the disk itself. As mentioned previously, a small freer elevator can be used to explore the disk from the inferior joint space and check for perforations that may not be visible on initial entry into the joint space.

FIG. 4.38



Perforated meniscus. The perforation can occur either in the meniscus itself, which would make it irreparable, or in the posterior attachment, which sometimes allows for meniscal repositioning and repair.

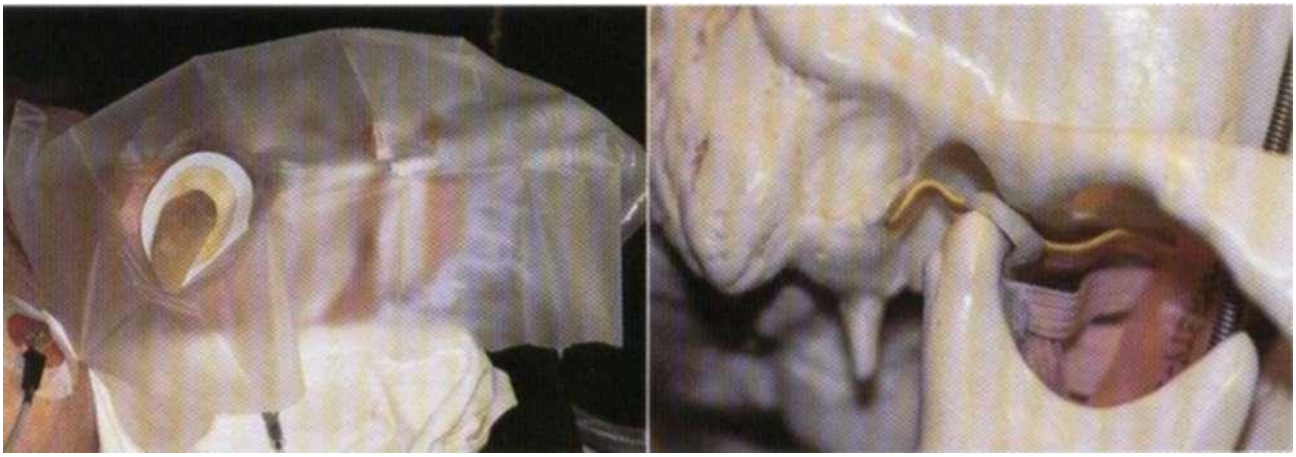
FIG. 4.39



A, Open arthroplasty showing dissection into superior joint space and inferior joint space with anteriorly displaced meniscus. Note increased area in glenoid fossa along with the greater maneuverability for meniscal surgery with the use of the Wilkes retractor. **B,** Tissue forceps simulating posterior and lateral repositioning of meniscus with Wilkes retractor in place. Note large perforation in meniscus. The herniated lateral pole of the condyle is visible through the perforation.

FIG. 4.40

A



B

A, Sterile draping of a patient for open arthroplasty procedure. Note sterile intraoral extension of drape, which allows manual manipulation of the condyle during open joint surgery. **B,** This allows the surgeon to depress the posterior molars to reposition the condyle inferiorly and anteriorly, which greatly increases the joint space during meniscal repairs and meniscectomy.

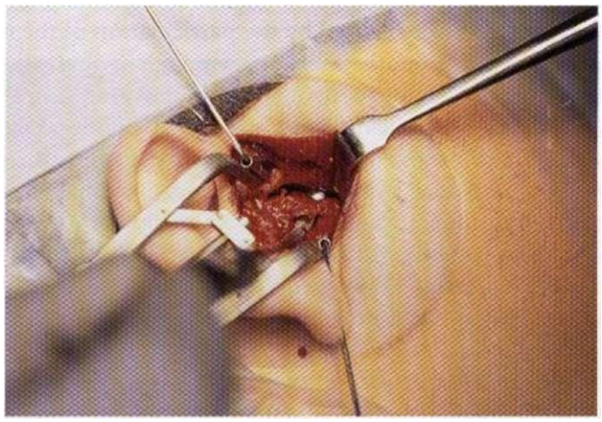
FIG. 4-41

A



B

A, Large perforation through both intermediate zone and posterior band of meniscus. **B,** Large perforation through posterocentral portion of meniscus.



Diagnosis of small perforations within the disk is sometimes difficult, Use of a small Freer elevator From an inferior approach is helpful to probe for perforations.

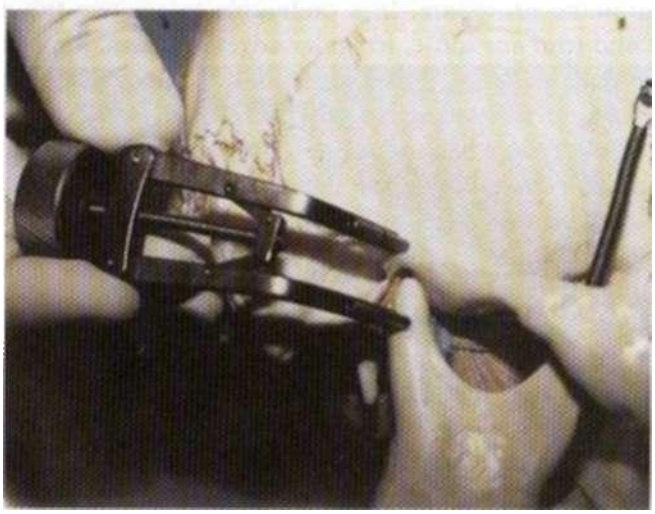
FIG. 4*42

Perforations that occur in the posterior ligament can be excised as part of a meniscal repositioning procedure. It is preferable to remove the majority of the meniscal tissue and trim any loose, irregular edges at the margins of the meniscectomy to prevent potential adhesions and fibrosis. Controversy exists in the literature about the type of reconstructive procedure that should be performed after meniscectomy. Some researchers advocate meniscectomy alone without replacement, and some long-term follow-up studies of these procedures show that patients can experience marked pain relief with an adequate range of motion. Universally, adaptive changes are apparent, even in successful meniscectomies, which appear radiographically as flattening of the anterior-superior slope of the condyle with sclerosis and some beaking of the anterior lip of the condyle. Crepitus is also a common finding after meniscectomy without replacement. A very effective technique, as described by Wilkes, was the use of the temporary silicone "pull-out" implant. The medical-grade silicone sheeting is contoured into an ovoid intraarticular interpositional implant with a temporal extension that can be placed under the superficial or deep temporalis fascia. The silicone forms a heavy fibrous capsule and, when used in this short-term fashion, does not appear to cause any foreign-body type of reactions. When silicone was used as a permanent implant in the joint, documented reactions included silicone synovitis and giant cell-mediated

foreign-body reactions that were caused by the participation of the material during excessive wear. Even in that event the reactions were not as aggressive as those seen with the PTFE implants. (These reactions will be covered more extensively in Chapter 7.) The temporary silicone implants prevent adhesions between the condyle and the glenoid fossa and promote the formation of a fibrous tissue lining, which can separate the bony articular surfaces of the joint. Once the temporary silicone implant is in place, the surgeon should move the mandible to ensure that all the articular surfaces are covered by the implant and that motion does not displace the implant from the glenoid fossa. The surgeon must remove the implant, and this can be performed as an office procedure with intravenous sedation and local anesthesia. The implant is generally removed approximately 6 to 12 weeks after surgery, but removal can be delayed for several months beyond this point if the patient's condition warrants that decision. It is reasonable to remove the implant when the interincisal opening is approximately 35 mm and the patient's pain level has decreased to a level at which narcotic medications are unnecessary. A small incision, which is 1 cm to 1.5 cm, is sufficient to remove the silicone implant.

Text continued on p 87

FIG. 4.43



Wilkes retractor in position, with condyle in closed position.

FIG. 4.44

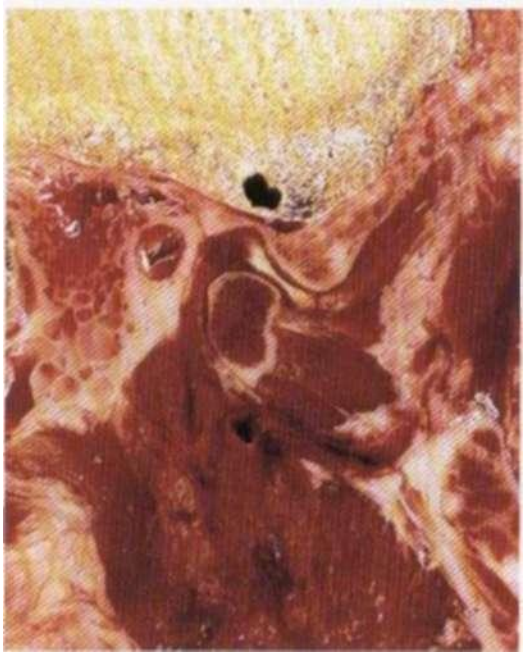
A



B

A, Right angle vascular clamp **(B)** being used to cross clamp the posterior attachment before the meniscectomy begins. This greatly decreases the amount of bleeding during the procedure. The tissues should also be infiltrated with a vasoconstrictor before the meniscectomy.

FIG. 4-45



Sagittal view of normal joint anatomy showing junction of posterior band and posterior attachment. The curved temporomandibulor-joint scissors should be placed 3 to 4 mm distal to this attachment to begin the meniscectomy dissection. This dissection at the junction of the anterior band with the capsule is more difficult. An attempt is made to excise the disk attachment right at the junction of the capsular wall without unnecessarily severing too much of the superior head of the lateral pterygoid muscle, which causes hemorrhage and possible postsurgical fibrosis.

FIG. 4.46



A, Specially designed curved temporomandibular-joint scissors **(B)** being placed 3 to 4 mm distal to the junction of the posterior band and the posterior attachment. Note that the condyle is positioned interiorly and anteriorly out of the fossa to allow for access for this maneuver. This can be performed by an assistant surgeon, or a Wilkes retractor can be used.

FIG. 4-47



Wilkes retractor in position. A .026 Kirschner wire is drilled through the root of the zygoma and the neck of the condyle. The retractor is activated to displace the condyle inferiorly out of fossa to allow for greater working area during meniscal plication or meniscectomy.

FIG. 4.48

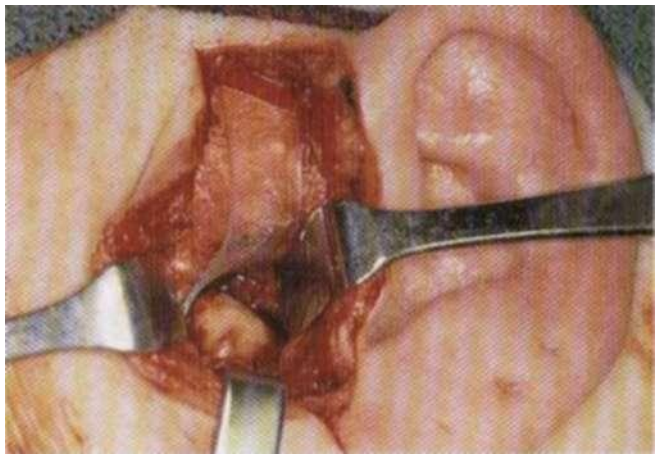
A



B

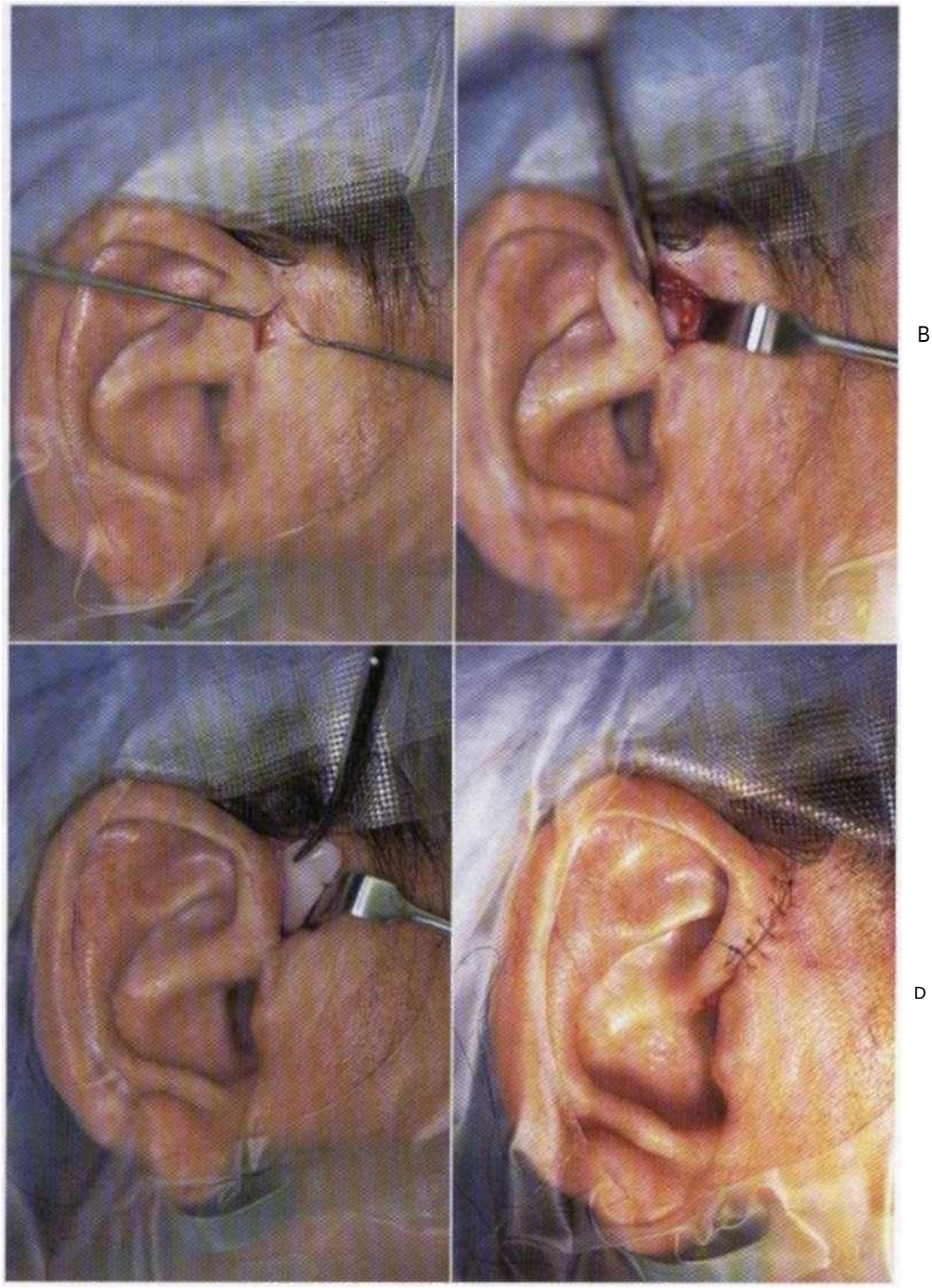
Stalus poslmeniscectomy with placement o(temporary silicone implant. **A,** Implant is contoured to cover all the articulating joint surfaces, and the temporal extension is then placed deep to either the superficial temoralis fascia or the deep temporalis fascia. **B,** The implant is placed deep to the superficial temporalis fascia in this view.

FIG. **4.49**



Temporary silicone implant showing temporal extension before positioning of the extension beneath the temporalis fascia.

FIG. 4.50



A, At approximately 8 to 12 weeks after surgery the temporary silicone implant is removed through a 1.5-cm incision at the superior edge of the previously placed endaural incision. **B,** A curved hemostal is used to free the implant on both its medial and lateral surfaces before an attempt to extract the implant is made. **C,** A long, curved Crile tissue forceps is used to gently grasp the implant at the junction of the temporal extension and the articular portion to remove the implant without tearing it. Once the implant is removed, it is inspected for fragmentation, wear, and perforation. **D,** Note the position of the temporal extension directly under the most superior aspect of the endaural incision. This allows easy identification and removal at a later date.

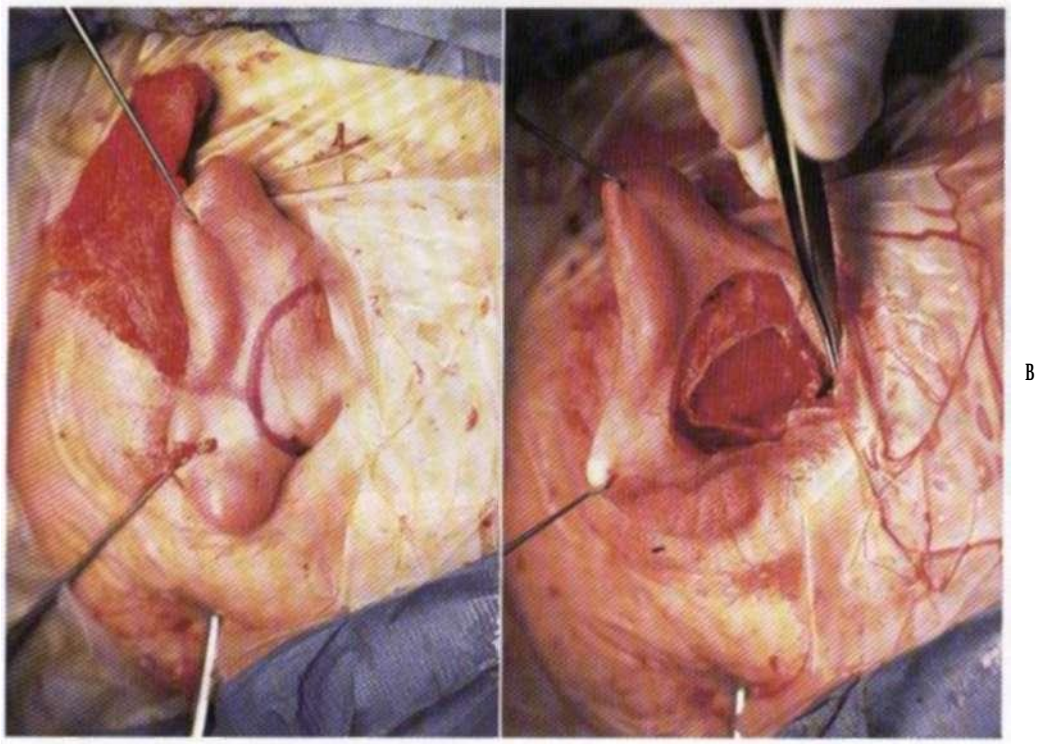
MENISCECTOMY WITH REPLACEMENT

Autogenous, allogeneic, and alloplastic materials have all been used to replace the disk after meniscectomy. Long-term studies of patients with meniscectomy without replacement indicate that some patients do very well without any tissue replacement. It is equally obvious that no viable alloplastic disk-implant material is available at this time. The well-documented severe pathologic responses to PTFE interpositional implants and, to a lesser degree, permanent silicone implants clearly negate this approach.

Of the autogenous tissues the three most commonly used are dermis, auricular cartilage, and temporalis fascia and/or temporalis muscle. Allogeneic materials such as fascia, dura, and cartilage have been used, but autogenous materials have the advantage of obviating the possibility of antigenicity or infectious disease transmission.

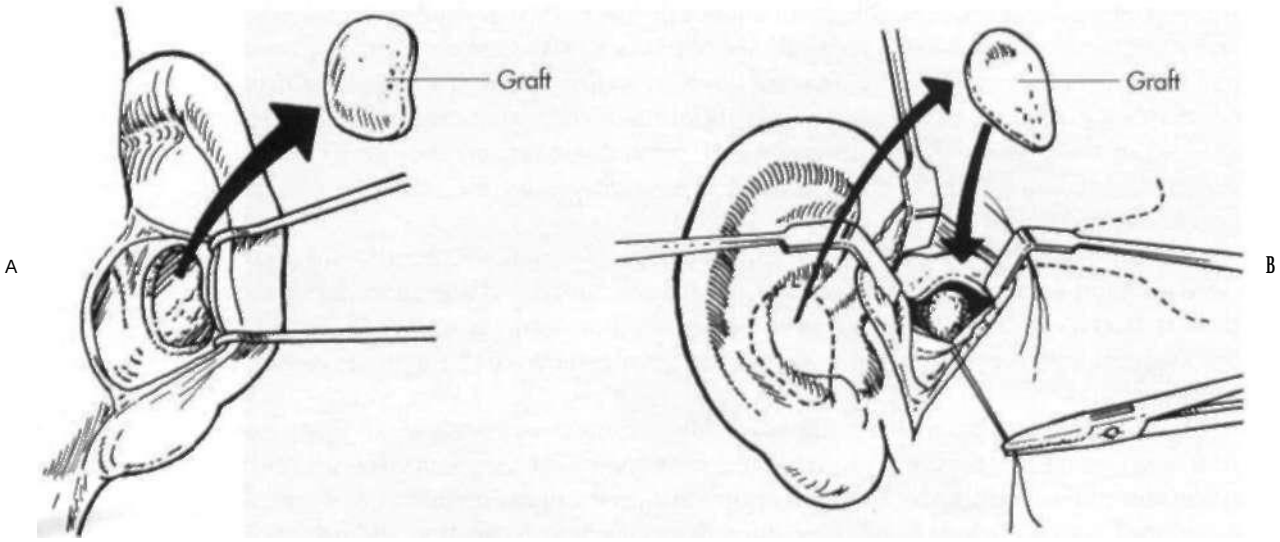
The dermal graft can be harvested "free-hand" in the lateral thigh or abdomen. An elliptical incision is made to excise the full-thickness graft with both epidermis and dermis intact. The graft should measure approximately 3 to 4 cm by 3 cm, and a #15 blade is used to remove the epidermal layer. Because the graft tends to contract during harvesting and handling, the piece of tissue excised should be larger than the actual dimensions of the meniscal defect.

FIG. 4-51



Posterior approach to ear to harvest auricular cartilage. **A,** The incision is approximately 4 cm. **B,** It is placed between the anlihelix and the outer helix. The incision is positioned so that it will remain over intact cartilage after graft harvesting. The graft removed should be smaller in diameter than the distance between the incision and the mastoid crease. Hemostasis must be achieved to prevent an auricular hematoma postoperatively.

FIG. 4.52



A, Postauricular approach for an autogenous conchal cartilage graft. **B,** The graft is then secured and contoured into the surface of the glenoid fossa.

FIG. 4.53

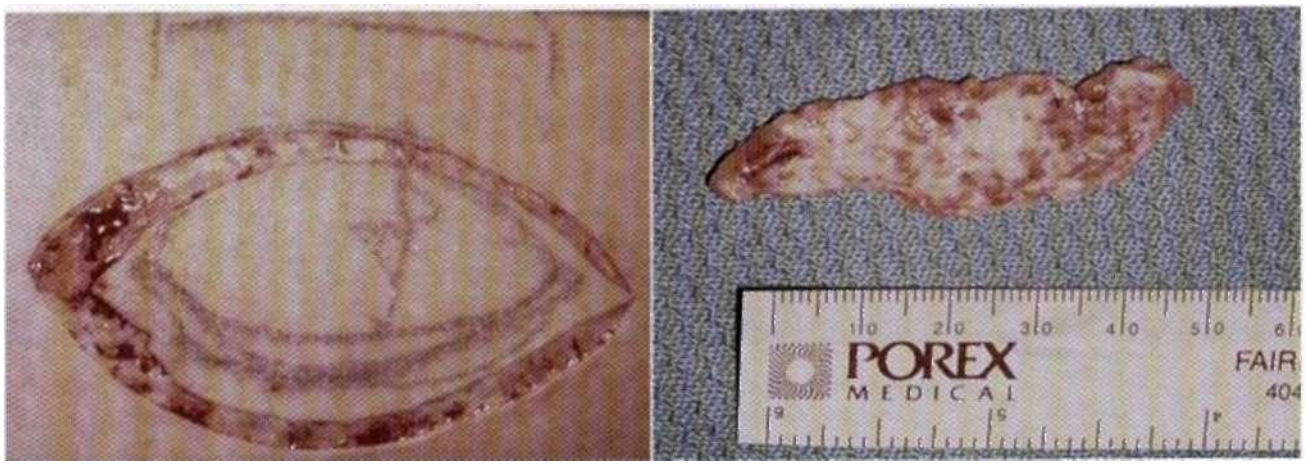


Auricular cartilage. **A,** The graft is approximately 3 cm x 3 cm and positioned in the glenoid fossa to allow the natural curvature of the auricular graft to complement the contour of the fossa. **B,** The auricular cartilage is stabilized to the glenoid fossa with four 3-0 nonresorbable sutures.

Another technique to harvest the dermal graft is to use a dermatone to create a full-thickness skin graft that is not detached at its base. The dermal graft is then harvested, and the skin graft is repositioned and sutured at the periphery. Some authors advocate using the #15 blade to make "quilting-type" cuts through the skin graft to prevent displacement by a subepithelial hematoma. Once the dermis is prepared, it is placed into the joint space and sutured to both remnants of the anterior and posterior attachment with 4-0 resorbable suture.

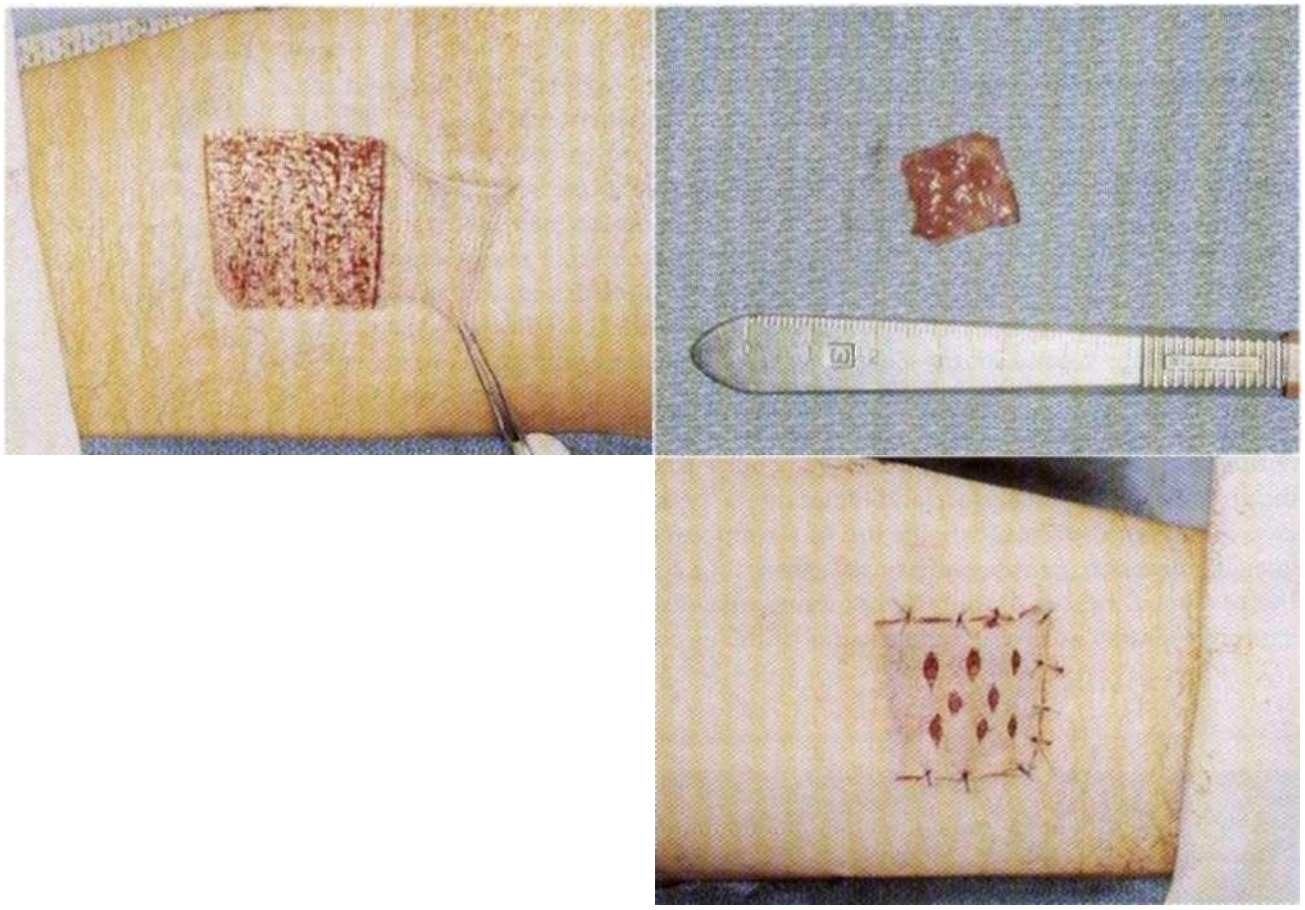
Auricular cartilage has also been used as a disk replacement and can be harvested by a posterior approach that leaves a very acceptable scar. Designing the incision so that it will cover intact cartilage after the graft is removed is extremely important. An attempt is made to harvest cartilage with a curvilinear shape so that it will match the contour of the glenoid fossa. Usually the cartilage must be secured to several small holes drilled on the lateral-inferior lip of the glenoid fossa. In harvesting the graft, surgeons must be careful not to violate the rim of the antihelix during graft removal. They must also remember to dissect the perichondrium off the graft on the lateral surface and maintain the perichondrium on the medial surface. Some surgeons advocate the use of a temporary silicone implant for approximately 6 weeks to prevent adhesions between the condyle and the auricular graft. Use of a small rubber drain in the postauricular ear wound and a pressure dressing to prevent an auricular hematoma is of the utmost importance.

FIG. 4-54



A, Dermis graft is harvested by making an elliptical full-thickness incision in the skin of the lateral thigh. **B,** After the epidermis is removed, the dermis graft is fashioned to account for contraction during its preparation. The donor site can be closed primarily with minimal undermining.

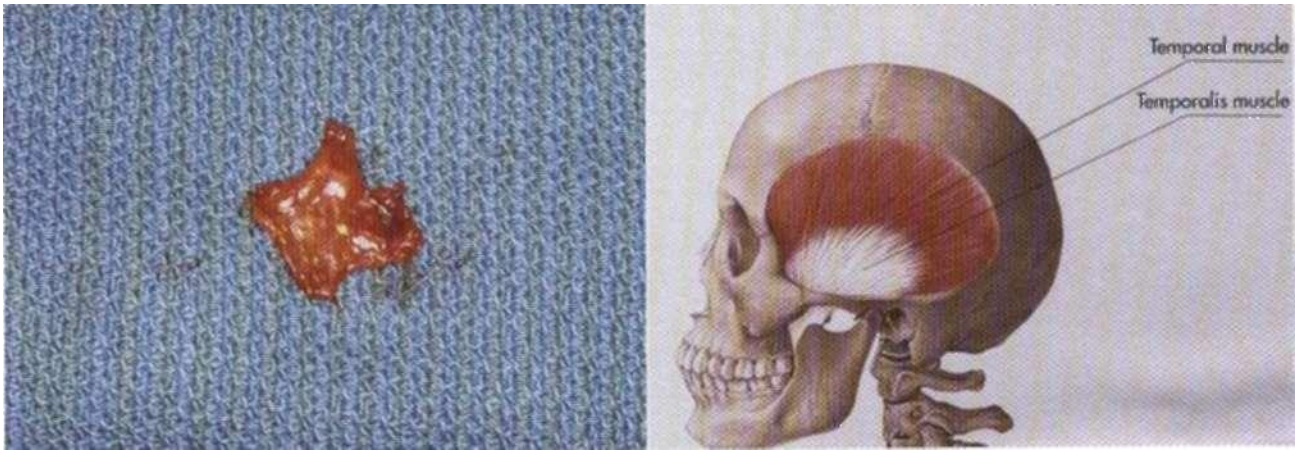
FIG. 4.55



A, An alternative procedure for harvesting a dermis graft is to use a dermatone to raise a full-thickness skin graft. **B,** The dermal graft is then excised with a #15 blade, and the skin graft is repositioned and sutured after placement of several "quilt cuts" to prevent a hematoma. **C,** Repositioned split-thickness skin graft with epidermal "quilting" perforations to prevent hematoma formation.

FIG. 4.56

A



B

A, Temporalis fascia graft harvested for autogenous meniscal replacement by extension of temporal arthroplasty incision. **B,** Diagram of temporalis fascia as a source of autogenous meniscal replacement tissue.

FIG. 4.57

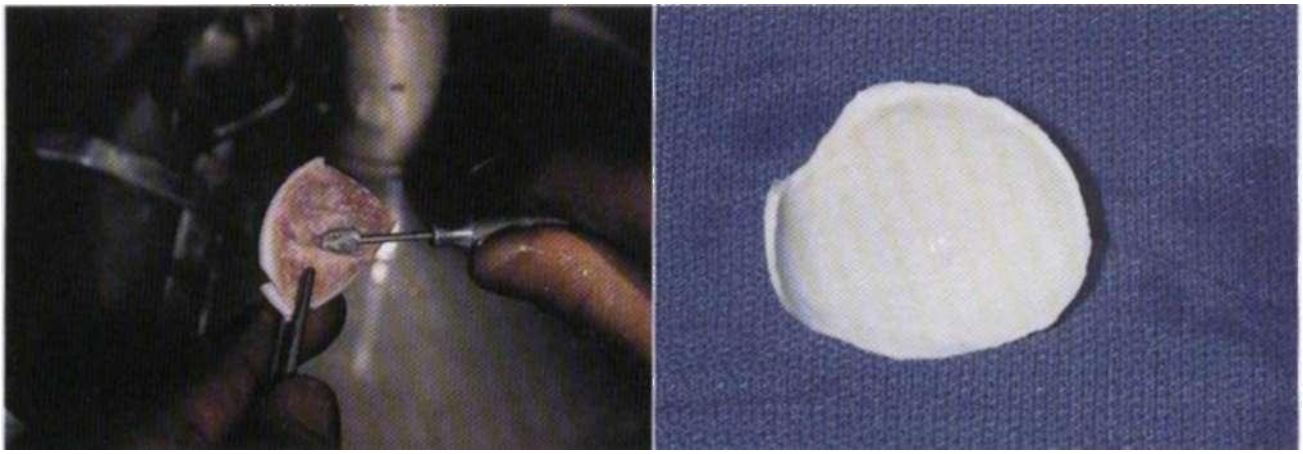
A



B

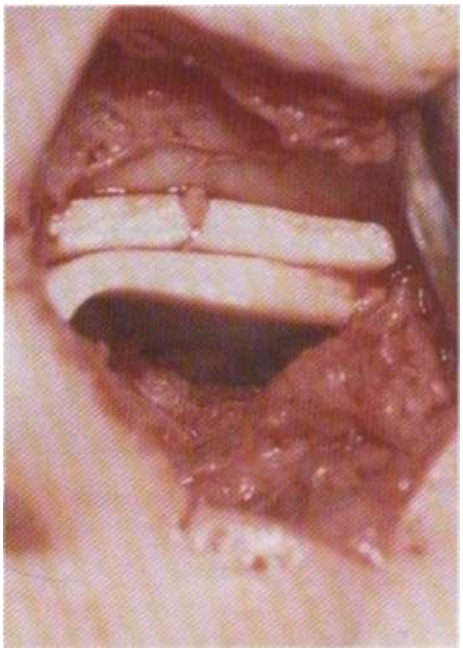
A, B, Status postmeniscectomy with temporalis fascial graft in position. Graft is sutured anteriorly to anterior capsular ligament and the lateral pterygoid muscle and posteriorly to the posterior attachment.

FIG. 4.58

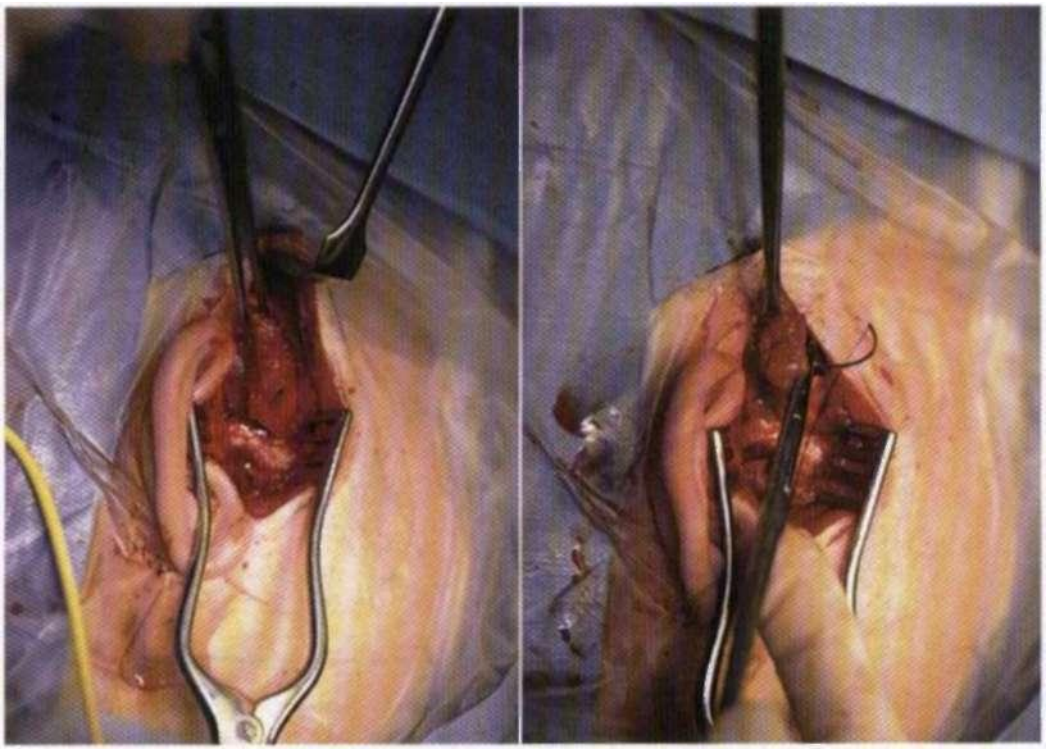


Fresh-frozen femoral head cartilage for meniscal replacement. **A,** Removing bone from undersurface of cartilage. **B,** Cartilage after bone removal.

FIG. 4.59



Double layer of fresh-frozen femoral head cartilage in glenoid fossa to offset loss of vertical height in condyle secondary to erosion from PTFE-implant giant cell reaction.



A, Interiorly based temporalis flap is elevated, with care taken to maintain blood supply from the superficial temporal artery. **B,** The edges of the temporalis flap are sutured around its circumference with a running 3-0 chromic stitch. The flap is then rotated down around the lateral portion of the zygomatic arch and into the glenoid fossa as a lining graft after meniscectomy.

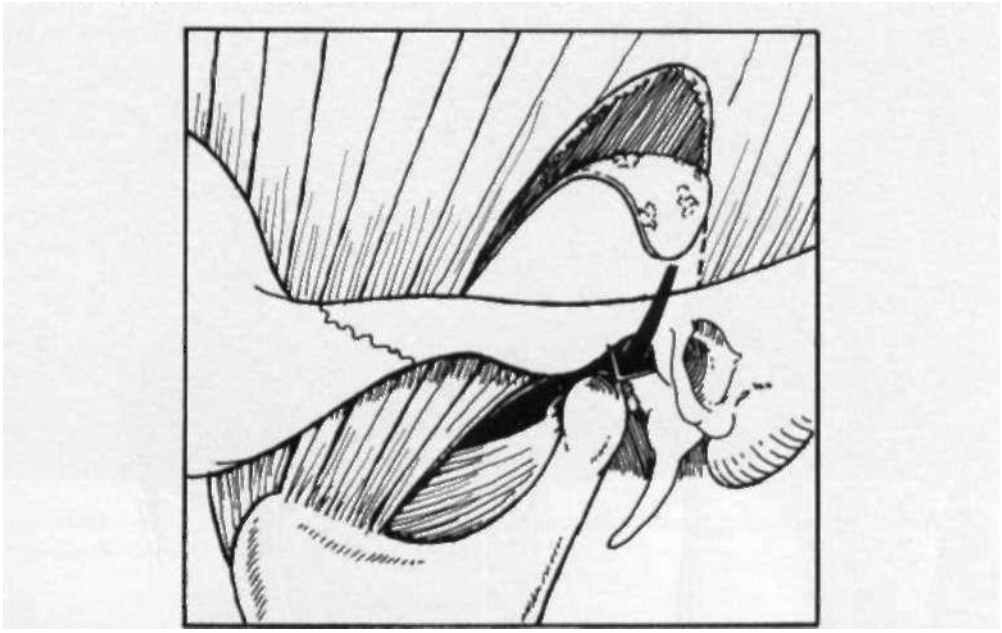
FIG. 4.60

TEMPORALIS MUSCLE AND FASCIAL GRAFTS

Temporalis fascia was used as a free autogenous interpositional graft in the past but has largely been abandoned in favor of the temporalis myofascial flap because the fascia alone proved insufficient in mass to function adequately. The temporalis myofascial flap is harvested by extending the endaural incision into the temporal region approximately 2 to 3 cm. This interiorly based flap, a full-thickness flap incorporating the muscle with superficial and deep fascia, is outlined and freed with a #15 blade or a cautery tip. To account for contraction, the distal width of the flap should be wider than the actual dimensions of the joint space to be covered. In general, the length of the flap from the superior edge to the zygomatic arch is 5 to 6 cm and approximately 3 cm in width. The edges of the flap are then sewed together with multiple 4-0 chromic sutures. The flap is rotated laterally over the zygomatic arch and placed as a lining into the glenoid fossa so that the periosteum from the temporal bone is facing against the glenoid fossa. The flap is held in position with two nonresorbablc sutures that are passed through holes drilled in the posterior edge of the fossa and the bone on the anterior slope of the eminence.

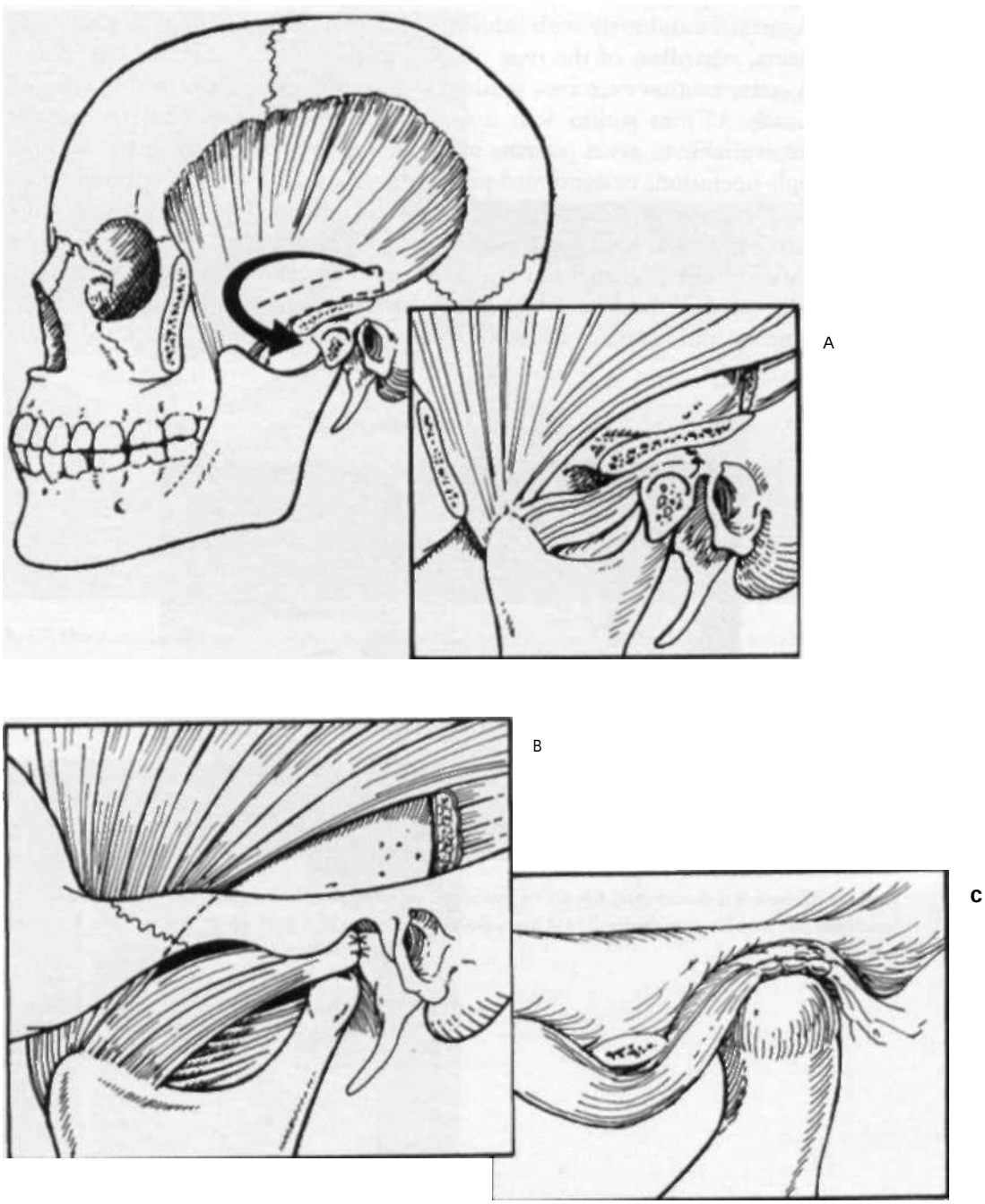
An alternative method for placing the temporalis flap is to raise the same inferiorly based temporalis myofascial flap, bring the free edge through the infratemporal space, and pass it from the articular eminence posteriorly into the joint space. Once it is passed under the articular eminence, it is sutured to the rim of the glenoid fossa in a similar fashion.

FIG. 4.61



Inferiorly based temporalis flap with blood supply from the superficial temporal artery, which is shown being positioned inferiorly and lateral to the zygomatic arch as a lining tissue for the temporomandibular joint after meniscectomy, with or without condyloplasty.

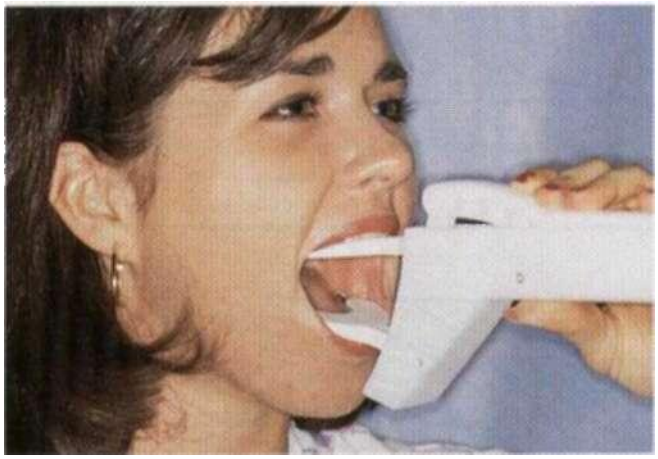
FIG. 4.62



A through **C,** Inferiorly based temporalis flap, which is secured into the fossa from an anterior approach to provide lining for the glenoid fossa after meniscectomy.

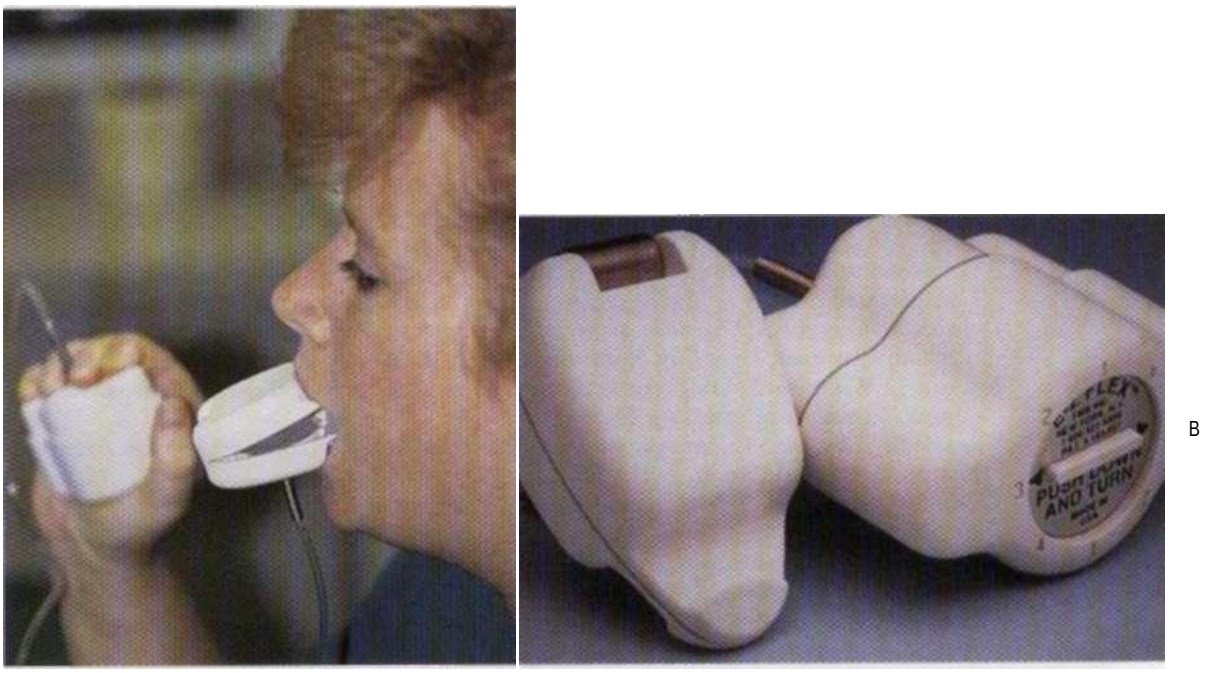
Postoperative care is clearly an important aspect of any intracapsular joint surgery. Aggressive and early mobilization of the joint is tantamount to success. In most patients, regardless of the type of surgical procedure, progressive mobilization, with active motion exercises, is adequate to achieve an interincisal opening of approximately 35 mm within 4 to 6 weeks of surgery. Hand-held jaw-exercise devices are available to assist patients in achieving this goal. In patients who have had multiple operations or continued problems with adhesions or heterotopic bone formation, a continuous passive motion device, in conjunction with active physiotherapy, can be helpful. In general, mobilization without mastication-induced joint loading should be encouraged for the first few weeks after surgery. A soft diet is usually advocated in the first 4 to 6 weeks following surgery. Once an adequate, pain-free interincisal opening is achieved, the diet can be rapidly advanced.

FIG. 4.63



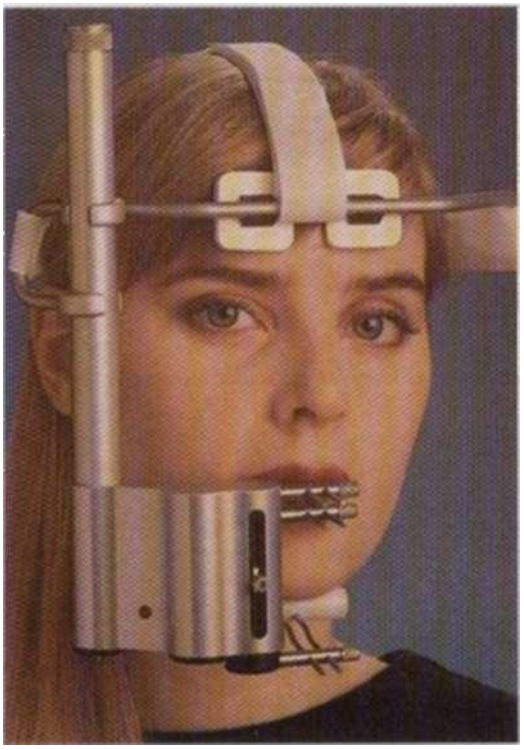
Postsurgical patient demonstrating the use of Therabite jaw exerciser. Patients are instructed to use a hand-held jaw mobilization device 3 to 4 times daily for a period of 4 to 6 weeks after surgery to maintain mobility.

FIG. 4.64



A, E-Z Flex mandibular exerciser being used by postmeniscectomy patient. **B,** Close-up view of the E-Z Flex device.

FIG. 4.65



Continuous passive motion apparatus used for rehabilitation after joint surgery.

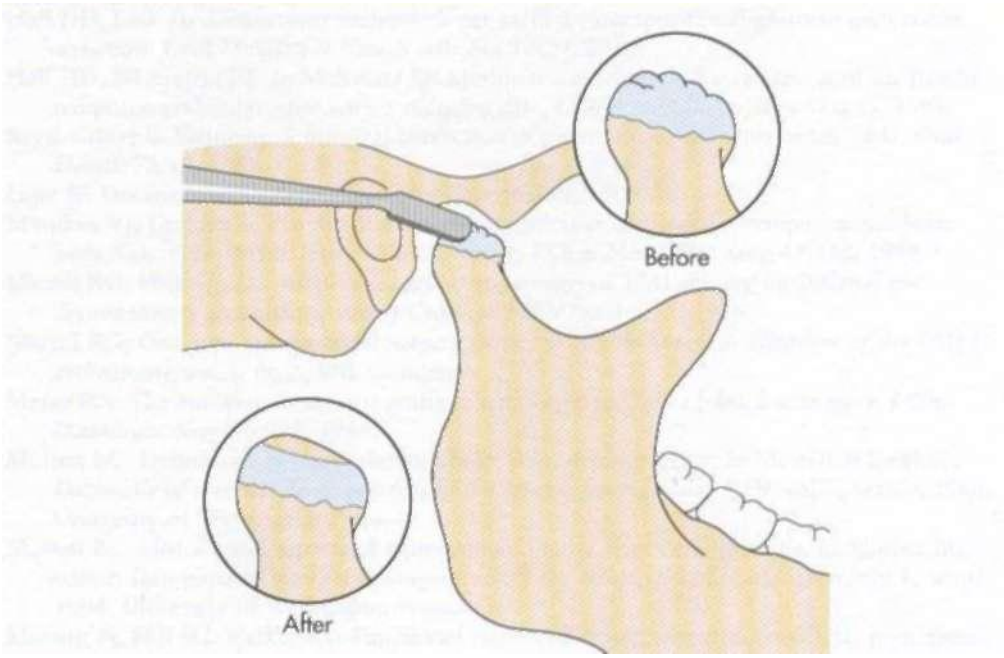
CHAPTER FIVE

OSSEOUS SURGERY OF THE TEMPOROMANDIBULAR JOINT

CONDYLOPLASTY

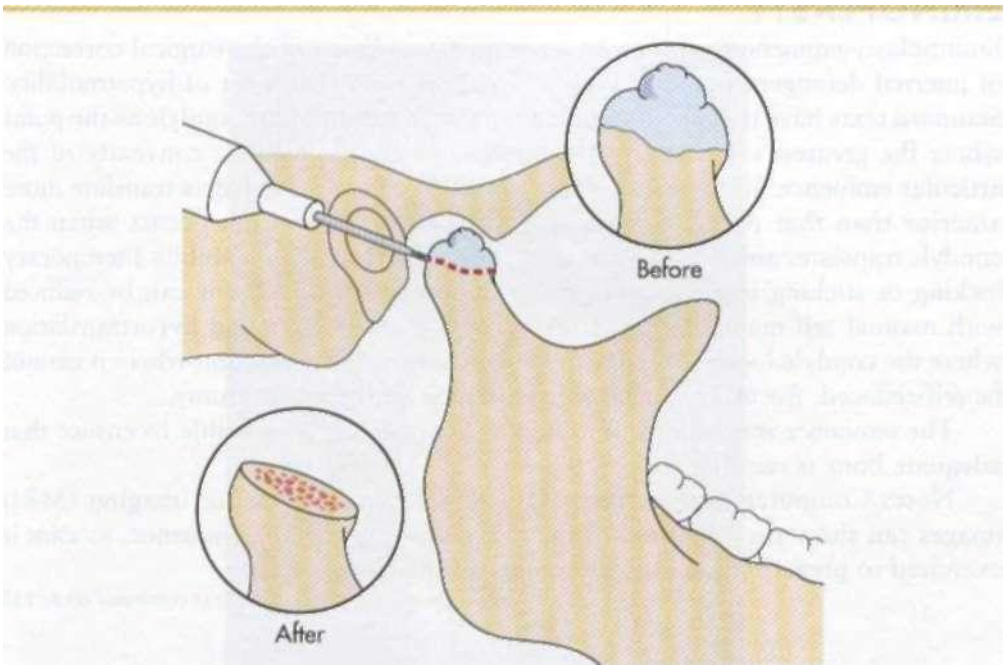
Several authors have popularized the technique of condyloplasty, or condylar shave. Arthroplasty is the reshaping of articular surfaces to remove irregularities (osteophytes) and erosions. It can be performed as an isolated procedure or in conjunction with meniscal repair. It appears to be more suited for small, isolated areas of disease, as opposed to the practice of removing 3 to 4 mm of the entire anterior-superior slope of the condyle. Follow-up of condyloplasty patients shows significant evidence of progressive degeneration with sclerosis and erosion. Fibrocartilage does not regenerate in areas where condyloplasty has been performed.

FIG. 5.1



Bone file being used to contour the head of the condyle during condyloplasty procedure. Although this maneuver can sometimes be beneficial in removing osteophytes, the fibrocartilage damaged during the procedure does not regenerate and further degenerative changes can occur secondary to the procedure itself.

FIG. 5.2



High condylar shave. A l-mm fissure bur is used to remove a 3- to 4-mm section of the anterior-superior slope of the condyle. The cortical edges are then smoothed with a bone file. This maneuver often exposes underlying marrow in the condylar head and leads to progressive sclerosis and degeneration. (This procedure, in widespread use in the 1970s and early 1980s, involved a 2- to 4-mm resection of the anterior-superior slope of condyles that exhibited signs of degeneration, including sclerosis, breaking, subchondral cysts, and osteophytes.)

FIGS. 5.3, 5.4



Condylar shave specimen. Note that the entire surface of the anterior-superior slope of the condyle with its fibrocartilage, cortical bone, and a small amount of cancellous bone has been removed.



Cryoseclion showing the dimensions of the anterior-superior condylar head in area where condylar shave is performed,

EMINOPLASTY

Eminoplasty-eminenectomy can be an important adjunct in the surgical correction of internal derangements, or it can be used alone for treatment of hypermobility. Standard texts have defined normal maximal translation of the condyle as the point where the greatest convexity of the condyle meets the greatest convexity of the articular eminence. In practice, as many as 60% of normal subjects translate more anterior than that point without any symptoms. Subluxation occurs when the condyle translates anterior to its normal range and the patient exhibits a temporary locking or sticking sensation that either abates spontaneously or can be reduced with manual self-manipulation. Dislocation is a more advanced hypertranslation where the condyle locks out anterior to the eminence to a position where it cannot be self-reduced. Recurrent dislocation is treated with eminenectomy.

The eminence must be recontoured as far medially as possible to ensure that adequate bone is removed.

Note: Computer tomographic (CT) or magnetic resonance imaging (MRI) images can show the extension of the cancellous bone in the eminence, so care is exercised to prevent intracranial exposure of the temporal lobe.

Text continued on p. 112

FIG. 5.5

Side view of a skull depicting the position of the condyle anterior to the eminence in dislocation. ***Dislocation*** implies complete separation of the articular surfaces of the condyle and articular eminence. Subluxation is partial separation of these surfaces and is self-reducing. In unilateral dislocation, there should be deviation of the midline to the contralateral side with an ipsilateral open bite.

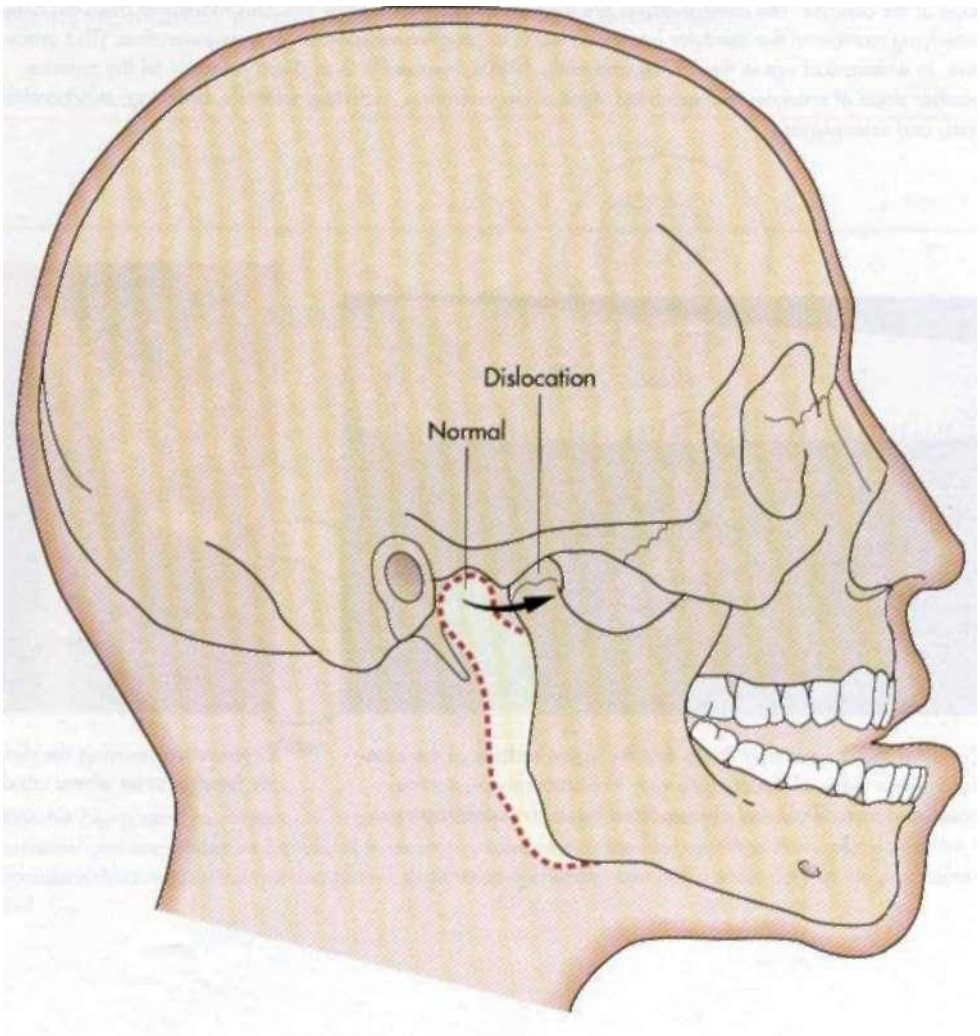


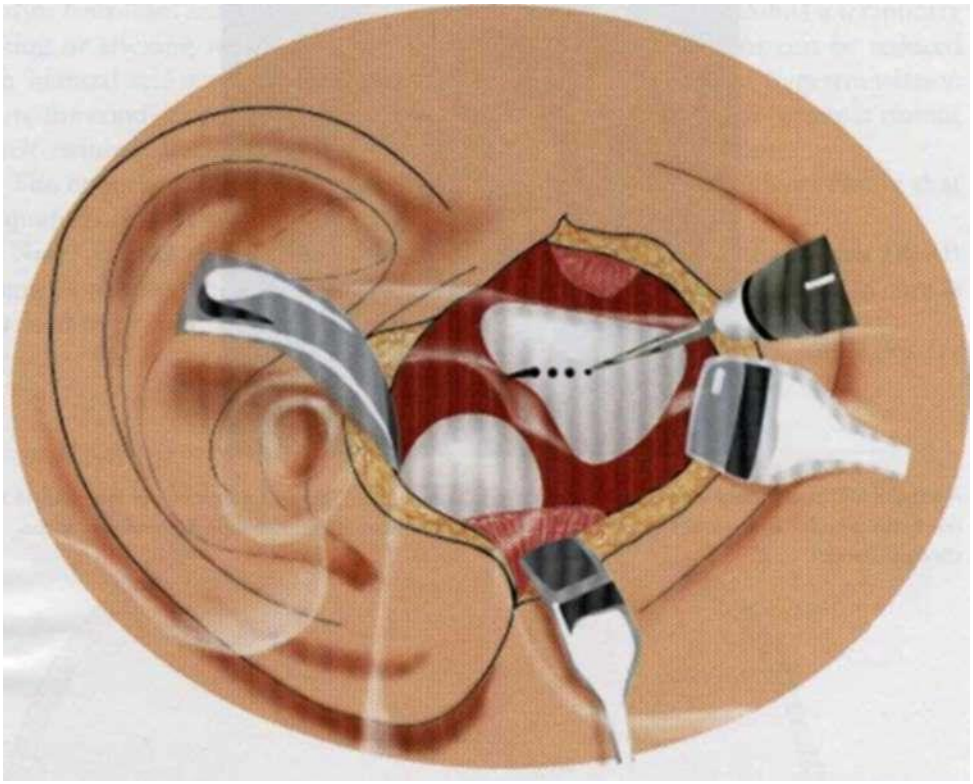
FIG. 5.6



A sagittal MRI of a patient with chronic subluxation. Note the exaggerated translation of the condyle anterior to the articular eminence. The anterior band of the meniscus is in a distal position relative to the condylar head.

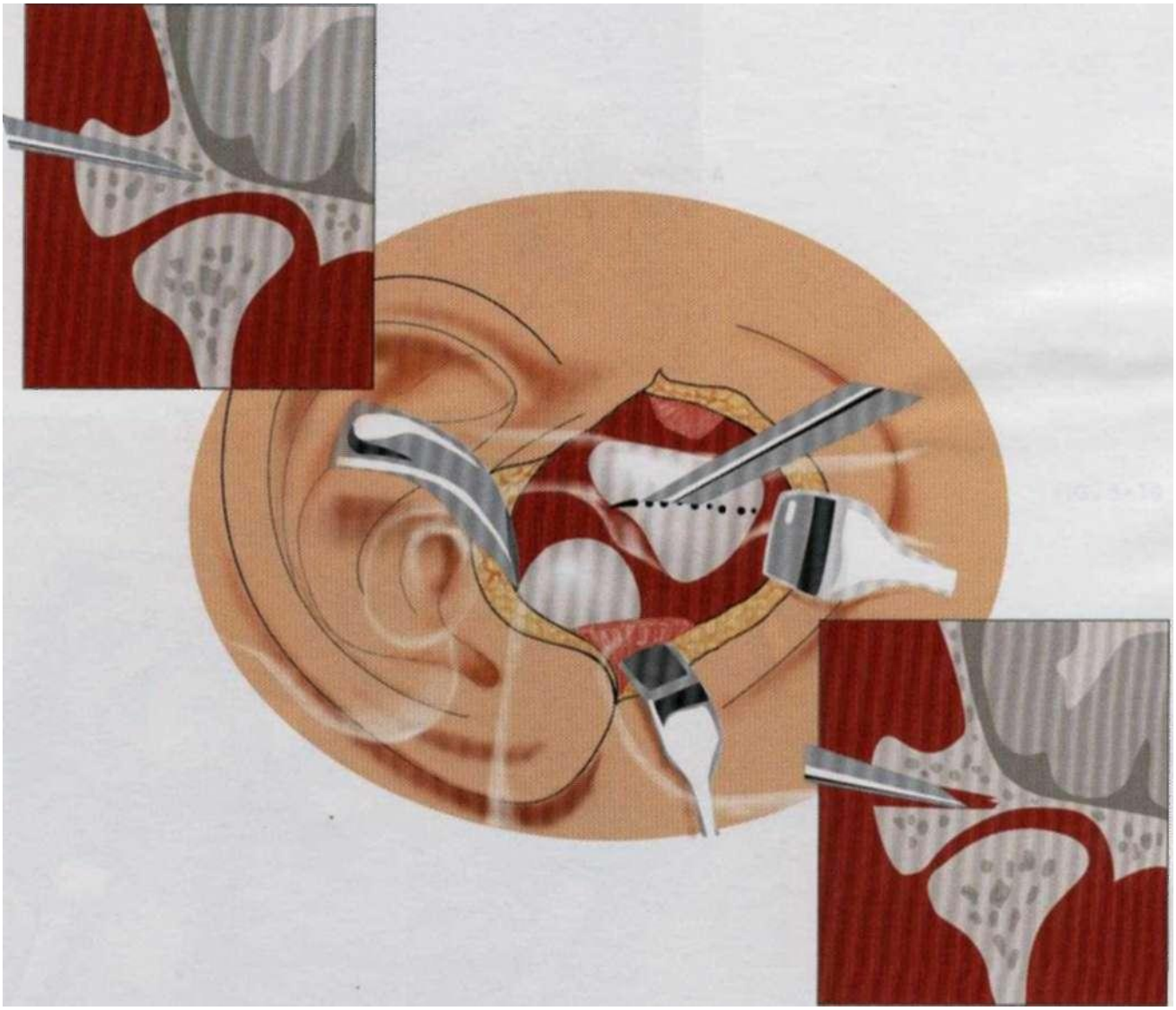
FIG. 5.7

A



A, Initiating osteotomy of articular eminence with 1-mm fissure bur. Approximately 90% of the cut is performed with the bur. *Continued*

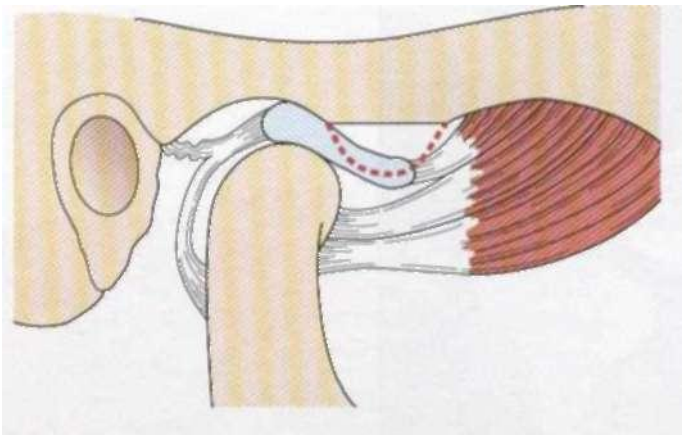
FIG. 5.7, CONT'D



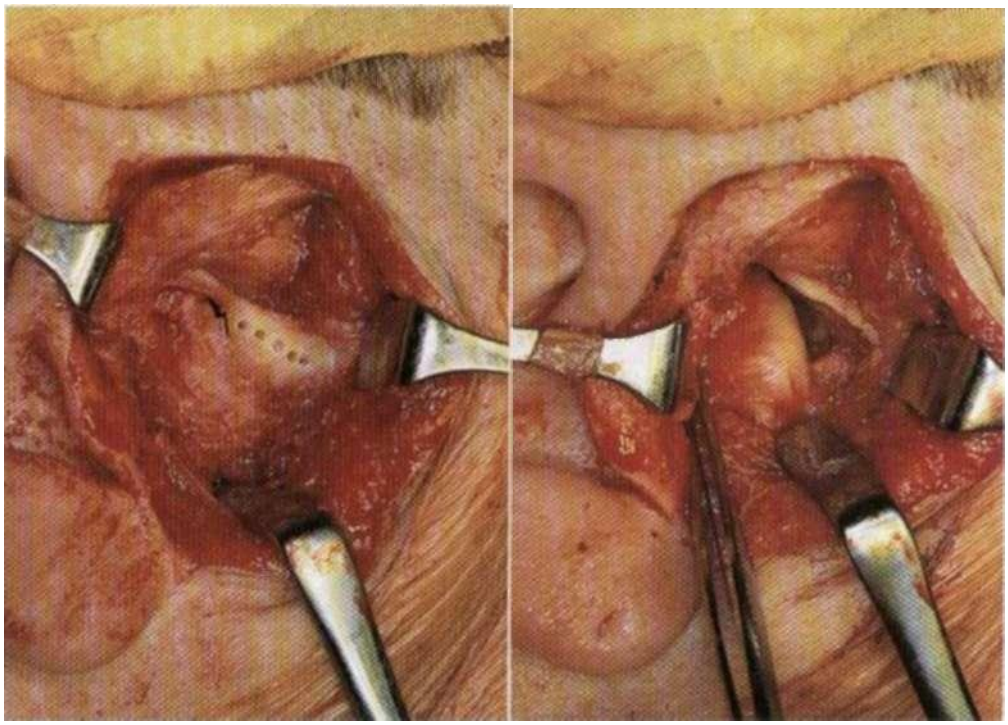
B

B, Completing emineclomy with osteotome. Note inferior angulation to ensure that the bony cut slays below the base of the skull.

FIG. 5.8



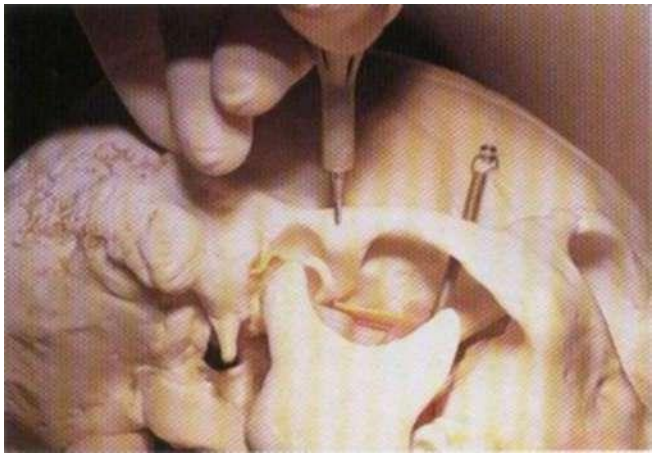
A



B C

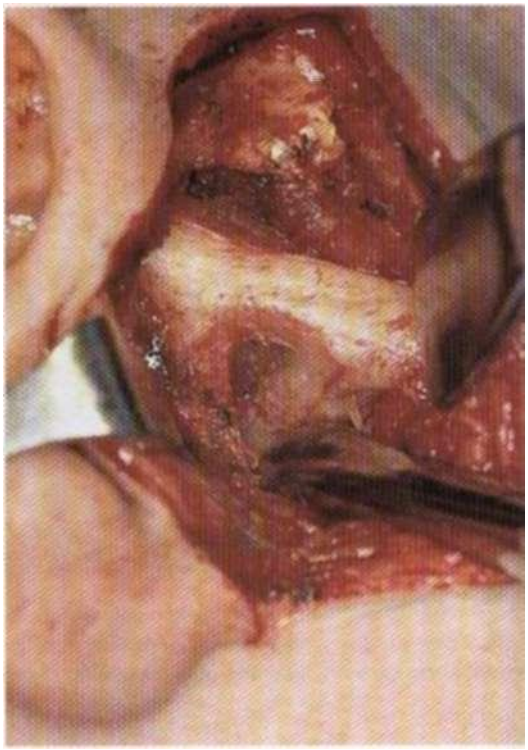
A, The superior joint space status postarticular emineclomy. Note that theoretically the procedure affords great freedom of movement to the articular disk as well as lessens the chance of condylar dislocation. The dotted line denotes the amount of bone removed during the emineclomy procedure. Removal of the convex ridge of the eminence in its entire medial extent is critically important to relieve the impingement of the condyle against the meniscus. **B,** Bony perforations placed in articular eminence with 1-mm Fisher bur to outline articular emineclomy. **C,** Status posteminectomy. Approximately 18 mm of the eminence was removed to ensure an unobstructed path of condylar translation.

FIG. 5.9



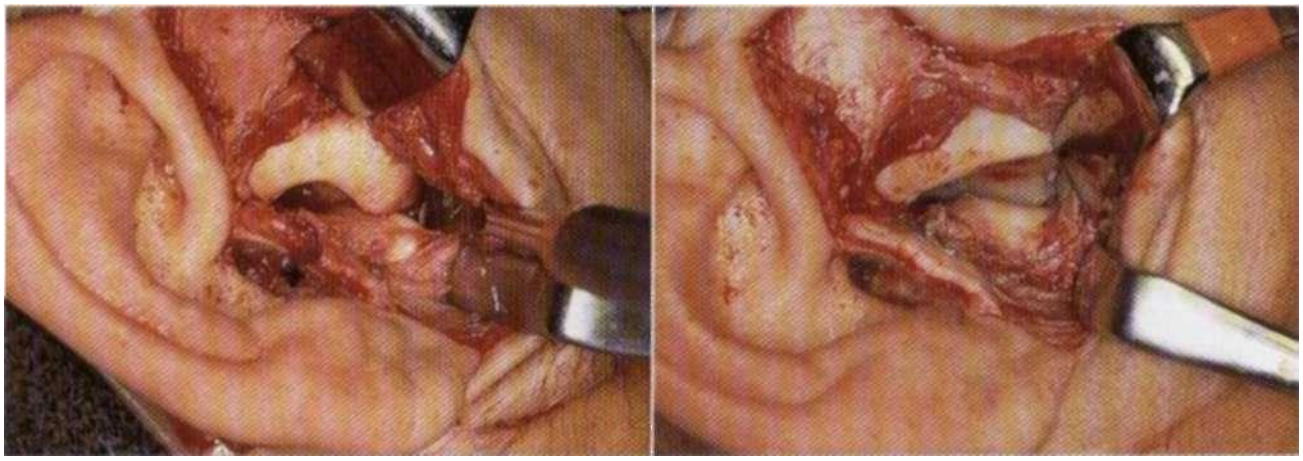
1-mm fissure bur positioned for lateral cortical eminectomy cut.

FIG. 5.10



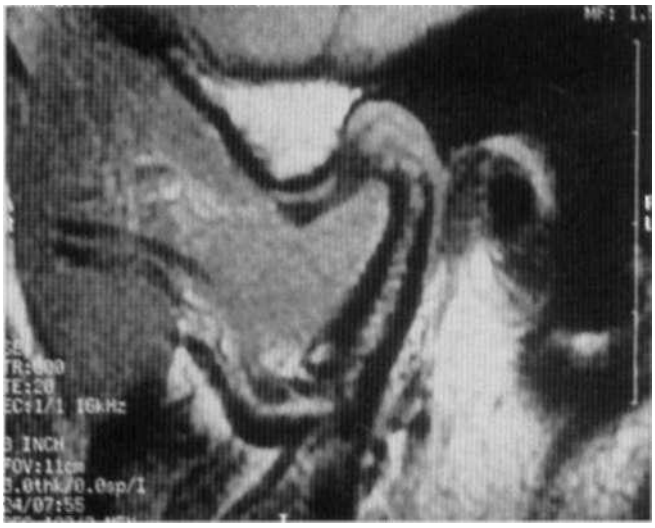
Inferior view of articular eminence showing full extent of area that needs to be reduced during the emineclomy procedure.

FIG. 5.11

A  B

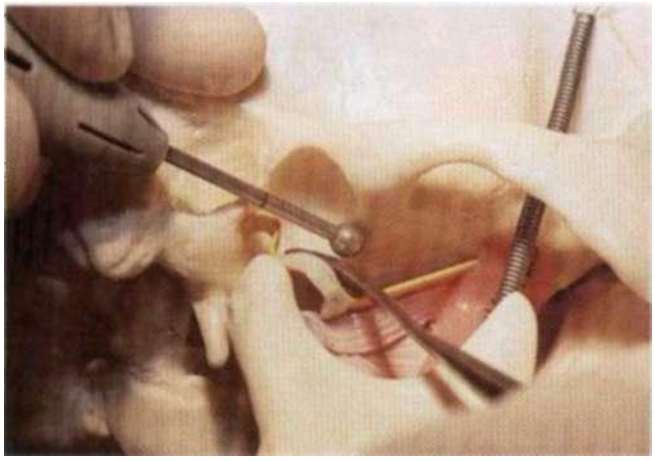
A, B, Combination articular eminenectomy with meniscal plication. The patient had sustained excessive stretching and laxity in the posterior attachment secondary to chronic subluxation.

FIG. 5.12

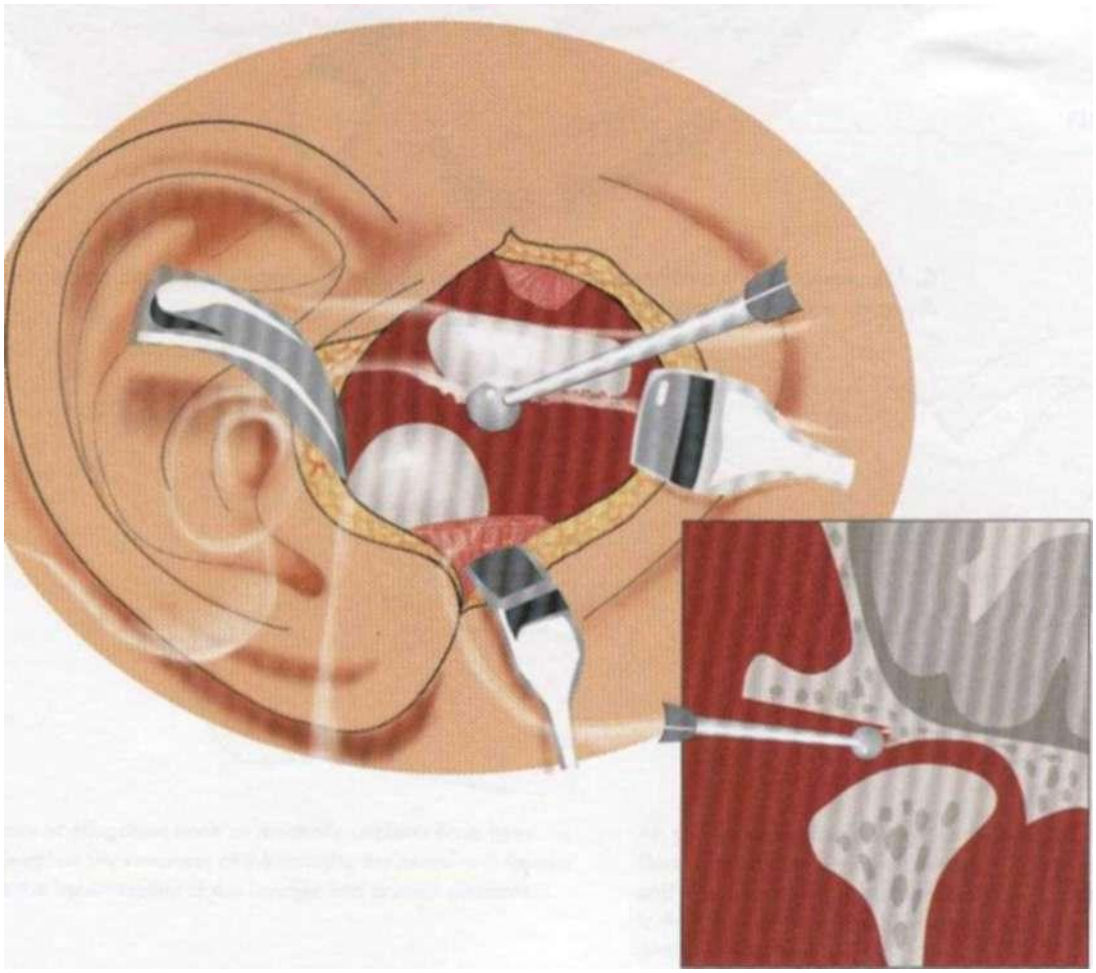


An MRI showing the bright signal of the marrow in the articular eminence. Imaging of the structure of the articular eminence before emineclomy is extremely important to prevent possible perforation into the middle cranial fossa with exposure of the temporal lobe and possible leaking of cerebrospinal fluid.

FIG. 5.13



A



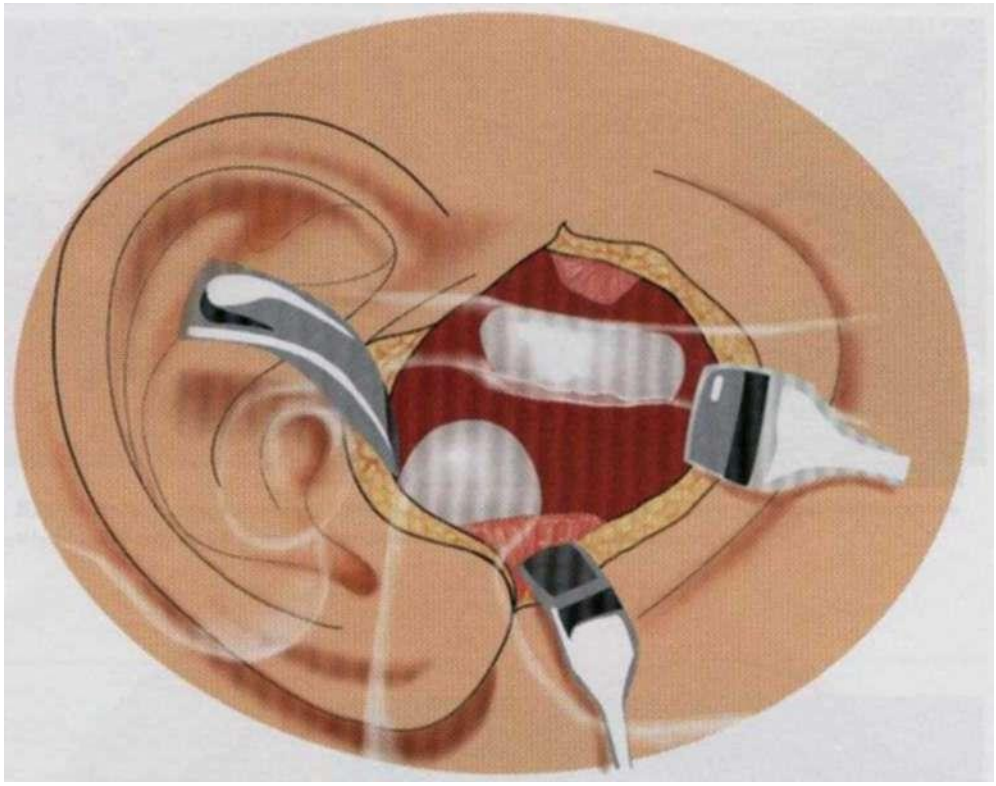
B

A, A large, round diamond bur placed in position to remove the inner ridge of the articular eminence. Note that the eminence must be contoured to the full extent of its medial extension to achieve adequate reduction in the bony contour. Also note the use of a broad, flat elevator to depress and protect the meniscus and condyle from inadvertent damage caused by the diamond bur. **B,** Large, round diamond bur used to contour medial osteotomy cut.

Continued

FIG. 5.13, CONT'D

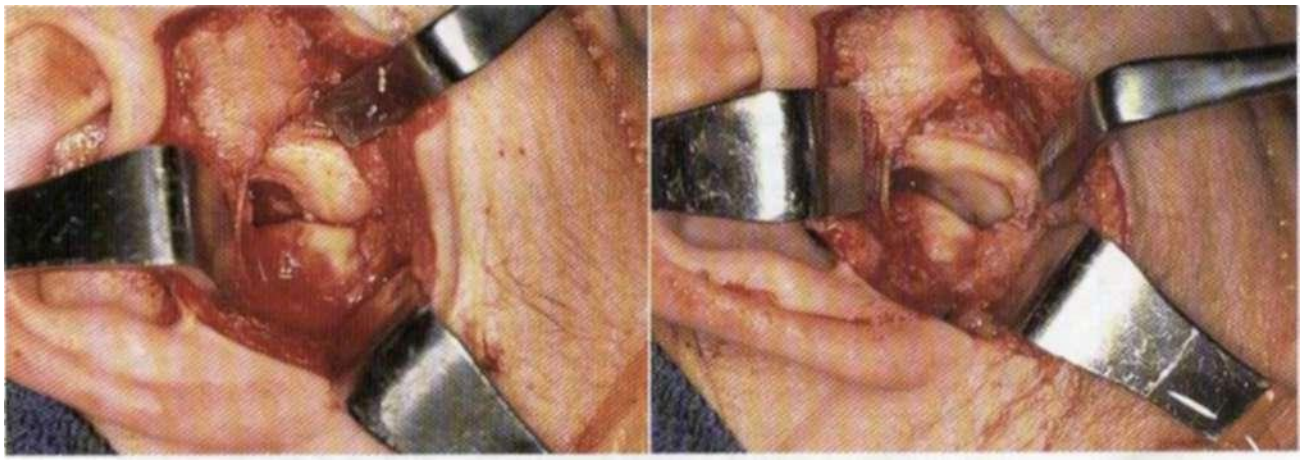
C



C, After eminectomy is completed, the mandible is manipulated to ensure unobstructed condylar motion during normal range of motion.

FIG. 5.14

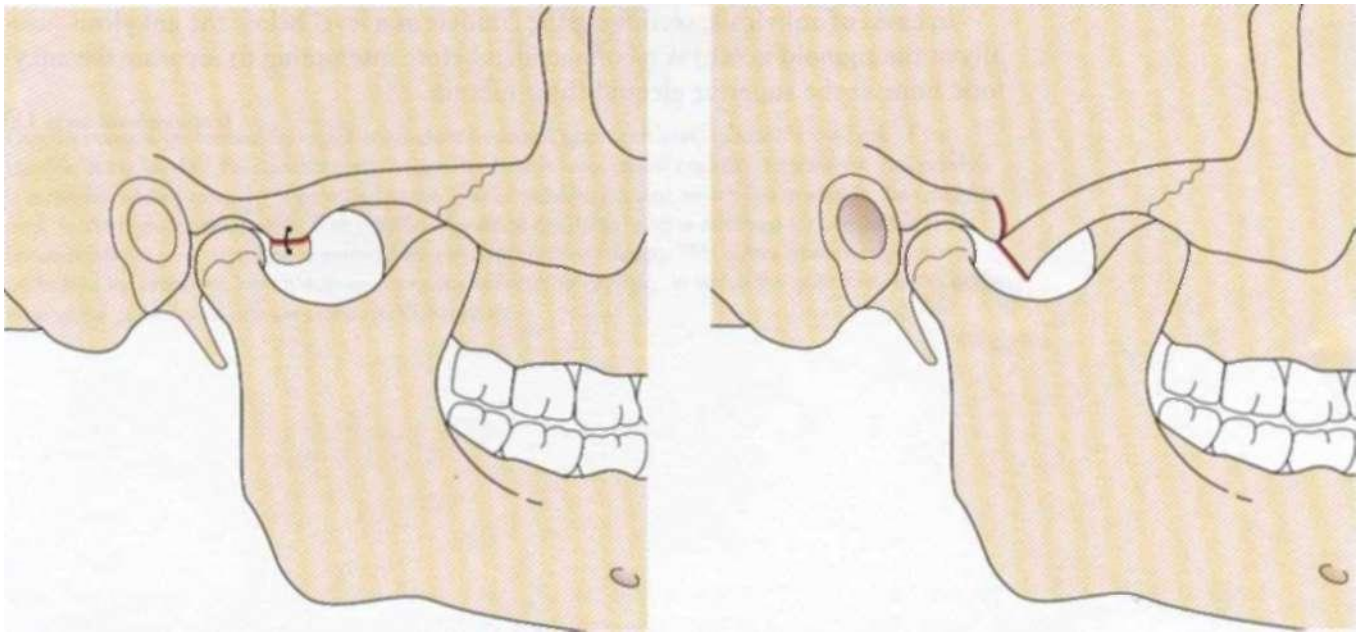
A



B

A, View of o palienl with chronic subluxation showing condyle-disk relationship at normal range of motion immediately before excessive motion, which results in anterior subluxation. **B,** Status postarticulor emineclomy. Note the depth of surgical recontouring to eliminate condylar-eminence contact.

FIGS. 5.15, 5.16



Autogenous or allogeneic bone or prosthetic implants have been used to lengthen the steepness of the articular eminence and thereby decrease the hypermobility of the condyle and prevent dislocation.

An alternative method to lengthen the articular eminence is the Dautrey procedure, in which the zygomatic arch is osleolomized and then fractured in an inferior position. Il is subsequently secured to the depth of the articular eminence to lengthen the slope of the anterior eminence.

CONDYLECTOMY

As an isolated procedure for joint pain, condylectomy has been largely abandoned. It is a necessary surgical maneuver to treat ankylosis and prepare the joint for a total alloplastic prosthesis or a costochondral graft. The procedure involves a standard preauricular approach, with special emphasis on visualizing the base of the condylar neck at the level of the sigmoid notch.

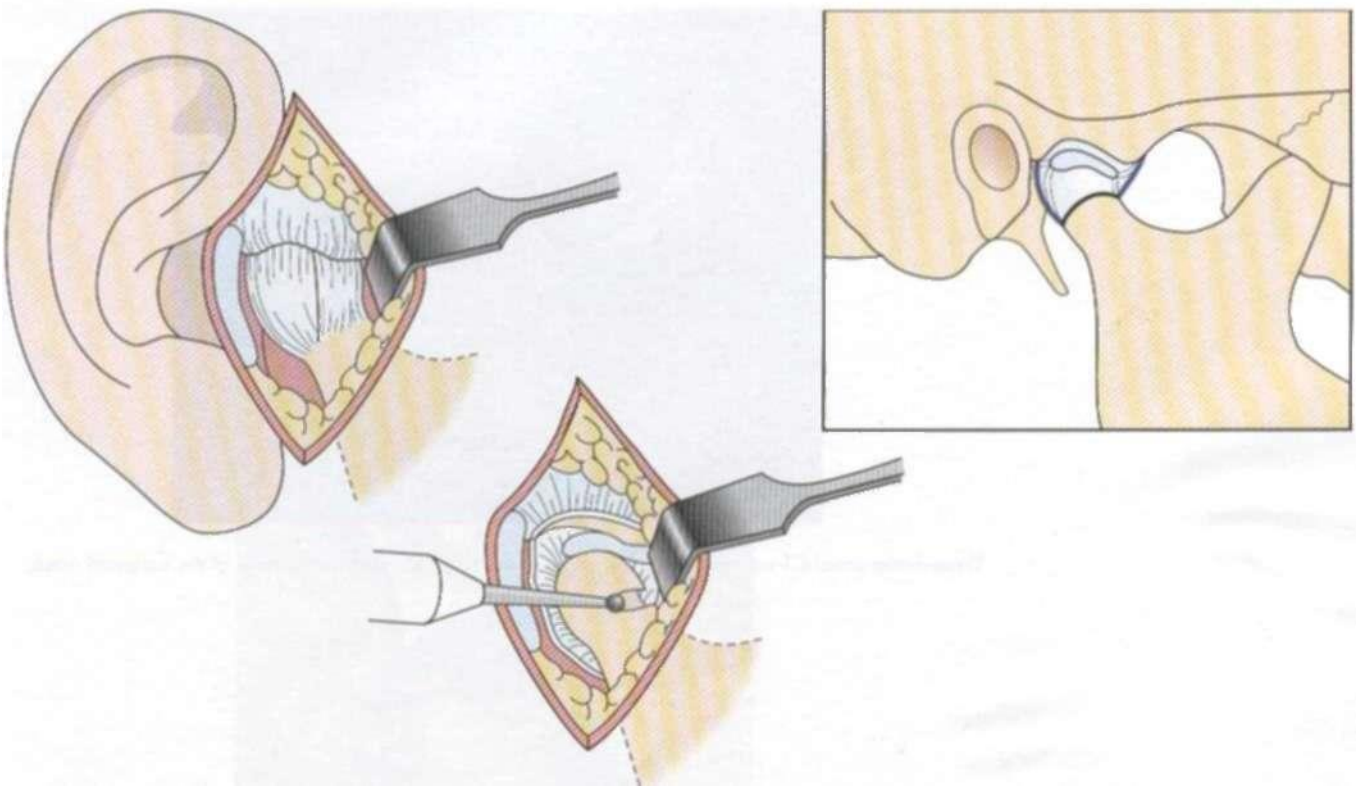
Many surgeons also complete the inferior dissection through a modified posterior mandibular incision before the condylectomy. This procedure allows digital access to the medial surface of the ramus (from below) to apply pressure to the internal maxillary artery in the event it is severed while the condyle is sectioned. Because of the proximity of the artery to the condylar neck, specially designed retractors (e.g., Dunn-Dautrey condylar retractors) should be placed before the osteotomy.

A 1-mm fissure bur is used to make a cut at the level of the sigmoid notch. The cut is made completely through the lateral, anterior, and posterior surfaces, but the last section of medial cortical bone is preserved. A T-bar osteotome is gently tapped and torqued to complete the condylar cut. If bleeding occurs, the cut must be quickly completed to allow access to the area for adequate compression and ligation, if this measure is necessary. Initial control can be maintained with thrombin-soaked sheets of Avitene. Pressure and medium Hemo-clips can be used if the severed vessel can be visualized. As previously mentioned, digital compression can also be applied to the medial aspect of the ramus from the submandibular incision.

In cases of ankylosis, sectioning the condyle at a level below the ankylosis (usually at the sigmoid notch) is recommended before attempting to separate the ankylotic bone at the superior glenoid fossa margin.

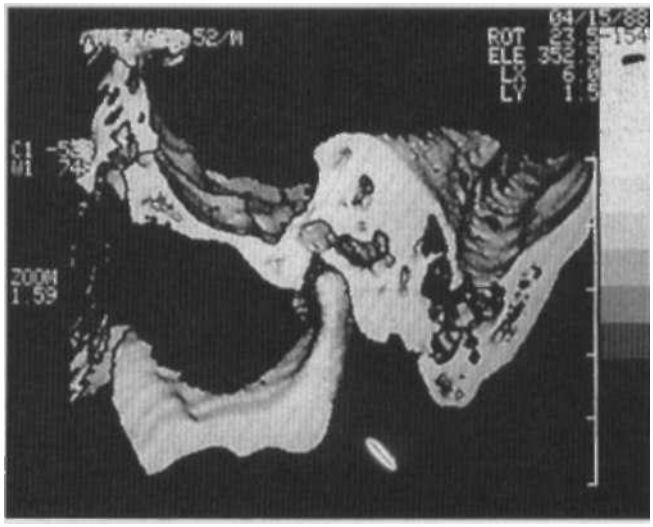
Text continued on p. 120

FIG. 5. 17



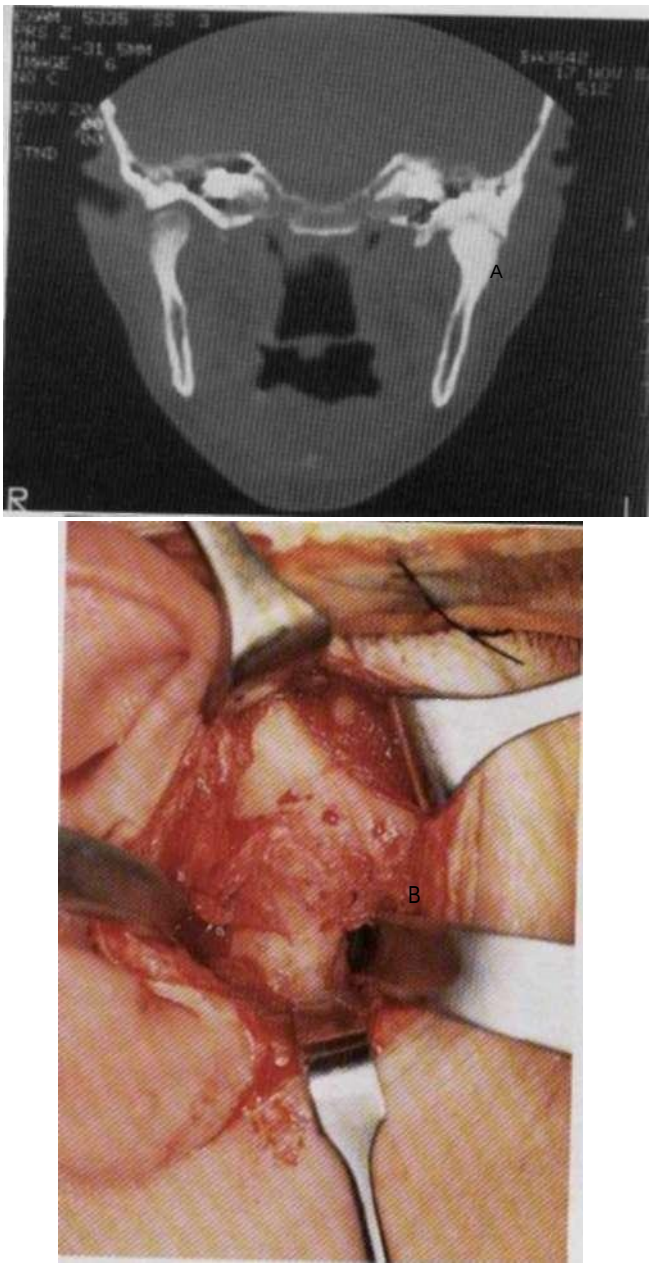
Condylectomy is performed through the standard endaural approach used to identify the neck of the condyle at the level of the sigmoid notch below the most inferior-lateral capsular attachment. The condyle is sectioned while protection is provided to the interior maxillary artery, which lies medial to the condylar neck. In the high condylectomy, 7- to 8-mm of the entire condylar head is removed for intractable temporomandibular joint pain that is unresponsive to conservative therapy. This differs from condylectomy performed for prosthetic joint placement or costochondral rib grafting, in which the osteotomy cut is at the base of the coronoid to prevent postsurgical ankylosis.

FIG. 5.18



Three-dimensional CT scan showing the shape of the condylar neck at the level of the coronoid notch.

FIG. 5.19

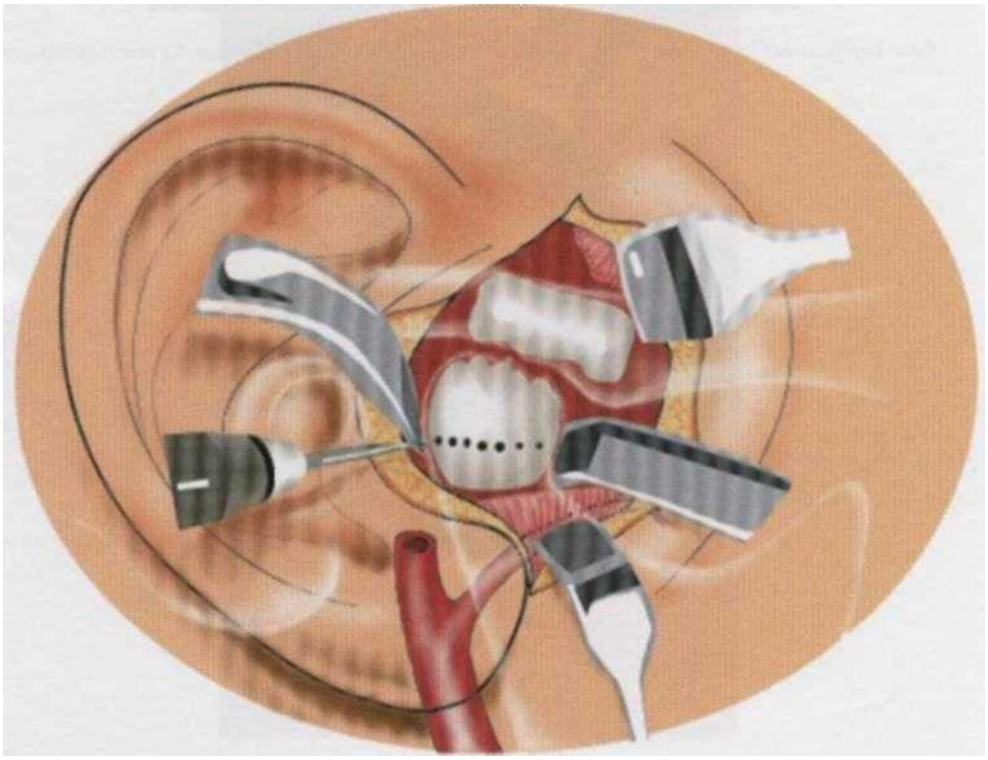


A coronal CT scan bone window showing fibroosseous ankylosis of the right condyle. Note the complete fne absence ot any identifiable joint space.

FIG. 5.20



A B

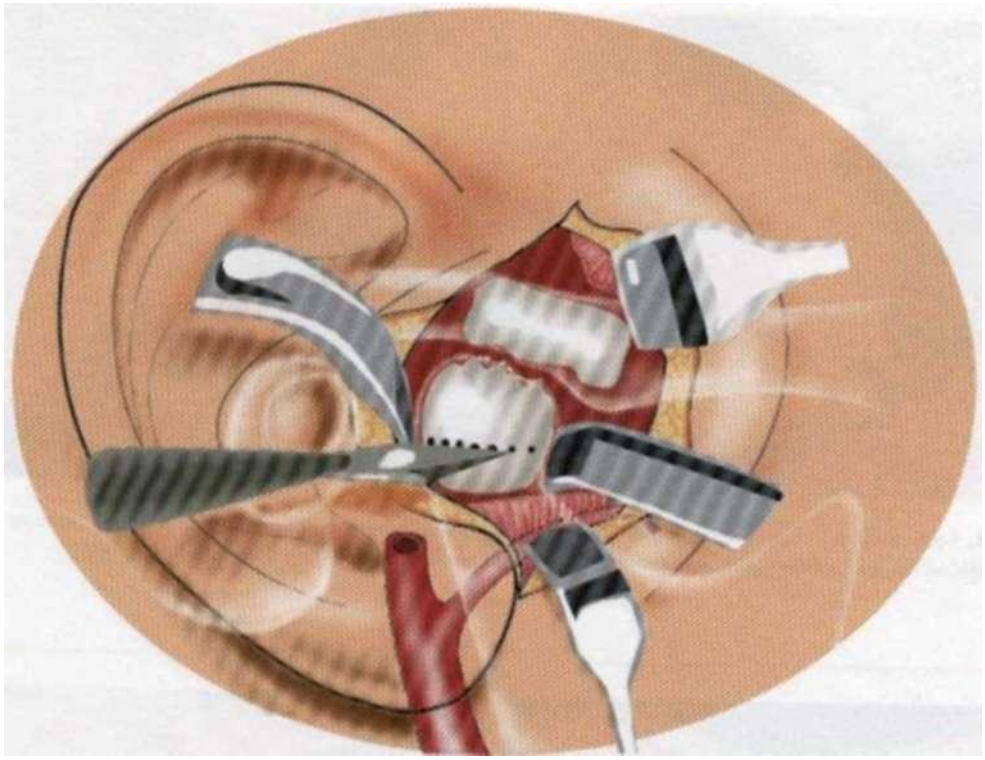


C

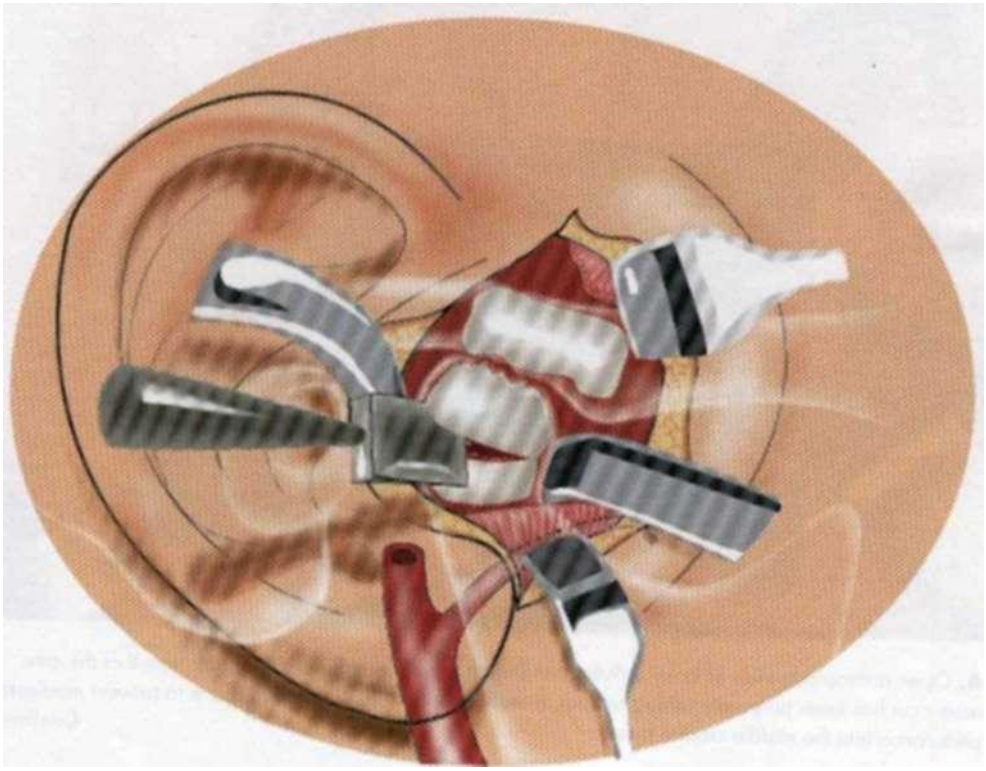
A, B, Dunn-Dautrey retractors in place for condylectomy, **C,** A 1-mm fissure bur is used to make the osteotomy cut at the neck of the condyle. Dunn-Dautrey retractors protect the internal maxillary artery during the procedure.

Continued

FIG. 5.20, CONT'D



D

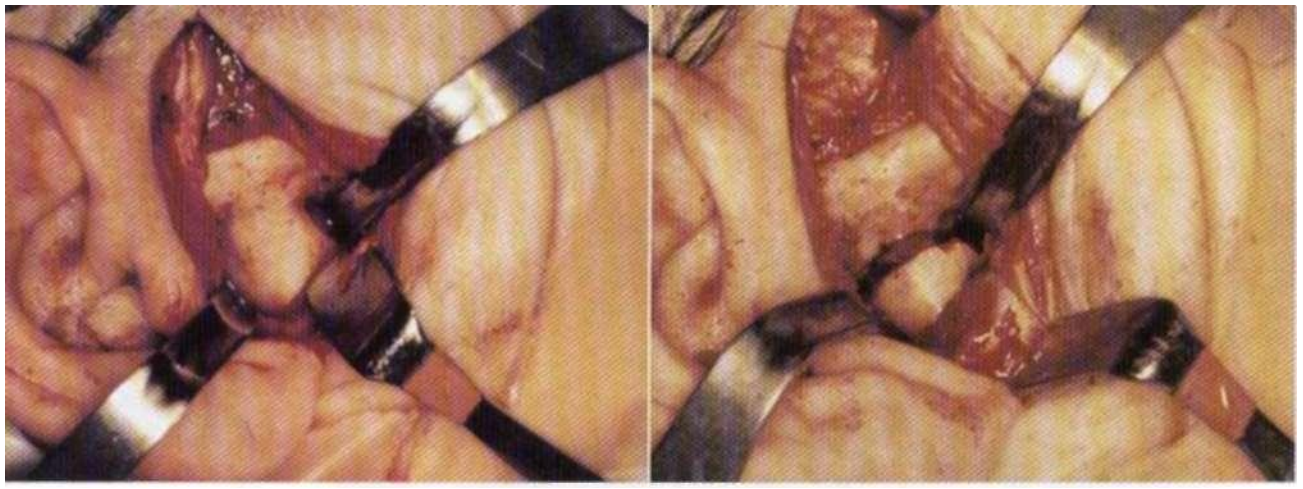


E

D, Small T-bar osteotome is gently lapped to separate the thin medial cortex of the condyle **E,** The T-bar osteotome is rotated 180 degrees to mobilize the condylar head. A sharp periosteal elevator is then used to strip the lateral pterygoid attachment rom the anterior surface of the condyle.

FIG. 5.21

A

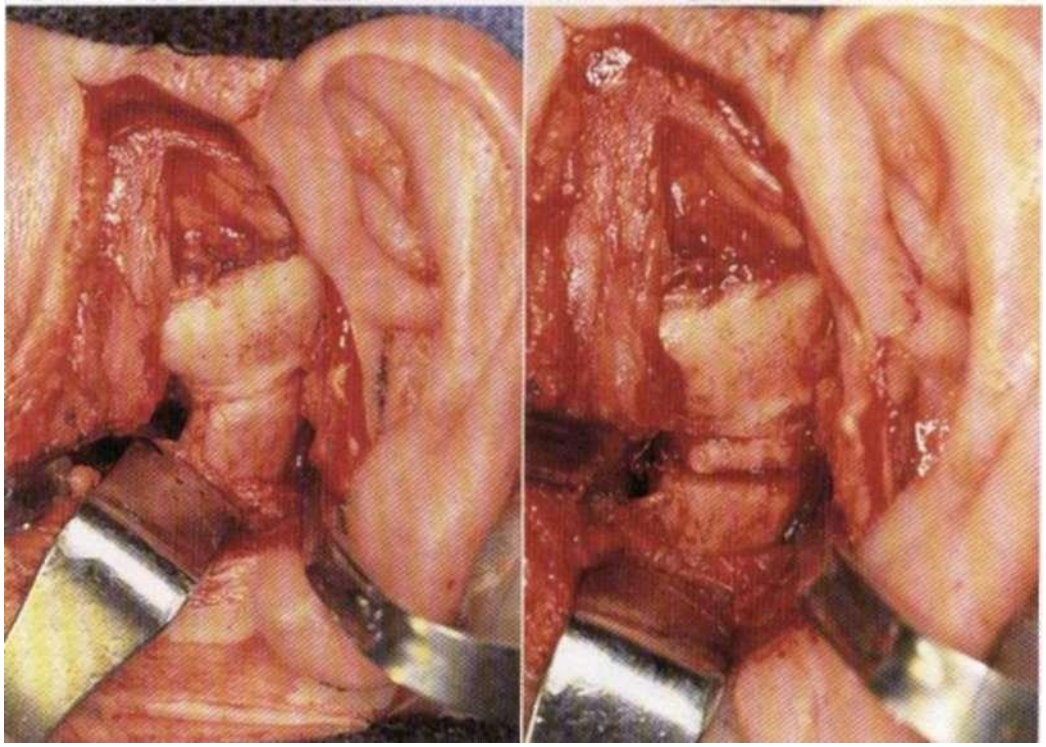


B

A, Bony ankylosis of right temporomandibular joint. **B,** Note position of Dunn-Daulrey condylar retractors behind the neck of the condyle to protect the internal maxillary artery during condylar osteotomy.

FIG. 5-22

A

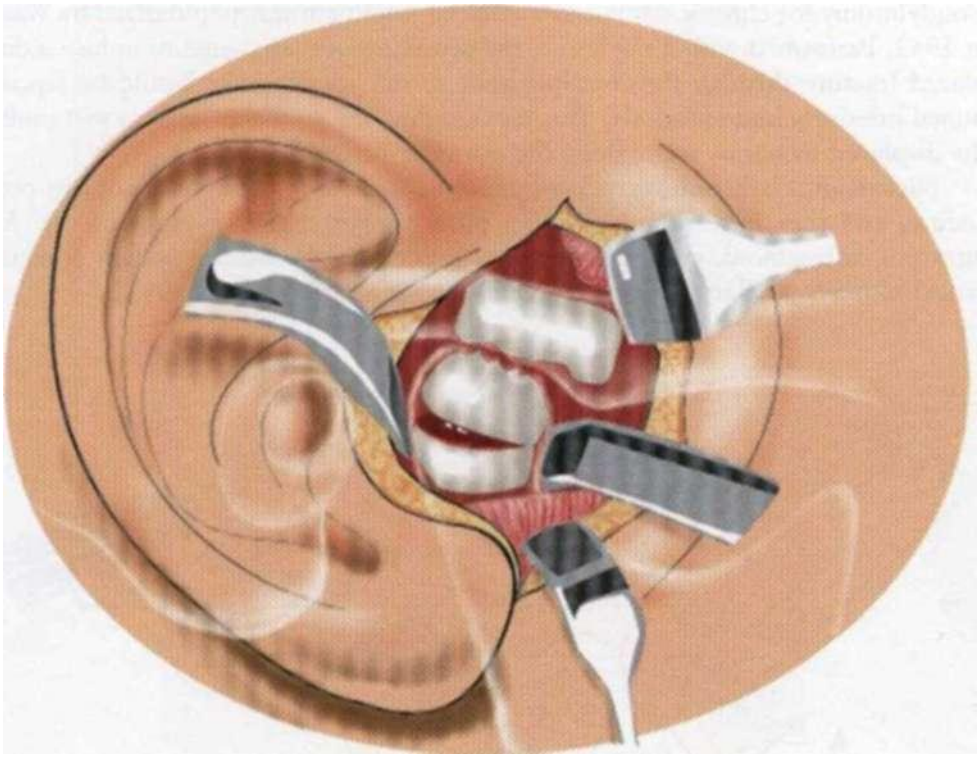


B

A, Open arthroplasty view of bony ankylosis of the left temporomandibular joint. **B,** Note that the osteotomy cut has been purposely placed inferior to suspected position of the joint space to prevent inadvertent perforation into the middle cranial fossa.

Continued

FIG. 5.22, CONT'D



C

C, Diagram of the procedure.

FIG. 5.23



Use of spring-loaded Bell exerciser to lyse adhesions status postcondylectomy.

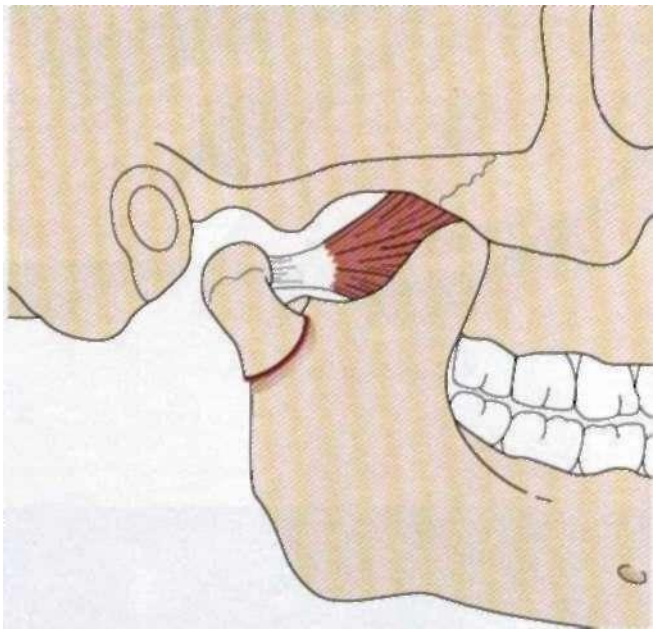
CONDYLOTOMY

Condylotomy for chronic temporomandibular joint pain was popularized by Ward in 1952. Performed with a Gigli saw, the procedure was designed to induce a displaced fracture through the condylar neck so that the condyle would be repositioned inferiorly and anteriorly. This would allow the condylar head to seat under rhe displaced meniscus and unload the posterior attachment.

Nickerson, Hall, and others have renewed interest in the concept of this procedure, and they have popularized an open approach to the condylotomy. An intraoral, subsigmoid, vertical osteotomy is performed, and the patient is maintained in intermaxillary fixation with elastics for a 2- to 4-week period.

FIG. 5.24

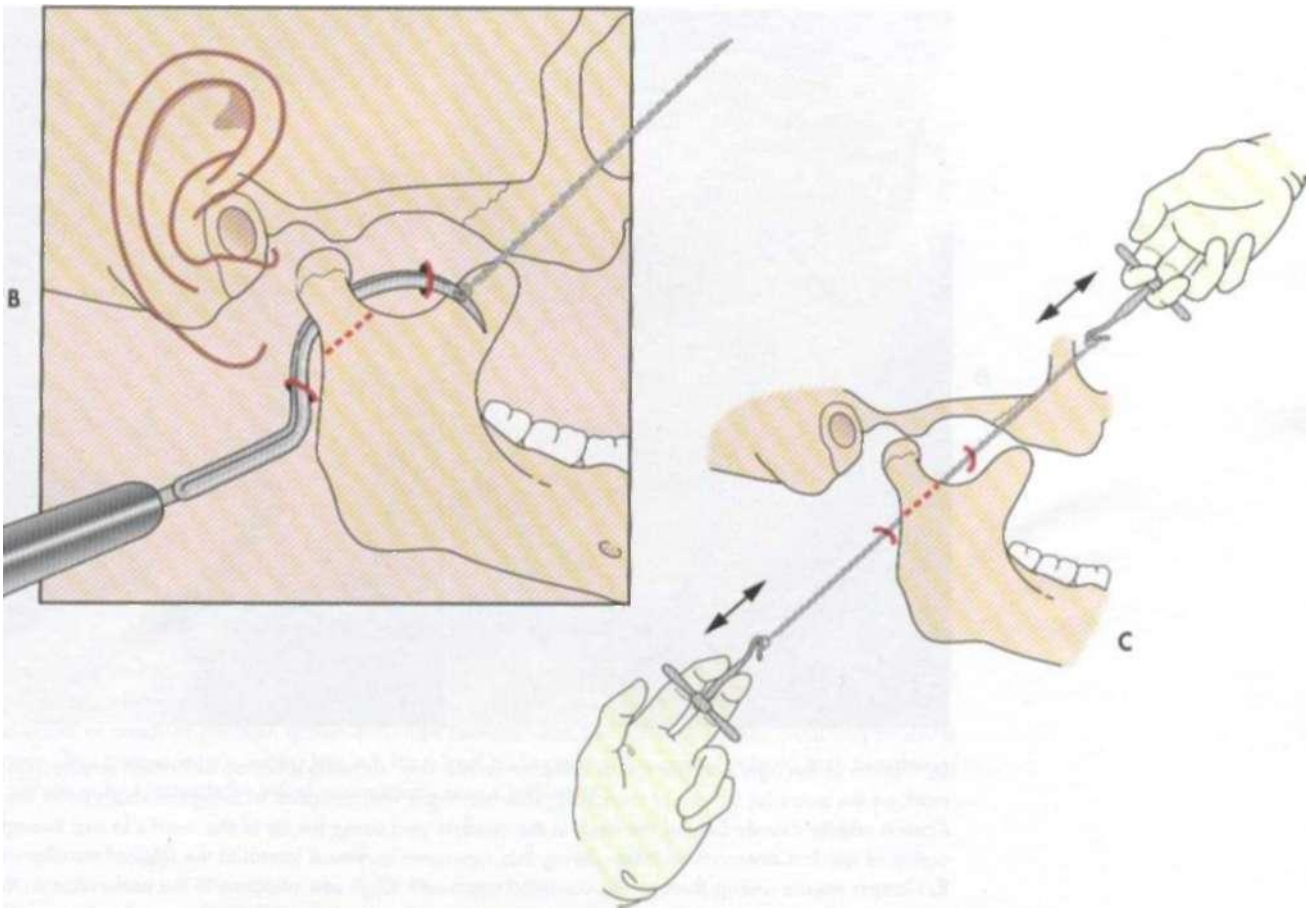
A



A, Ward condylotomy. Note the telescoping of the condylar segment in an anterior and inferior position. This malpositioned condyle would theoretically unload the meniscus and result in c more physiologic condyle-disk relationship.

Continued

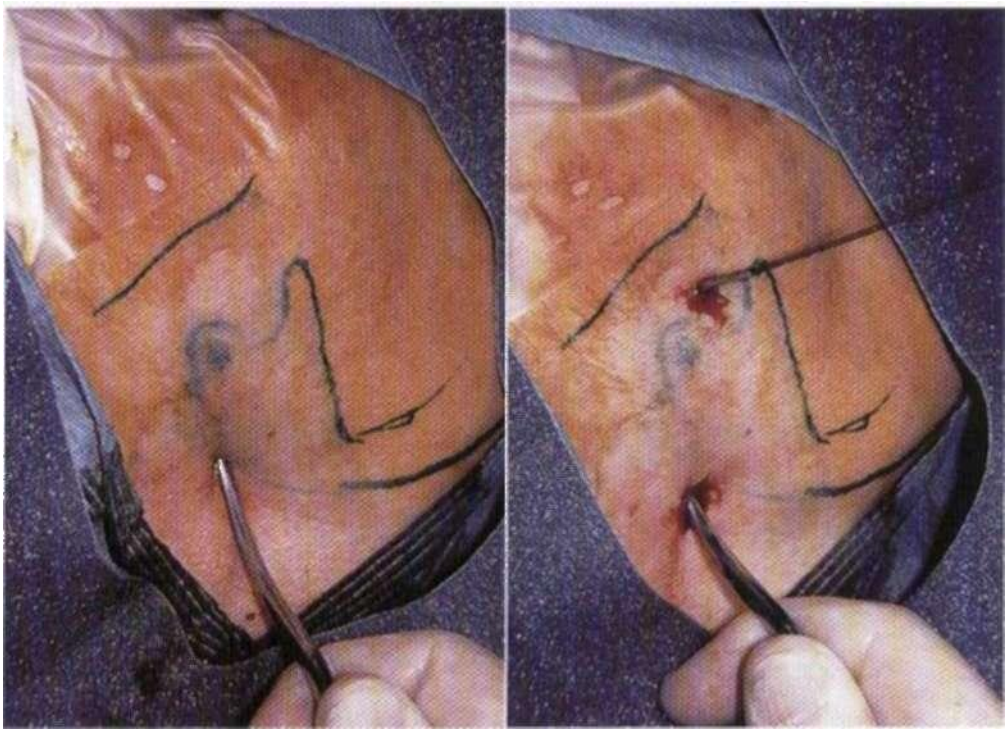
FIG. 5.24, CONT'D



B, Ward condylolomy. Coslich needle is passed posterior to the ramus with the exit point in the coronoid notch. Great care is taken to ensure the needle is passed in close proximity to the lateral surface of the condylar neck to avoid entrapping the internal maxillary artery between the Gigli saw and the condylar neck. **C,** Carefully sectioning the condylar neck at the level of the sigmoid notch, the operator does not bring the Gigli saw completely through all the cortical bone and periosteum on the lateral side but rather leaves a small bridge of bone and soft tissue that can be fractured with digital pressure. This prevents a complete dislocation of the segment ou; of the glenoid fossa by the unopposed lateral pterygoid muscle. Similar to the intraoral vertical subsigmoid osteotomy, this procedure theoretically induces an anterior-inferior displacement of the condylar head, thereby allowing the osteotomized condyle to seek a better position in relation to the displaced meniscus

Continued

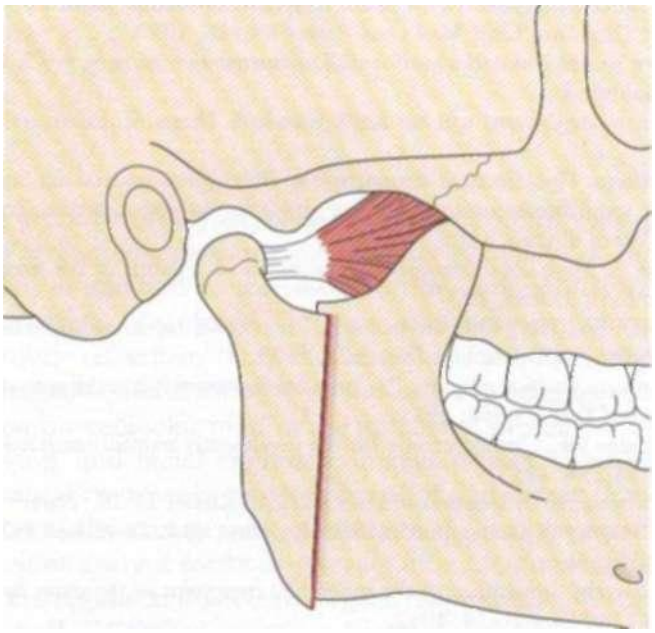
FIG. 5.24, CONT'D



D E

D, Outline of the right condyle ramus complex on the skin, showing insertion of Costich needle with entry mark on the posterior border of mandible. This technique was designed to bring the sharp tip of the Costich needle directly behind the neck of the condyle and cause the lip of the needle to exit through the coronoid notch. Care must be taken during this maneuver to remain lateral to the internal maxillary artery. **E,** Costich needle exiting through the coronoid notch with Gigli saw attached to the perforation in the terminal lip of the Costich needle. The Gigli saw is ihen pulled back through the coronoid incision so thai its culling surface lies along the medial surface of the condylar neck.

FIG. 5.25



Compared wilh the Ward condylotomy, vertical subcondylar osteotomy offers a more controlled approach to condylar repositioning. In this open osteotomy procedure the operator is able to attain a more controlled vector of condylar positioning and maximize bone-lo-bone contact between the distal and proximal fragments. This procedure also poses less risk for a total dislocation of the condylar head from the glenoid fossa, which can occur with the Ward condylotomy |see Chapter 4).

TRAUMA

CHAPTER SIX

Facial injuries are increasingly common in modern society. This increase can he attributed to technologic development of faster automobiles and other modes of transportation, in addition to increased hostility among drivers and a rise in assaults and other forms of violence. The temporomandibular joint is certainly not exempt from injury related to these factors. The anatomic complexity of this region makes diagnosis and treatment particularly challenging. Additionally, the role of the temporomandibular joint in the functional processes of speech, mastication, swallowing, and facial expression makes proper management of these injuries paramount. Few areas of oral and maxillofacial surgery have generated as much controversy as the management of injury to the temporomandibular region. This chapter reviews current methods of evaluation, diagnosis, and management of injuries to this region and several surgical approaches. Pertinent anatomic review can be found in Chapter 3.

INCIDENCE, ETIOLOGY, AND PATTERN OF FRACTURE

The literature reports variable statistics for the incidence of fracture involving the mandibular condyle. Factors such as the age, geographic location, and socioeconomic level of the study population did not influence the findings. F.arly studies report the incidence of mandibular fractures to be as low as 8%, with later reports as high as 50%. (Table 6-1 summarizes the literature of the past 50 years with respect to the number of mandible fractures involving the condyle.) The relatively-low incidence in early studies may relate to differences in the way fractures were reported, but they probably result from advances in the field of diagnostic imaging, which now allows more accurate detection of these fractures. A reasonable assumption is that fractures involving the condylar process probably compose between one quarter and one third of all mandibular fractures.

The type of fracture produced by an injury depends partly on the age of the patient and the magnitude and direction of the force. However, certain mechanisms of injury consistently result in specific fracture patterns. Therefore knowledge of the mechanism of injury may yield clues to guide the clinician during the patient's hrst visit. For example, a direct blow to the temporomandibular-joint region may result in a fracture of the underlying condyle. However, this event is fairly uncommon because of the protection afforded to the condyle by the lateral rim of the glenoid fossa. More commonly, a blow directed horizontally to the mandibular body, such as that delivered by a fist, results in a fracture of the ipsilateral mandibular body and the contralateral condyle. A force delivered to the parasymphyseal region may also cause an ipsilateral condylar fracture. When a force is directed axially to the chin, such as when the chin strikes the ground after a fall or the dashboard during an automobile accident, force is transmitted along the mandibular body to the condyles. This typically results in a symphyseal or parasymphyseal fracture combined with a unilateral or bilateral fracture of the condylar region. When the condyles are driven superiorly and posteriorly into the glenoid fossae, concomitant fracture of the tympanic plate with damage to the

TABLE 6.1 ***Incidence of condylar fracture as a percentage of total mandibular fractures***

SERIES	YEAR	INCIDENCE OF CONDYLAR FRACTURE (%)
Chalmers J. Lyons Club	1947	8
Kromer	1953	25
Ekholm	1961	27.7
Schuart	1966	25.0
Row and Killey	1968	35.6
Tasanen et al.	1975	32.4
Larsen and Nielson	1976	37
VanHoof et al.	1977	. 47
Olson	1982	52.4
Hill et al.	1984	49
Andersson et al.	1984	40
Ellis et al.	1985	29
Haug et al.	1990	21
Silvennoinen et al.	1992	52.4

(Fonseca RJ, Walker RV: *Oral and maxillofacial trauma,* **ed 2, Philadelphia, 1997, WB Saunders.)**

external auditory canal, or fracture of the glenoid fossa with penetration into the middle cranial fossa may result. Because children have a greater modulus of elasticity in bone, a blow to the chin may result in bilateral "green stick" fractures of the condyles. The previous examples demonstrate that the mechanism of injury provides useful insight into the type of injury to be expected.

SIGNS AND SYMPTOMS ASSOCIATED WITH CONDYLAR FRACTURE

A thorough history of the mechanism of injury should always precede the clinical examination of a patient with a suspected fracture or injury of the mandibular condyle. The patient with a fracture of the mandibular condyle usually has a history suggestive of this finding and one or more of the following physical findings:

1. Evidence of facial trauma that may include contusion, abrasions, laceration of the chin, ecchymosis, and hematoma in the temporomandibular-joint region: These injuries should alert the examiner to possible fractures underlying not only the area of injury but also the ipsilateral and contralateral temporomandibular joint.
2. Laceration or bleeding of the external auditory canal: This may result from fracture of the anterior tympanic plate from a posteriorly displaced condyle.
3. Swelling over the temporomandibular-joint region may be secondary to hematoma or edema or may result from a laterally dislocated condylar head, which is directly palpable under the skin.
4. Facial asymmetry may be due to soft tissue edema or secondary to foreshortening of the mandibular ramus caused by overlap of the proximal and distal fracture segments.

5. Pain and tenderness to palpation over the affected temporomandibular joint: Attempted manipulation of the jaw by the examiner or patient may also cause significant pain.
6. Crepitus over the affected joint: This is caused by the friction of the irregular fracture ends sliding over one another during mandibular movement.
7. Malocclusion is often a reliable indicator of the underlying injury. A unilateral condylar fracture usually results in ipsilatcral premature contact of the posterior dentition caused by foreshortening of the ramus on the fracture side. A contralateral posterior open bite is due to a canting of the mandible. Bilateral condylar fractures may result in a marked anterior open bite and retrognathia.
8. Deviation of the mandibular midline may be seen both at rest and with attempted excursive movement of the mandible. Secondary to foreshortening of the ipsilateral ramus, the mandible may deviate to the affected side at rest. In the presence of a unilateral condylar fracture, contraction of the lateral pterygoid muscles on attempted opening produces no mandibular motion on the ipsilateral side and normal mandibular motion on the contralateral side. This results in a pronounced deviation of the mandibular motion toward the fractured side. Similar deviation is produced with protrusive movements. Attempts at excursive movements laterally from the fractured side are extremely difficult because of the ineffective ipsilateral lateral pterygoid muscle. Bilateral condylar fractures may result in little midline deviation because both condyles are involved.
9. Muscle spasm occurs, with associated pain and trismus.
10. Dentoalveolar injuries are apparent.

FIG. 6.1

A



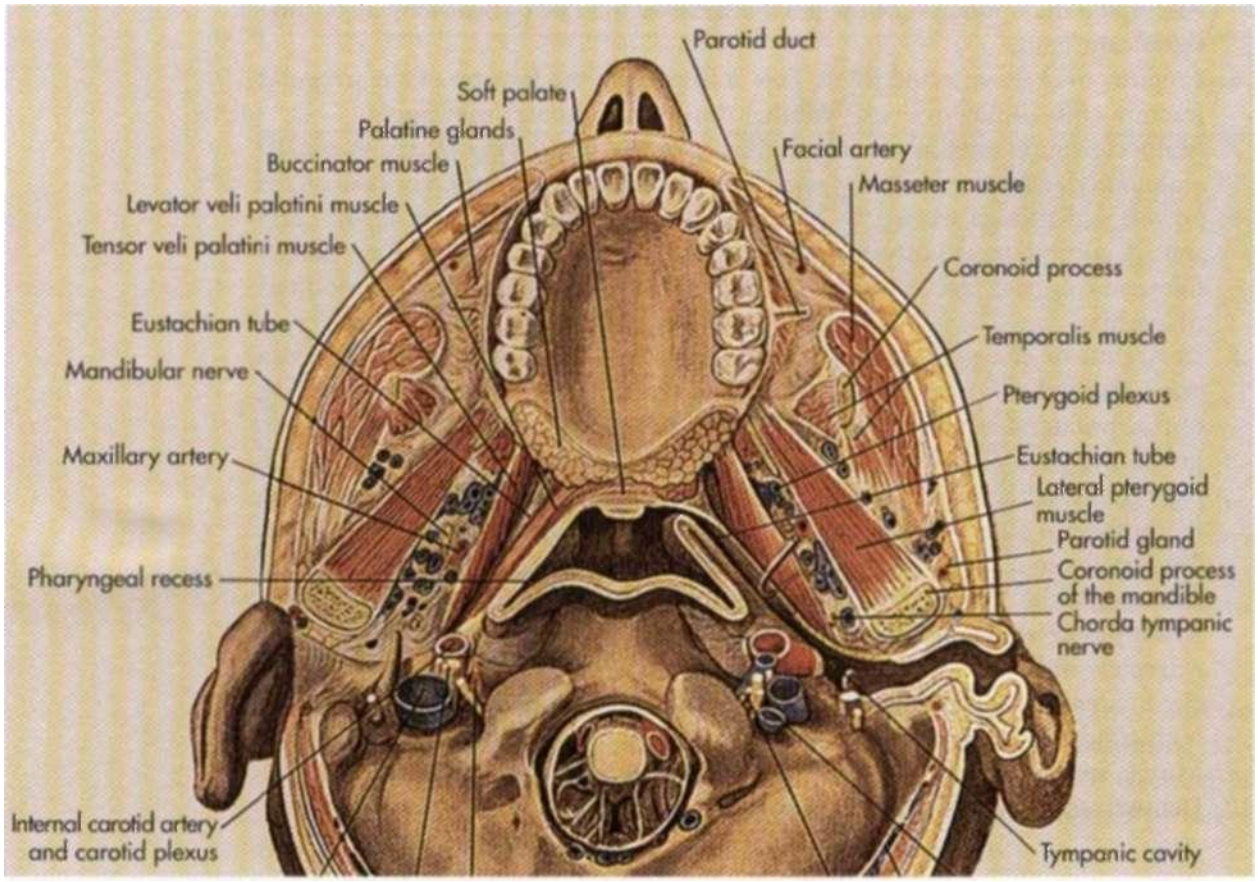
B

A, 15-year-old patient with a symphyseal laceration that had been closed 72 hours before. No intraoral examination had been performed, and the condylar fracture was undiagnosed. Symphyseal trauma should always raise the question of condylar fracture. **B,** MRI depicting anterior-medial pull of lateral pterygoid muscle.

Continued

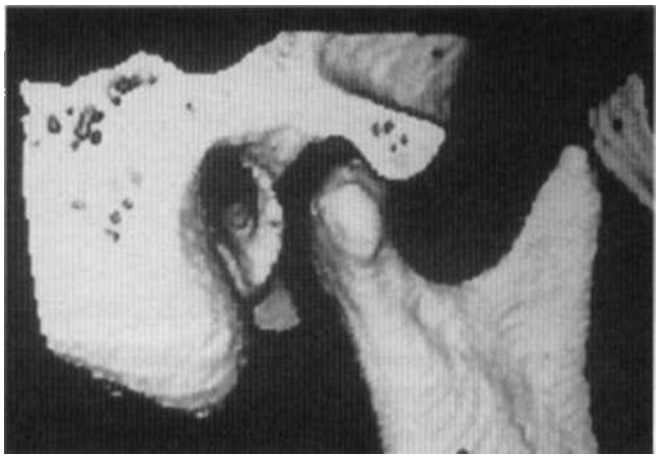
FIG. 6.1, CONT'D

C



C, Axial diagram showing 45-degree angulation of lateral pterygoid muscle from fovea to lateral pterygoid plate. This angulation results in anterior-medial displacement of condylar fractures.

FIG. 6.2



Three-dimensional CT scan showing the anatomy of the condyle. Fractures are classified according to the level of fracture. The first level is intracapsular, or within the head of the condyle. The second is in the neck of condyle (and by definition extracapsular) but above the sigmoid notch. Subcondylar fractures occur below the neck and can extend to the most inferior point on the sigmoid notch anteriorly, with the posterior extent of the fracture at a more inferior level along the posterior border of the mandible.

IMAGING OF THE TEMPOROMANDIBULAR REGION

Maxillofacial radiographic technique mandates that at least two radiographs be obtained at right angles to each other for adequate evaluation of the temporomandibular-joint region. In most centers the mandible series consists of a posterior-anterior skull image, two lateral oblique views, and a Towne's projection. If available, a panoramic radiograph may be added to this series. The panoramic radiograph alone may be a more useful screening tool, with a reported accuracy rate of 92% in detecting all types of mandibular fractures. (The standard mandibular series has an accuracy rate of only 66%.)

With the advent of newer imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI), the standard mandibular and facial survey has been largely supplanted in the diagnosis of maxillofacial trauma. The CT scan yields excellent bony detail of the facial skeleton in multiple views and, when the contrast is adjusted, provides adequate soft tissue detail. MRI yields excellent soft tissue detail but less bony resolution when compared with CT scanning. MRI may be useful as an adjunctive study if significant soft tissue injury of the joint is suspected.

CLASSIFICATION OF FRACTURE OF THE MANDIBULAR CONDYLE

Because condylar fractures are complex with respect to mechanism, anatomy, and associated injuries, development of an all-inclusive classification system for these injuries is difficult at best. Several authors have proposed systems based on the anatomic location of the fracture and the relationship of the condylar fragment to the mandible and glenoid fossa. Some of the more comprehensive systems are unsuited to clinical use but warranted for statistical purposes.

In 1977, Lindahl proposed a system that classified condylar fractures based on several factors, including the following: (1) the anatomic location of the fracture, (2) the relationship of the condylar segment to the mandibular segment, and (3) the

FIG. 6-3

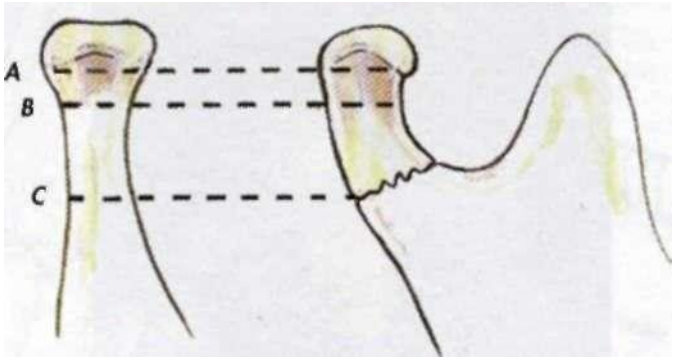


Diagram of the three levels of condylar fracture. *A,* Intracapsular (or condylar head) fractures. *B,* Condylar neck fractures. **C,** Subcondylar fractures, (Fonseca RJ, Walker RV: *Oral and maxillofacial trauma,* ed 2, Philadelphia, 1997, WB Saunders.)

relationship of the condylar head to the glenoid fossa. This system requires that radiographs be obtained in at least two views at right angles to each other. The classification is as follows:

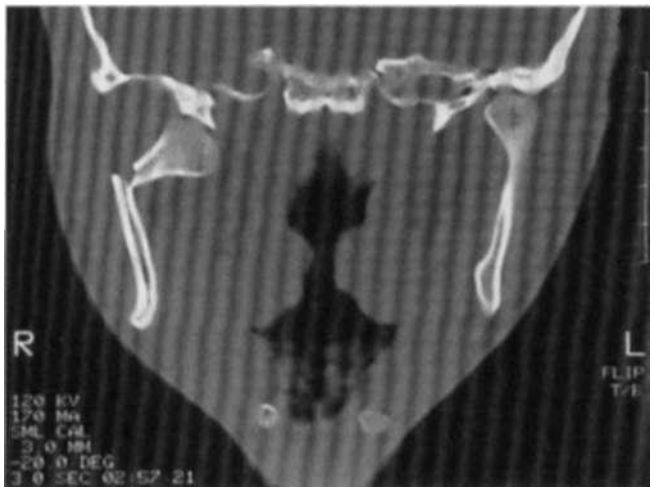
1. Level of Condylar Fracture:
   a. Condylar Head: Its exact anatomic borders are indistinct, but the condylar head is usually defined as the portion of the condyle that is superior to the narrow constriction of the condylar neck. Although difficult to define anatomically, the constriction of the condylar neck (and thus the head lying above) is relatively easy to identify radiographically. Fractures of the condylar head are intracapsular by definition, because the capsule attaches to the condylar neck. They can be subclassified as vertical, compression, and comminuted fractures.
   b. Condylar Neck: The condylar neck is the thin, constricted portion of the mandible below the condylar head and is readily identifiable on radiographs. Anatomically the caudal insertion of the joint capsule attaches to the condylar neck. Consequently, all fractures at or inferior to the condylar neck are extracapsular.
   c. Subcondylar: This region is inferior to the condylar neck and extends from the point of maximal concavity of the sigmoid notch anteriorly to the deepest point along the posterior border of the mandibular ramus. These fractures have been described as ***high*** or ***low,*** which may be useful in the selection of an open surgical approach.

FIG. 6-4



Subcondylar fracture Notice that the anterior edge of the fracture begins at the level of the sigmoid notch and courses posteriorly and inferiorly.

FIGS. 6.5, 6.6

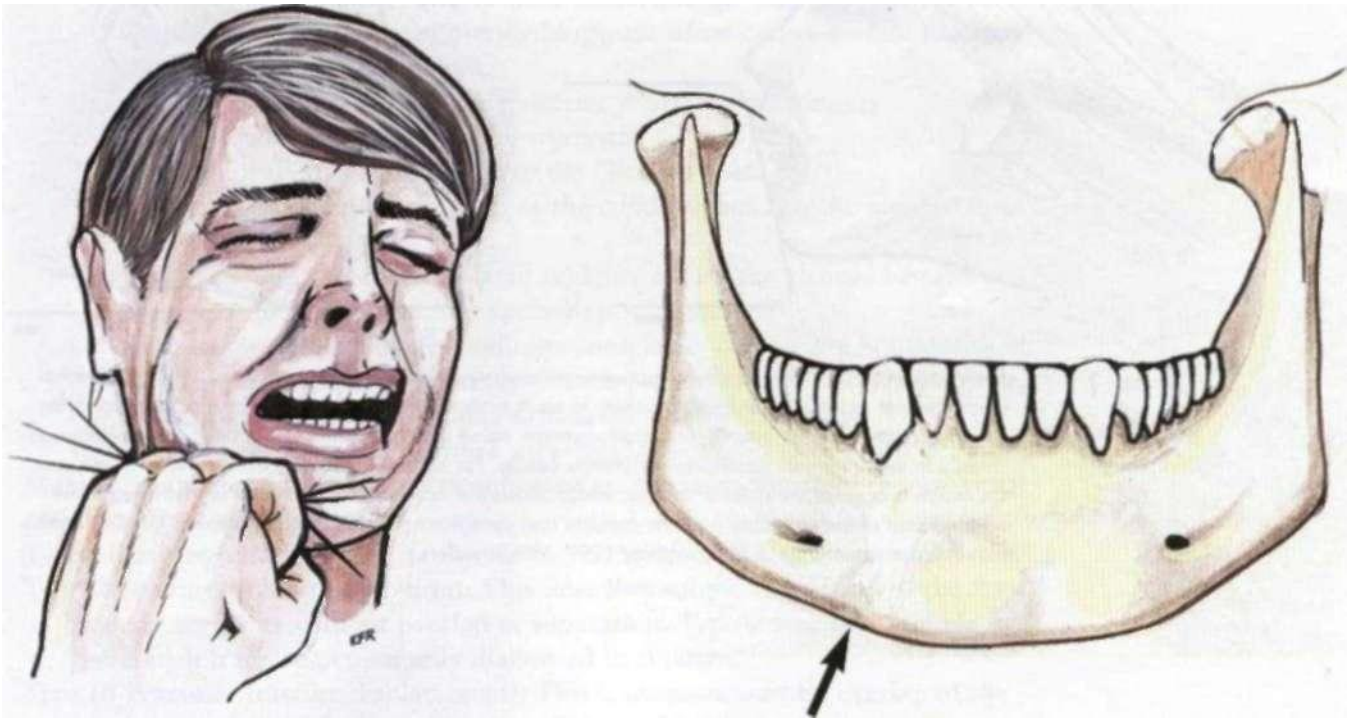


Anterior-medial displacement of condylar fracture from lateral pterygoid pull.



Cryosection through midpoint of meniscus showing insertion of superior head of lateral pterygoid muscle.

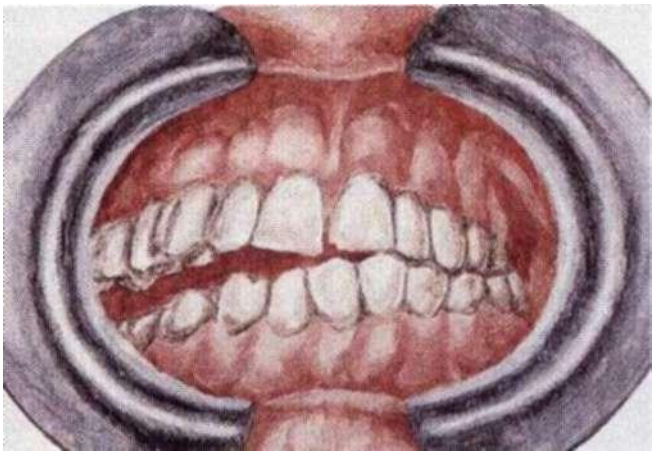
FIG. 6.7



A B

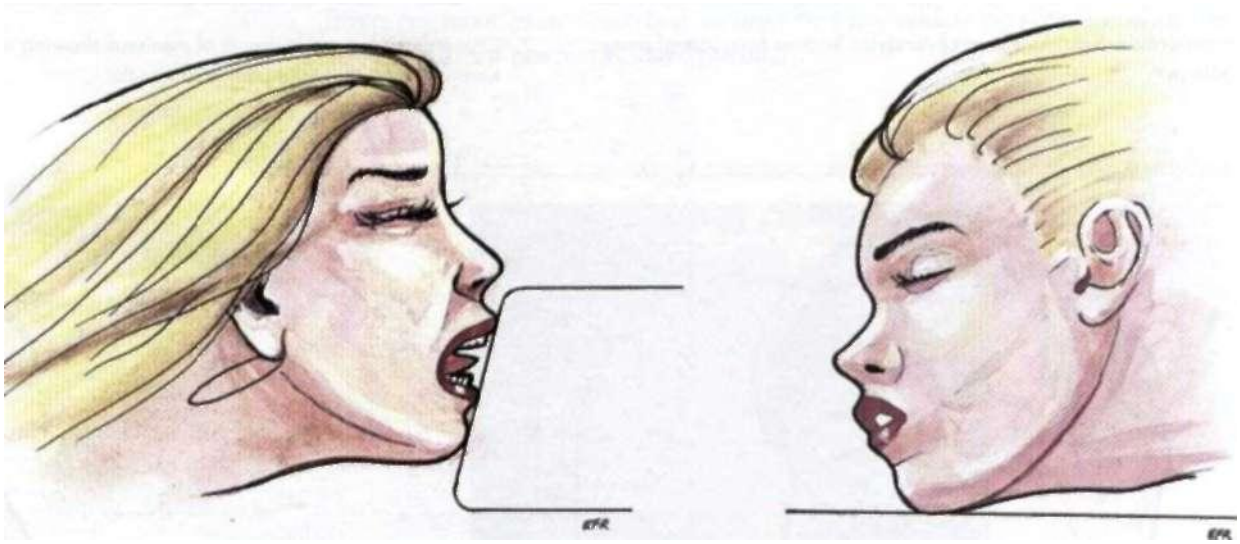
A, A blow being delivered to the left body of the mandible lends lo result in a contralateral, left-sided condylar fracture. Combination fractures in the mandible often result from this type of trauma. Diagnosis of a body fracture resulting from a direct blow should always cause the surgeon to suspect a contralateral condylar injury **(B).** (Fonseca RJ, Walker RV: *Oral and maxillofacial trauma,* ed 2, Philadelphia, 1997, WB Saunders.)

FIG. 6.8

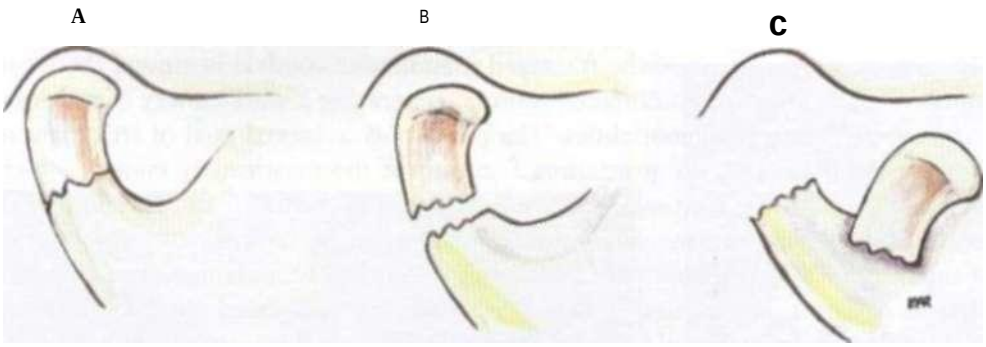


Acute malocclusion secondary to a displaced left condylar fracture with foreshortening of the left ramus and a right-sided open bile.

FIG. 6.9



The vector of force to the symphysis can determine whether condylar injury will occur. A force directed perpendicular to the inferior border is likely to result in dental trauma and less likely to cause condylar fracture or intracapsular trauma. The more common cause of condylar fracture is blunt trauma delivered directly to the symphysis parallel to the inferior border. For example, in most cases of vehicular trauma, the mouth is open at the point of impact, which allows the majority of the force to be delivered to the weakest part of the mandible (i.e., the condyle and condylar neck). (Fonseca RJ, Walker RV: *Oral and maxillofacial trauma,* ed 2, Philadelphia, 1997, WB Saunders.)



Relationship of condylar (proximal) segment to the mandibular (distal) segment. **A,** Nondisplaced—normal relationship of the condylar head to the glenoid fossa. **B,** Displacement—the condylar head remains within the glenoid fossa, but change in the size of the joint space has occurred. **C,** Dislocation—the condylar head rests completely outside the boundaries cf the glenoid fossa.

FIG. 6.10

2. Relationship of the Condylar (Proximal) Segment to the Mandibular (Distal) Segment:
   a. Nondisplaced
   b. Deviated: This term describes an angulation of the condylar fragment in relation to the mandibular segment. The ends of the fracture segment remain in contact, without separation or overlap.
   c. Displacement with Medial or Lateral Overlap: This term describes a fracture in which the distal end of the condylar segment lies either medially or laterally to the superior end of the fractured distal (mandibular) segment. Contraction of the lateral pterygoid muscle often causes medial displacement of the condylar segment.
   d. Displacement with anterior or posterior overlap (uncommon)
   e. No contact between the fracture segments
3. Relationship of the Condylar Head to the Clenoid Fossa:
   a. Nondisplaced: The relationship of the condylar head to the glenoid fossa is normal.
   b. Displacement: The condylar head remains within the glenoid fossa, but a change in the size of the joint space has occurred.
   c. Dislocation: The condylar head rests completely outside the boundaries of the glenoid fossa. Because of contraction of the lateral pterygoid muscle, the condylar segment is usually dislocated anterior medially.

In an effort to establish a more clinically useful classification scheme, MacLennan proposed in 1954 a system based on the relationship of the proximal and distal fracture segments:

Type I Fracture (nondisplaced)

Type II Fracture (fracture deviation): This describes simple angulation of the fracture segments without overlap or separation. Type II fractures include green stick fractures, commonly diagnosed in children.

Type III Fracture (fracture displacement): This is characterized by overlap of the proximal and distal fracture segments. The overlap can be anterior, posterior, medial, or lateral.

Type IV Fracture (fracture dislocation): The condylar head resides completely outside the confines of the glenoid fossa and joint capsule. The dislocation may be anterior, posterior, medial, or lateral.

TREATMENT OF MANDIBULAR CONDYLE FRACTURES

The proper management of the fractured mandibular condyle is among the most controversial topics in maxillofacial trauma, generating a wide variety of opinions and proposed treatment modalities. The commonly accepted goal of treatment is the recstablishment of the pretrauma function of the masticatory system, which typically involves the restoration of the preoperative occlusion and facial symmetry. Unlike fractures of other bones, however, the exact anatomic reapproximation of the fracture segments may not be essential. This has been demonstrated in children in whom a conservatively treated displaced or dislocated condylar fracture heals with a perfectly functional and often morphologically reconstituted condylar process despite a lack of exact reduction. This phenomenon is probably related to the remarkable remodeling capacity of bone in children. A similar tendency exists in older patients, although the results are much less dramatic.

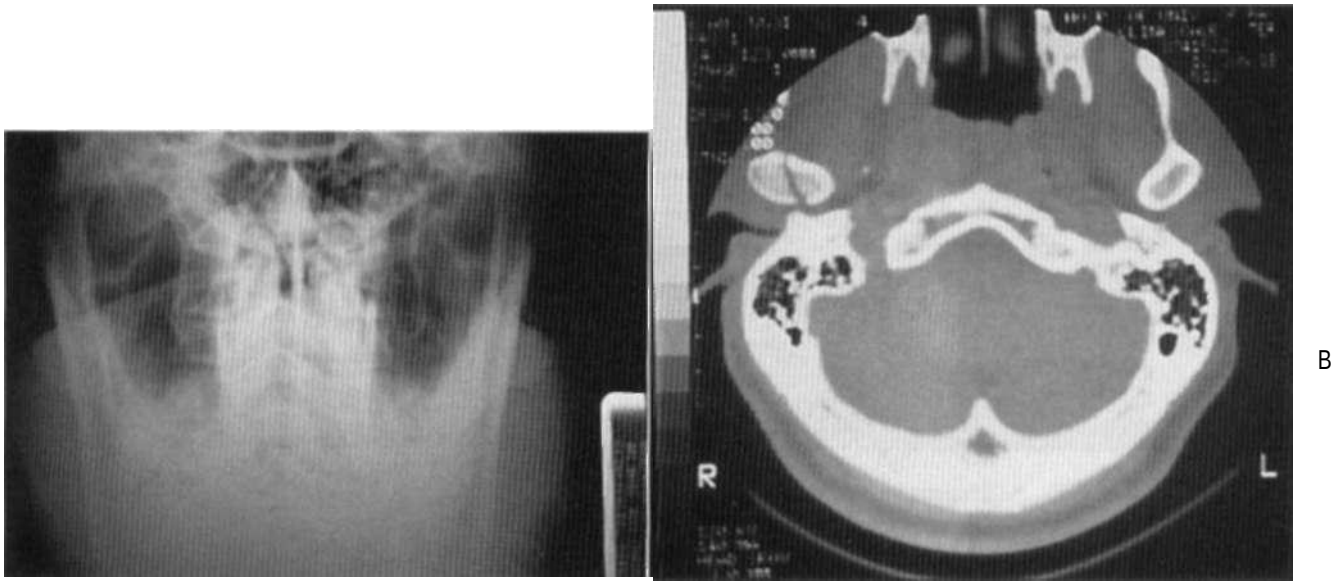
Early techniques for the management of condylar fracture included various methods and periods of joint immobilization. This approach was chosen because it produced fairly good results and many surgeons feared exposing the temporomandibular region to surgical complications. Moreover, early methods of internal fixation were clearly not preferable to more conservative methods. As surgical techniques improved and methods of rigid fixation were developed, surgeons became more comfortable with open approaches to the joint. An expanding set of indications for open surgical intervention evolved, but the technique continued to stimulate a great deal of debate, which persists today.

FIG. 6.11



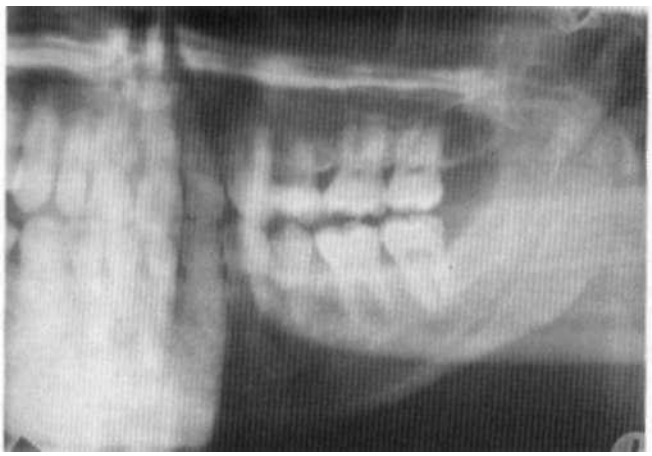
Towne's view of skull. This is the standard anterior-posterior skull film used to screen for condylar fractures. The beam is angulated at approximately a 35-degree angle to separate the mastoid air cells from the condylar region.

FIG. 6-12

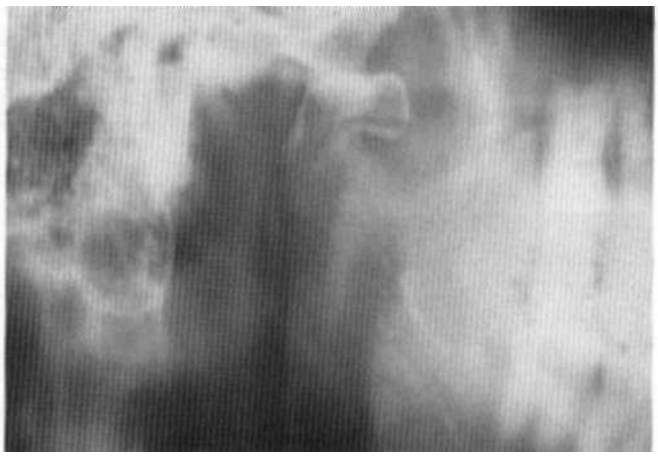


A, Reverse Towne's view of an 18-year-old man who complains of right-sided temporomandibular joint pain after blunt trauma. No definite abnormality is noted. B, An axial CT scan of the same patient that demonstrates an intracapsular fracture of the right condylar head in the sagittal plane with minimal displacement. This type of injury should be treated with closed reduction for approximately 2 weeks with early mobilization to prevent ankylosis.

FIGS. 6.13, 6.14



Panorex X-ray image depicting "telescoped" condylar segment. This patient has marked deviation to the side of the racrure.

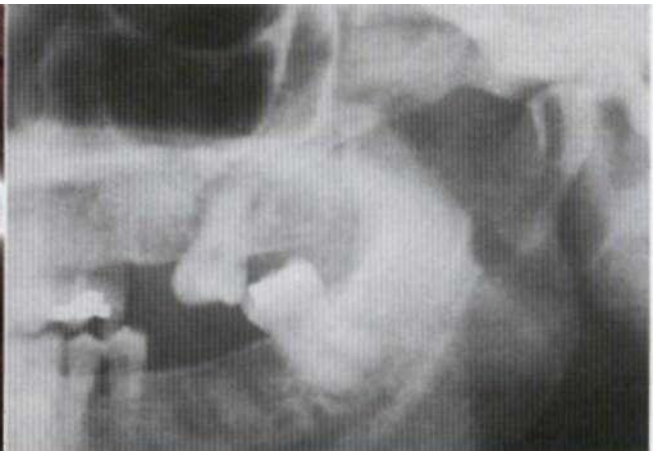


Tomogram showing right condyle grossly displaced anterior to the articular eminence.

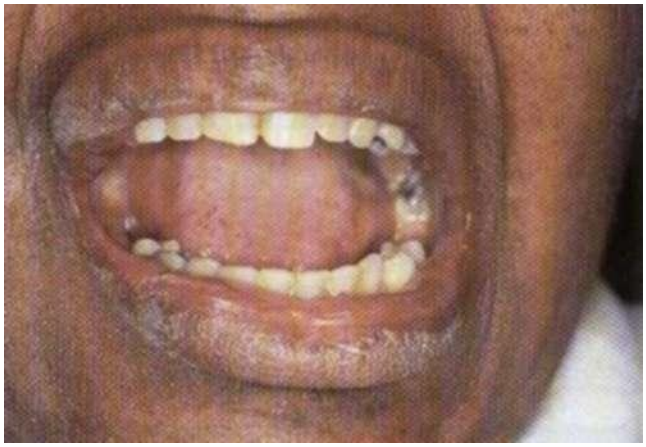
FIG. 6.15



A



B



C

A, A 46-year-old woman with untreated, telescoped left-condylar fracture resulting in laterognathia. B, Panorex of some patient showing lateral overriding of condylar and ramus fracture segments. C, Laterognathia on open position of the same patient, with malunited fracture.

FIGS. 6.16, 6.17



Coronol CT scan depicting nondispbced oblique fracture through condylar neck.



Sagittal fracture through condylar head with telescoping of proximal fragment.

Conservative Treatment

Available data overwhelmingly support the belief that many fractures of the mandibular condyle can be successfully treated through conservative means. The conservative management of condylar fracture ranges from observation and prescription of a soft diet to variable periods of immobilization followed by intense physiotherapy. If the patient is able to establish and maintain a normal occlusion with a minimal amount of discomfort, no active treatment may be necessary. The patient should be encouraged to eat soft foods and maintain as near normal function as possible. Close supervision is mandatory, and both clinical and radiographic reevaluation should be performed at the first sign of occlusal instability, deviation with opening, or increasing pain. Those findings may indicate the conversion of a nondisplaced fracture to a displaced one that requires more aggressive treatment. Only responsible patients who are committed to a period of close follow-up should be considered for the observation-only treatment regimen.

Usually the presence of malocclusion, deviation with function, or significant pain necessitates some form of immobilization. This generally involves intermaxillary fixation with arch bars, eyelet wires, or splints. The length of the period of immobilization is controversial: It must be long enough to allow initial union of the fracture segments but short enough to prevent complications such as muscular atrophy, joint hypomobility, and ankylosis. Currently the period of immobilization ranges from 7 to 21 days. The period may be increased or decreased depending on concomitant factors such as the age and nutritional status of the patient, the level of the fracture, the degree of displacement, and the presence of additional fractures.

Open Reduction of the Fractured Mandibular Condyle

Although incontrovertible evidence to support the efficacy of open techniques is lacking, a specific group of individuals appears to benefit from open surgical intervention. Zidc and Kent, Raveh et al, and others have proposed a set of absolute and relative indications for open reduction of the fractured mandibular condyle. However, each case should always be evaluated individually.

Absolute indications for use of an open technique are as follows:

1. Displacement of the condyle into the middle cranial fossa
2. Impossibility of obtaining adequate occlusion by closed techniques
3. Lateral extracapsular displacement of the condyle
4. Invasion of the joint by a foreign body

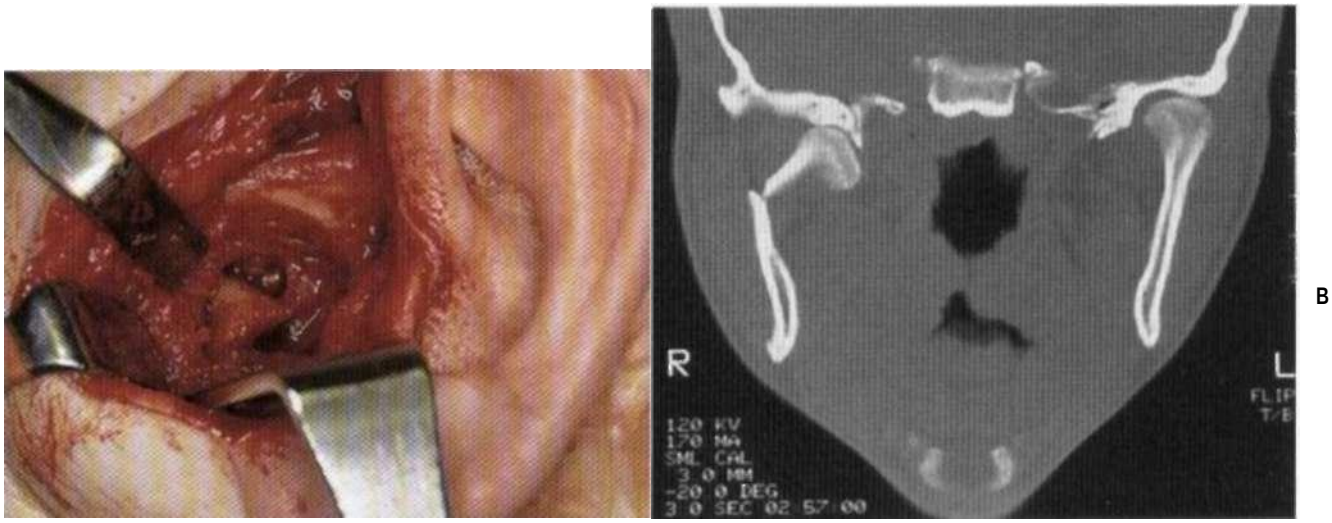
Relative indications for use of an open technique are as follows:

1. Bilateral condylar fractures in an edentulous patient when splints are unavailable or impossible because of ridge atrophy
2. Unilateral or bilateral condylar fractures when splinting is not recommended because of concomitant medical conditions or physiotherapy is not possible
3. Bilateral fractures associated with comminuted midfacial fractures
4. Bilateral fracture associated with other gnathologic problems

Once the decision has been made to use an open technique, the next step in treatment planning is to select a surgical approach. Over the years, many approaches to the temporomandibular joint have been developed, including intraoral, preauricular, endaural, retroauricular, retromandibular, and rhytidectomy approaches. Hach has its own advantages, disadvantages, and complications. Many of these approaches have fallen from favor; only the preauricular, submandibular, and intraoral routes are routinely used in most centers.

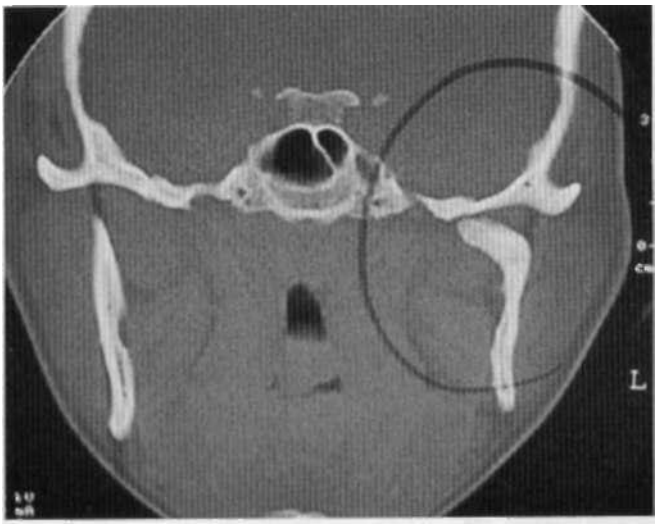
The location of the fracture and the degree of displacement are the prime determinants in the selection of the approach to the joint. If the fracture is intracapsular or high on the condylar neck, the preauricular or endaural approach is preferred. This approach offers better access, greater visibility of the fracture site, ease of manipulating soft tissues within the joint, and relative ease of placement of fixation devices. The inherent disadvantages are the possibility of damage to the facial nerve and the presence of a facial scar. Subcondylar fractures and fractures located lower in the condylar neck may be more easily reached by a submandibular or posterior-mandibular approach. The danger of this technique is possible injury to the marginal mandibular nerve with subsequent weakness of the depressor muscles of the lower lip. In some instances a combination of these approaches is necessary to gain adequate access to reduce and fixate the fracture segments. Several authors have advocated an intraoral approach to fracture of the condyle. This approach allows the surgeon to visualize the fracture reduction and the occlusion simultaneously, minimizes risk of damage to the facial nerve, and prevents an unsightly facial scar. Disadvantages include a more limited access, especially in high subcondylar and condylar neck fractures, and the difficulty of placing fixation devices. ***Text continued on p. 144***

FIG. 6-18



A, Surgical access lo a dislocated, fractured condylar head in left joint. Note "empty fossa," which indicates an anterior-medial displacement of the fractured condyle. B, CT scan depicting condylar neck fracture with anterior-medial displacement as depicted in A.

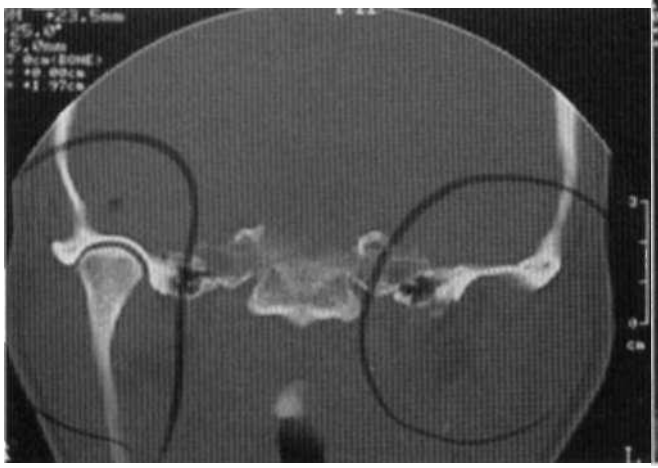
FIG.6.19



Malunion of disploced, untreated condylar fracture.

FIG. 6.20

A

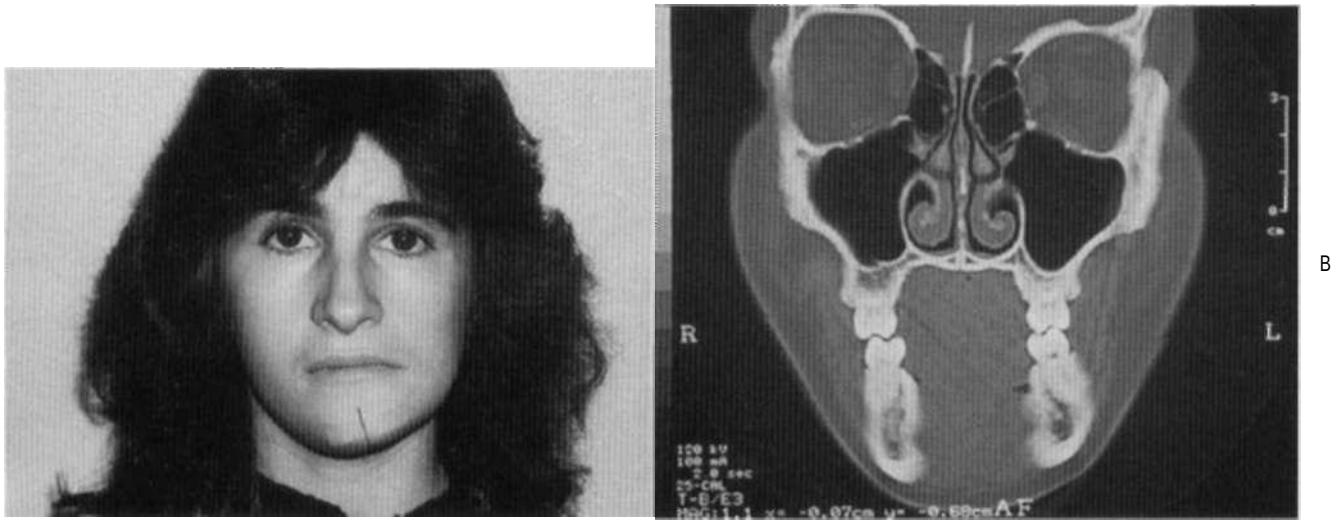




B

Coronal and axial scans showing empty fossa, which suggests displacement of the condyle out of the fossa.

FIG. 6-21



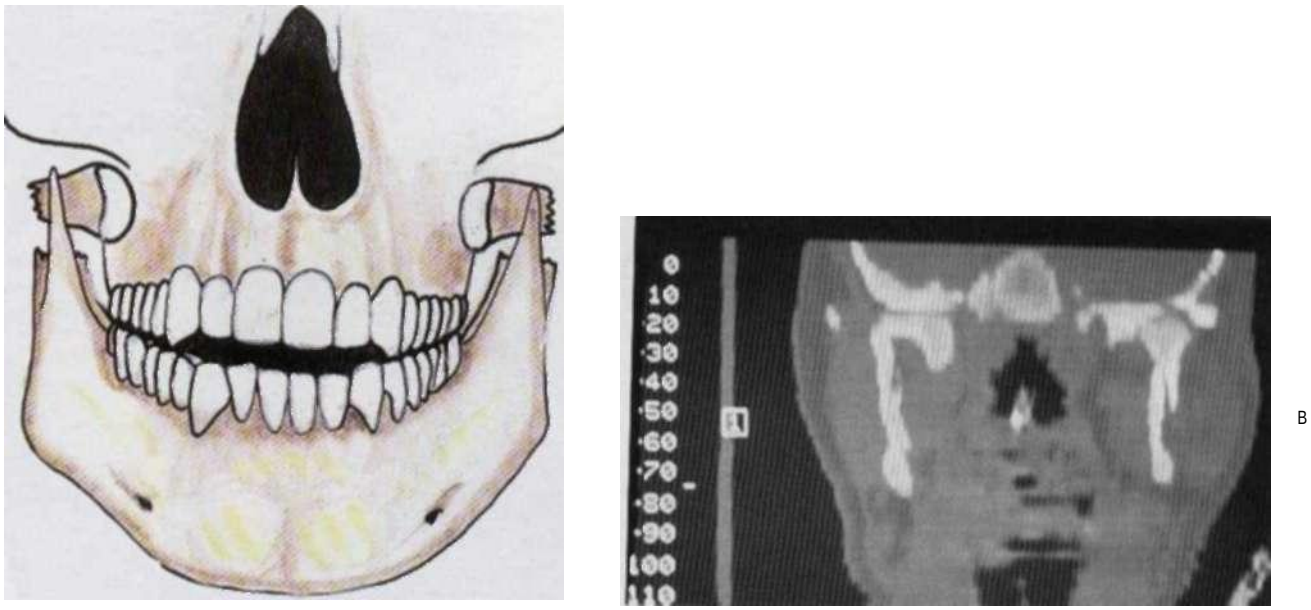
A, A 22-year-old woman who sustained an untreated condylar fracture at 7 years of age. Note the marked left-sided ramus foreshortening with symphyseal asymmetry. B, Facial asymmetry secondary to untreated condylar fracture in A.

FIG. 6-22



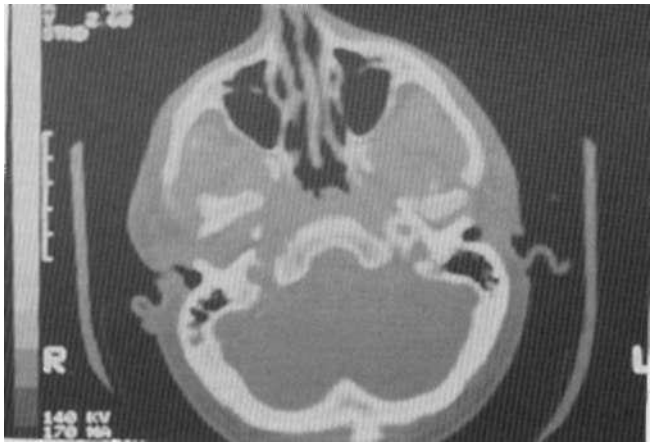
Axial CT showing hypoplastic condylar head secondary to traumatic injury.

FIG. 6.23



A, Bilateral condylar fractures with resultant apertognathia. B, Coronal CT scan of bilateral condylar fractures. Note that the right condyle is displaced ou, of the glenoid fossa completely.

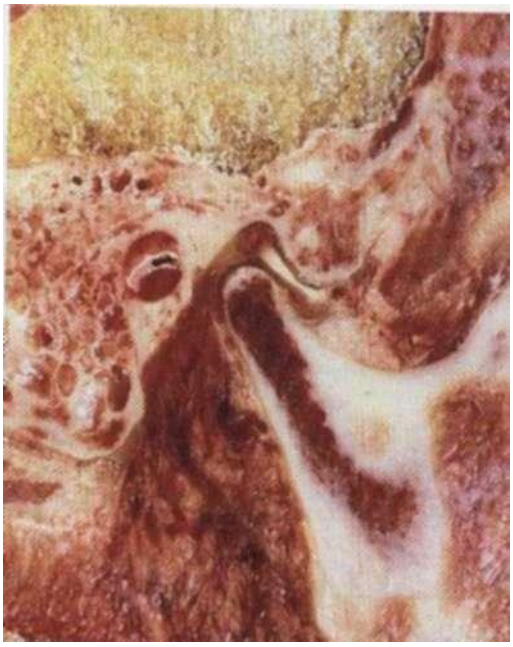
FIG. 6.24



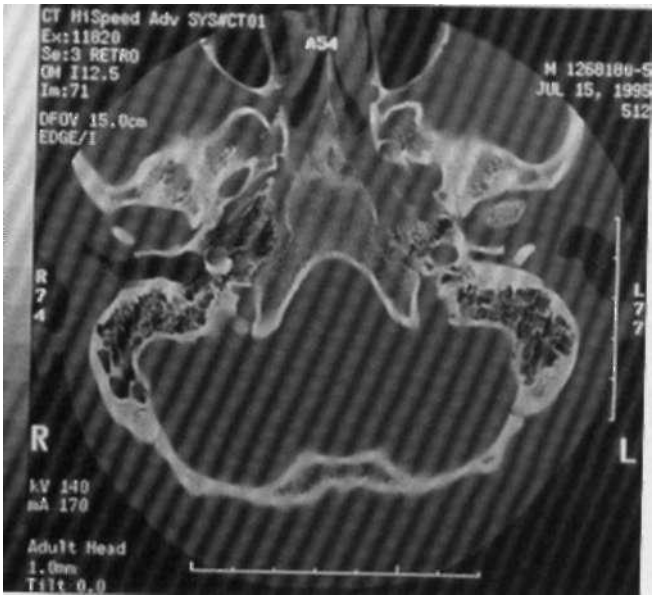
Axial CT scan showing fibroosseous ankylosis secondary fo untreated condylar fracture.

FIG. 6.25

A

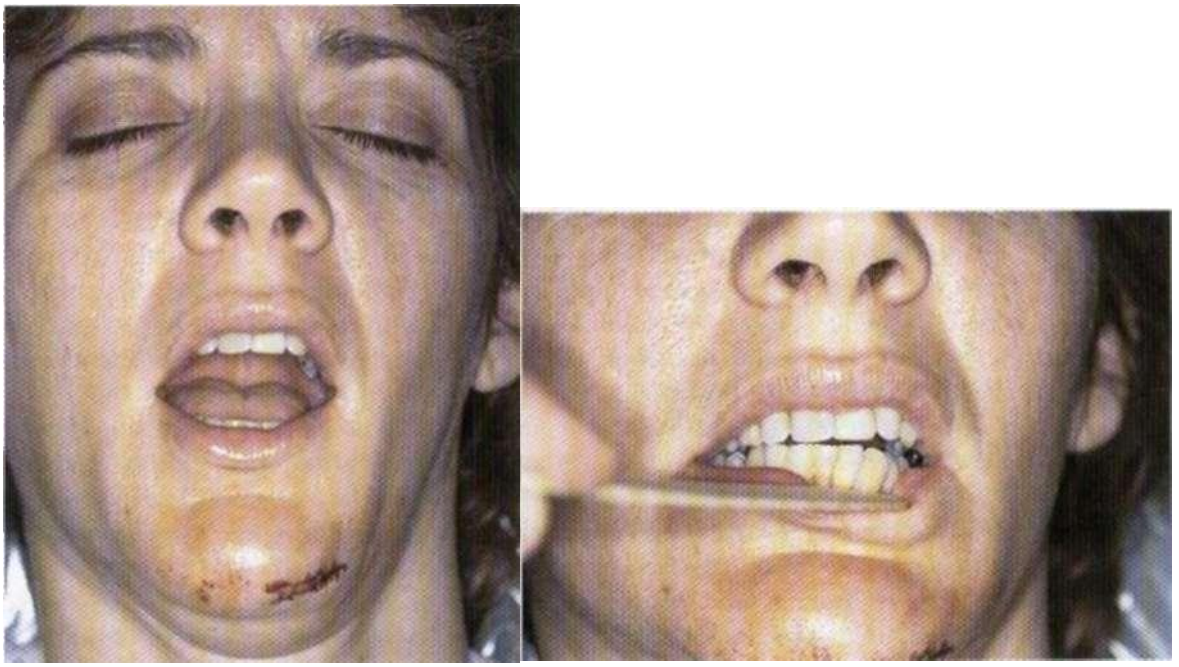


B

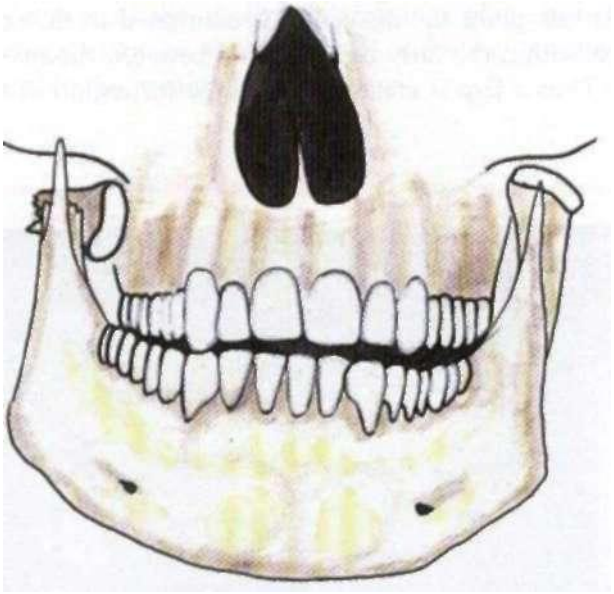


A, Note proximity of condylar head to bony external auditory canal. B, Axial CT scan showing displaced fragment of bone caused by blunt injury to external bony canal (left side).

FIG. 6.26



A B



C

A, Two of the clinical signs suggesting a possible condylar injury. The presence of a chin laceration or symphyseal trauma should prompt the clinician to check for a possible condylar injury. Note the deviation of this patient's mandible to the right when opening the mouth, which suggests a right-sided condylar injury. B, Occlusion occurring in the same patient, demonstrating a left posterior open bite with a premature occlusion on the right. This may also indicate a right condylar injury. C, Depiction of grossly displaced right condylar fracture with resultant right laterognathia and a left open bite.

[p]reou'"iculor Accroach

When preparing to gain access to the joint by the preauricular approach, the surgeon places a cotton pledget saturated with mineral oil into the external auditory canal to prevent debris and blood from accumulating and possibly damaging the tympanic membrane. Next, anesthetic solution with a vasoconstrictor is infiltrated into the preauricular skin and joint capsule to aid in hemostasis. The incision is initiated within the hairline of the temporal skin, approximately 1.5 to 2.0 cm anterior-superiorly to the superior attachment of the helix. Care should be taken to bevel this portion of the incision so that it is parallel to the hair follicles. The incision is made through the skin and passes in a gentle curve to the superior attachment of the helix, where it continues inferiorly within the skin crease just anterior to the auricle. The incision continues in this crease to the junction of the inferior helix and the skin of the cheek.

In the region superior to the zygomatic arch the incision is deepened to the level of the temporalis fascia. Immediately over the zygomatic arch the incision is carried to the overlying periosteum. Below the arch the incision follows just superficial to the tragal cartilage. Any vessels encountered during the dissection should be clamped, divided, and ligated to allow adequate access.

The temporalis fascia is then incised several millimeters anterior to the initial incision. The dissection is carried anteriorly and inferiorly between the temporalis fascia and the muscle fibers of the temporalis muscle. This plane is continued inferiorly to the level of the decussation of the temporalis fascia into the superficial and deep layers. At this point the dissection is continued to the superior edge of the zygomatic arch within the fatty tissue pocket between the two layers of the temporalis fascia. Thus a flap is created in the superior region of the dissection, con-

FIG. 6.27



Coronal CT of grossly displaced condylar head. The displacement was caused by a bullet wound.

sisting of the skin, subcutaneous tissue containing the superficial temporal vessels and branches of the facial nerve, the superficial layer of the temporalis fascia, and more superiorly, the temporalis fascia. The branches of the facial nerve are well protected in this soft tissue flap.

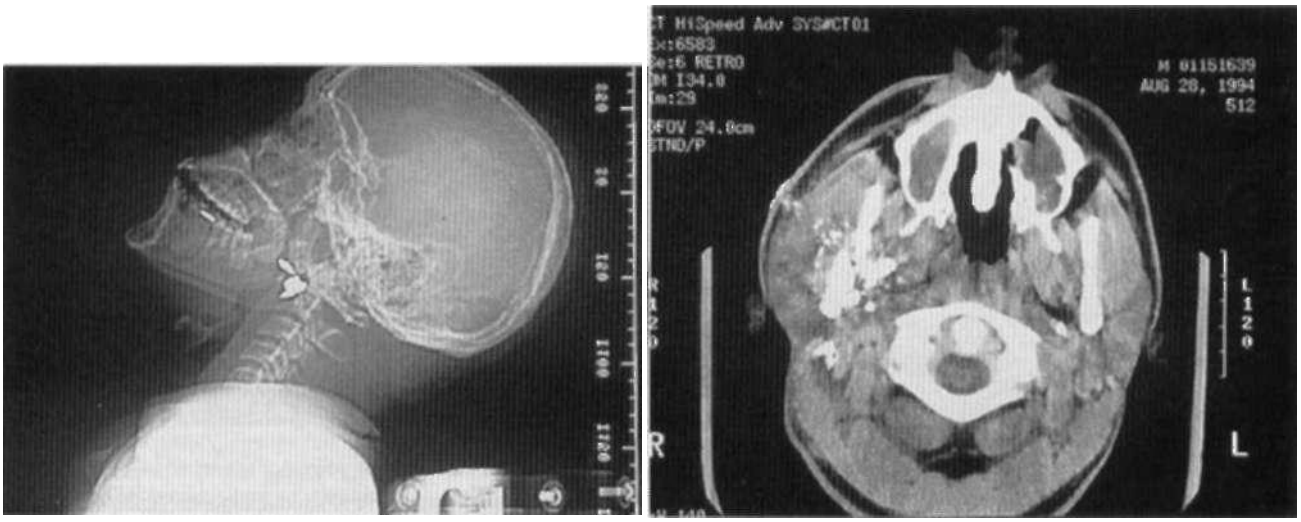
After reaching the zygomatic arch, the surgeon uses an elevator to reflect the periosteum from the lateral aspect of the arch. Reflection can be carried anteriorly as far as the glenoid tubercle. This should be done carefully because the periosteum, temporalis fascia, and subcutaneous tissue coalesce to form a single layer in this region, and the temporal branch of the facial nerve lies within this tissue as it passes over the arch toward the scalp.

Below the arch the dissection continues beneath the parotidomasseteric fascia, which is the continuation of the temporalis fascia from above. The flap is lifted anteriorly as a single unit, thus exposing the joint capsule and temporomandibular ligament. The dissection is carried inferiorly as needed until the fracture site is adequately exposed. Inferiorly the parotid gland is reflected anteriorly with the skin-fascial flap, thus provinding protection for the gland and the facial nerve.

Endourcit Approach

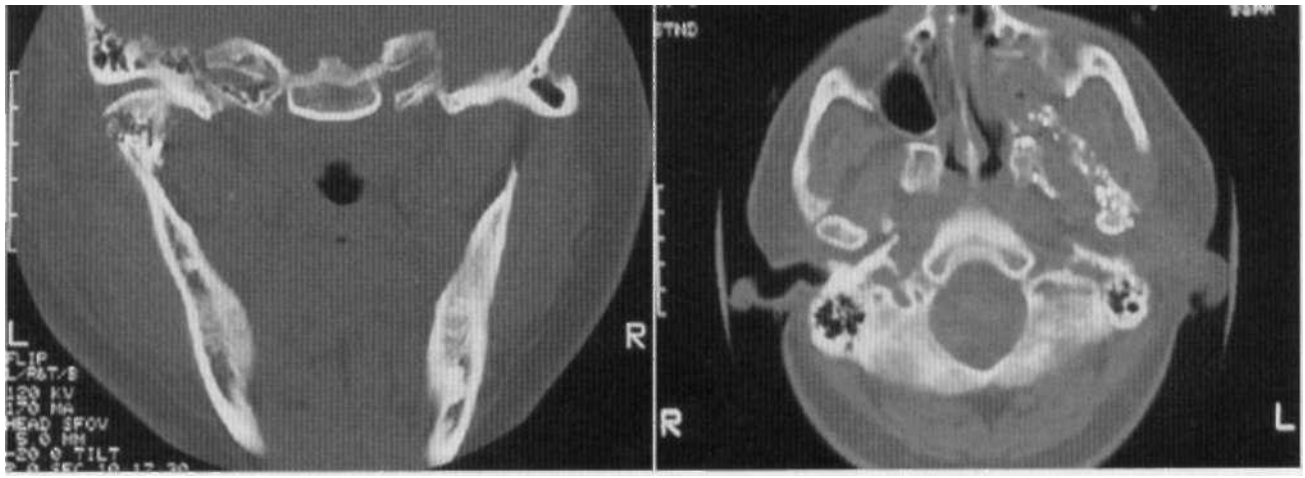
The endaural approach is similar to the preauricular approach but differs in that the initial incision is made to pass along just inside the lateral aspect of the tragus. The remainder of the skin incision is the same. The dissection in the area of the tragus is carried to the root of the zygomatic arch in a plane just above the perichondrium of the tragal cartilage. Once the level of the arch has been reached, the dissection is identical to the preauricular approach.

FIG. 6.28



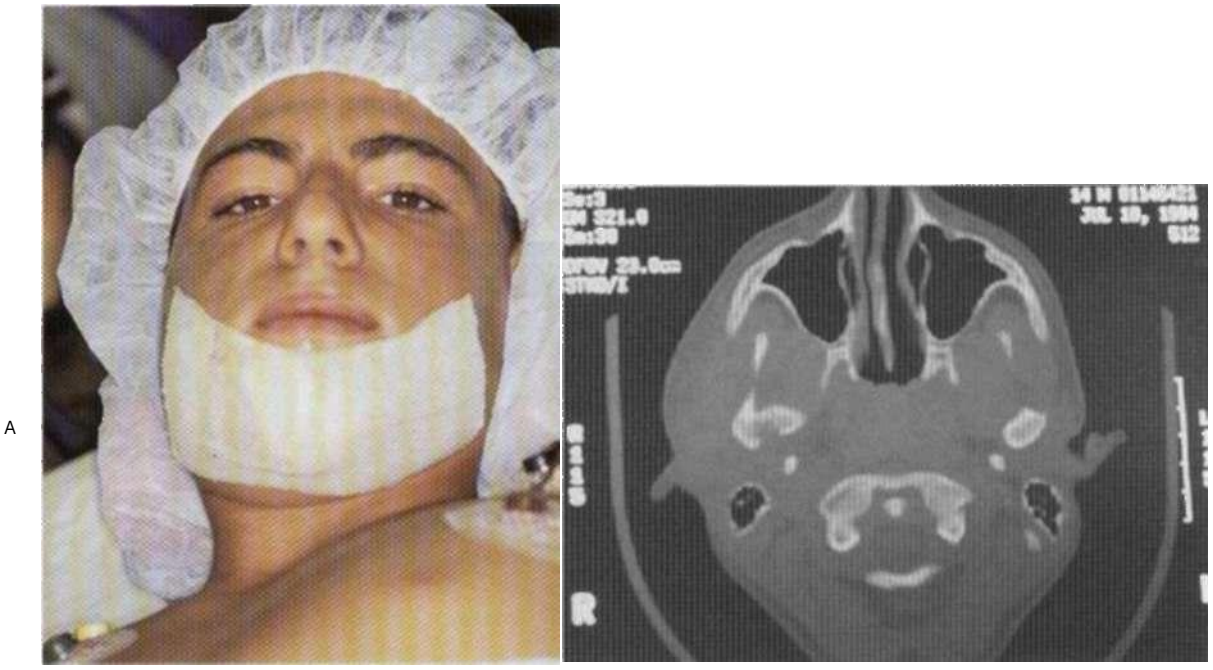
A, Lateral skull scout film showing bullet fragments lateral to left ramus. B, Soft tissue axial CT scan showing bullet wound entry and path of trajectory through masseter muscle. Note marked fragmentation of condyle and ramus.

FIG. 6.29



A, Coronal CT scan of the condyle showing marked destruction caused by a small-caliber bullet wound. B, On the axial CT scan, note the laleral-ro-medial tracking of the bullet wound through the posterior wall of the sinus.

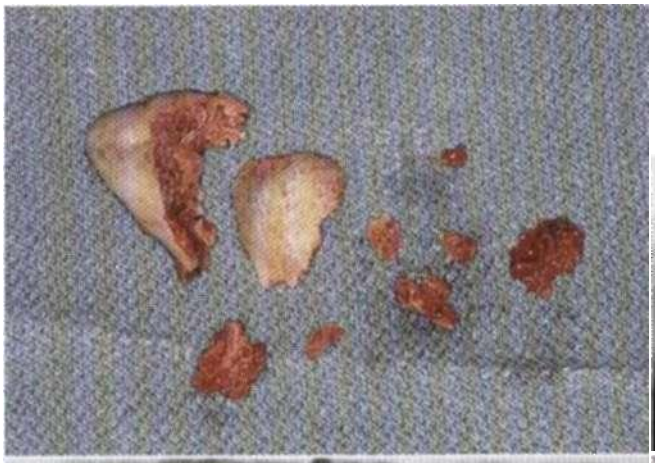
FIG. 6-30



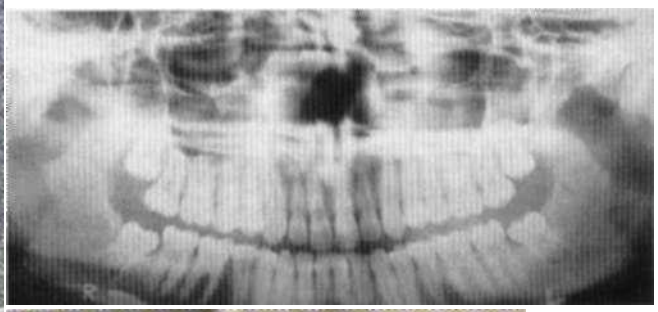
A, A 14-yecr-old boy who incurred an open chin laceration with degloving of the mandibular symphysis secondary to a motor vehicle accident. After the laceration wos repaired, he was referred for evaluation of persistent postoperative numbness in the distribution of the right lingual nerve. B, A CT scan demonstrated a severely comminuted displaced fracture of the right condylar head, which was impinging on the superior portion of the right lingual nerve.

Continued

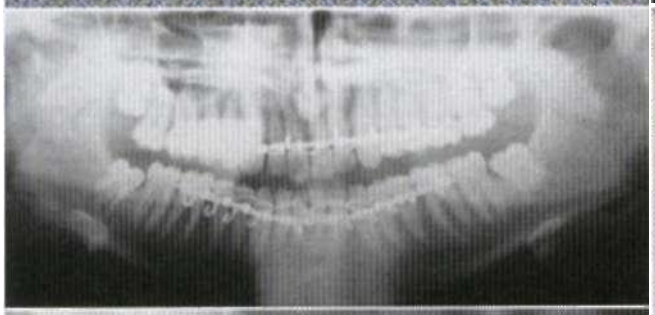
FIG. 6.30, CONT'D



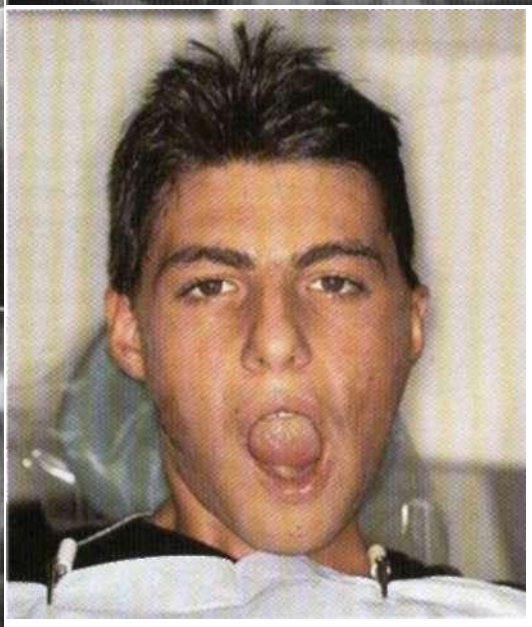
C



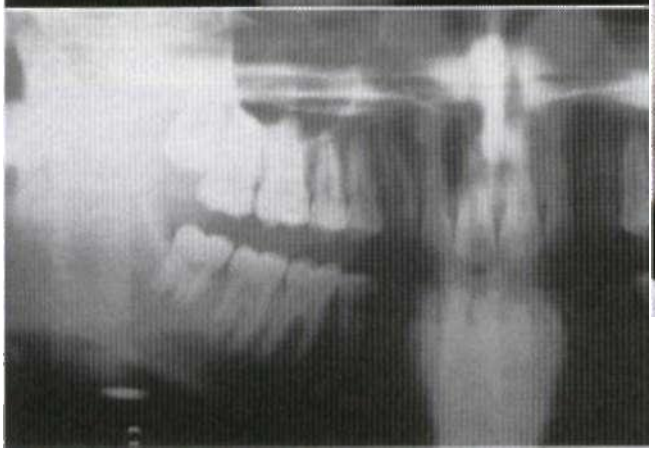
D



E



F

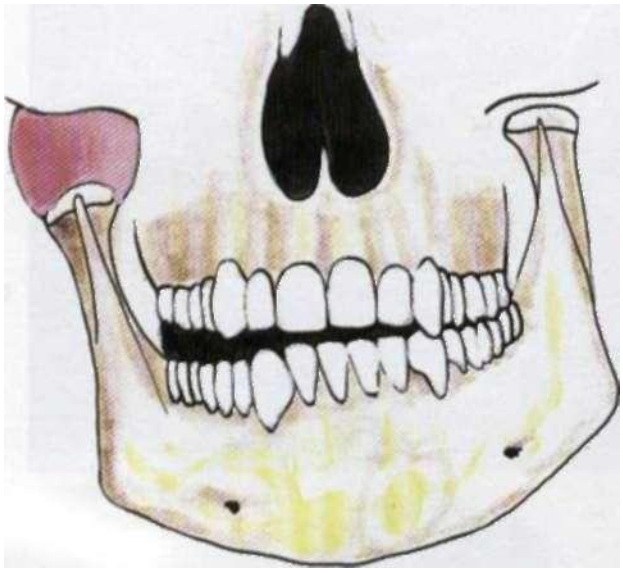


G

C, Surgical exploration of this fracture was performed through an endaural incision with removal of all fragments of the displaced, comminuted condylar fracture. **D,** A panorex radiograph demonstrating the displaced right condylar head fracture. **E,** A panorex radiograph (obtained immediately after surgery) demonstrating the defect after condyleclomy. **F,** A photograph of the patient showing deviation of the jaw to the right side approximately 2 weeks after surgery. The patient's mandible has adequate range of motion, and the patient experiences no adverse effects. The lingual parasthesia had resolved. **G,** A panorex radiograph (taken approximately 8 months after the operation) demonstrating regeneration of the condylar head on the right side. This phenomenon sometimes occurs in young patients if the periosteal envelope of the mandible is left intact.

FIG. 6.31

A



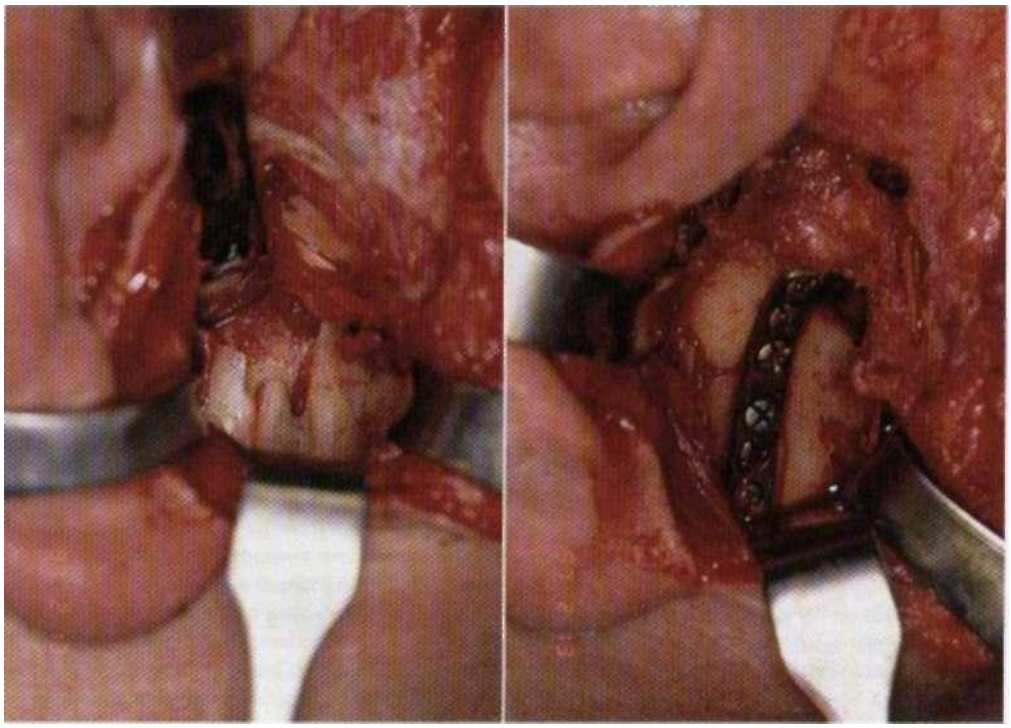


B

A, Hemarthrosis. The condyle can be displaced from its normal resting position in the fossa, and the patient experiences an open bite on the side of the hemarthrosis. MRI can be a valuable aid in diagnosing acute effusions of the temporomandibular joint. B, Sagittal MRI section showing gross effusion in superior joint space. Note the bright signal of joint effusion and distension of the superior joint space.

FIG. 6.32

A



B

A, Access to the left temporomandibular joint. The proximal portion of the subcondylar fracture has been displaced medially and inferiorly. B, Reduction of the subcondylar fracture with a bone plate that has three screws engaging both the proximal and distal segments. Note the realignment of the condyle within the glenoid fossa and the repositioned meniscus.

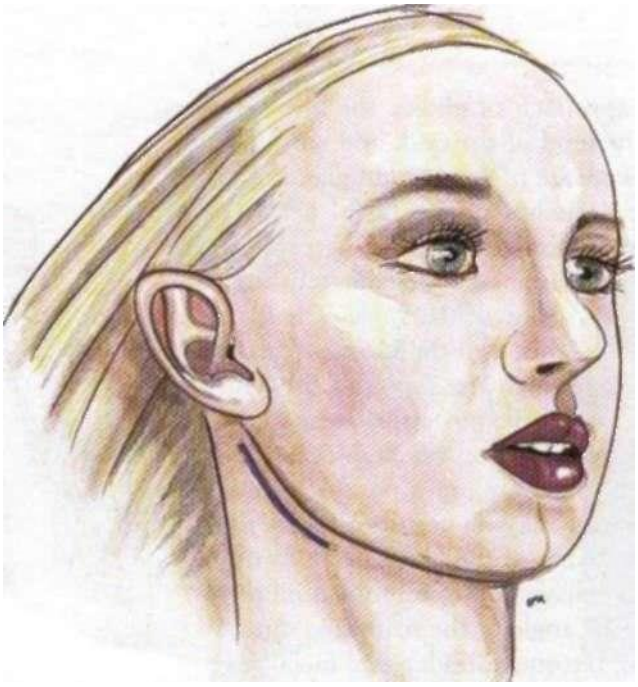
Submandibular-Retromandibular Approach

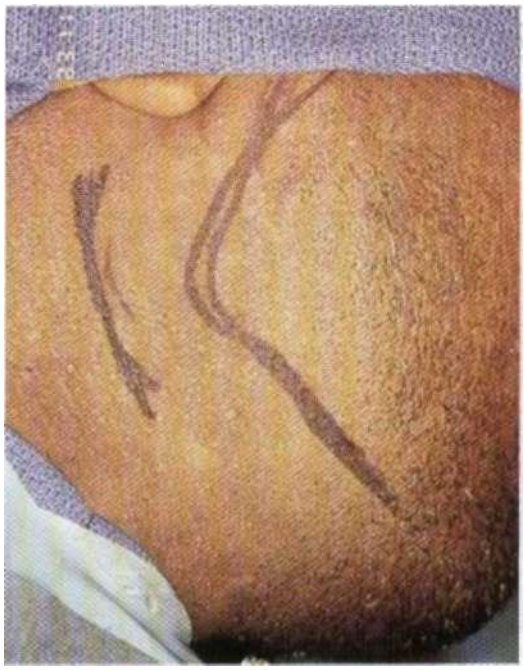
The submandibular, or Risdon, incision is the approach of choice for low subcondylar fractures. It allows good exposure to the level of the neck and coronoid notch. Blair has modified the incision to allow exposure of the parotid gland. The risk of injury to the temporal and zygomatic branches of the facial nerve is reduced, but the risk of damaging the marginal mandibular branch is increased.

The incision is made within the relaxed skin tension lines, approximately 2 cm inferior to the inferior border of the mandihle in the region of the angle. The Blair modification places the incision slightly posterior to this, and the incision curves superiorly behind the angle. The incision is made through the skin and subcutaneous tissue. Depending on the location of the incision, the posterior fibers of the platysma muscle may be identified. Near the posterior aspect of the incision the sternocleidomastoid muscle is visible, with its fibers running in a posterior-superior to anterior-inferior direction. A nerve stimulator may be useful to locate the marginal mandibular, cervical, and possibly main trunk of the facial nerve as dissection proceeds. The platysma is divided, and the dissection is continued bluntly in a superior and medial direction. At this point the angle of the mandible should lie fairly close to the surface. The external jugular, retromandibular, and facial vessels may be encountered during this approach and may require ligation. Once the inferior border of the mandible is reached in the region of the angle, the aponeurosis of the pterygomasseteric sling is sharply incised. A periosteal elevator is used to reflect the periosteum over the lateral aspect of the angle and ramus extending superiorly to the sigmoid notch. This should allow adequate exposure of most subcondylar and some low neck fractures. If additional access is necessary, the tissue at the posterior aspect of the incision may be released further, allowing the parotid gland with its contained facial nerve to be retracted anteriorly. Great care must be taken during any dissection in the deeper tissue just inferior to the auricle; this is the location of the main trunk of the facial nerve after it exits the stylomastoid foramen.

FIG. 6.33

A





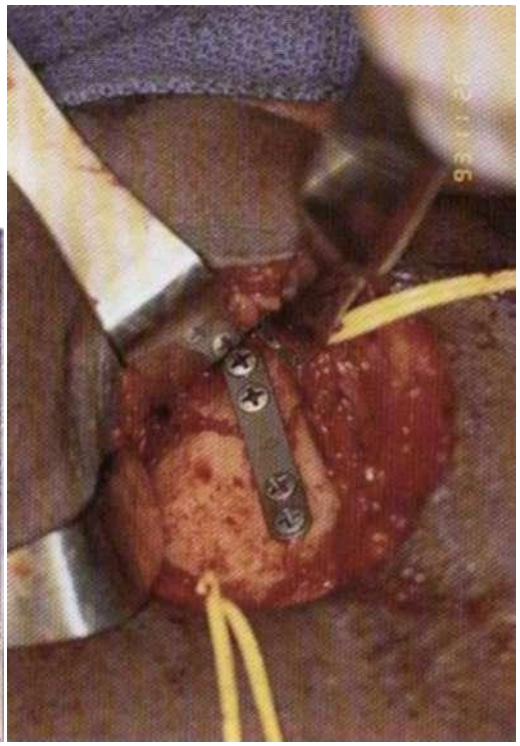
B

Posterior mandibular incision. This Blair modification of the Risdon incision dictates that the incision be more superior and posterior to gain adequate access to the region of the condylar neck and the sigmoid notch. Care must be taken to avoid damage to the marginal mandibular branch of the facial nerve.

FIG. 6.34

A





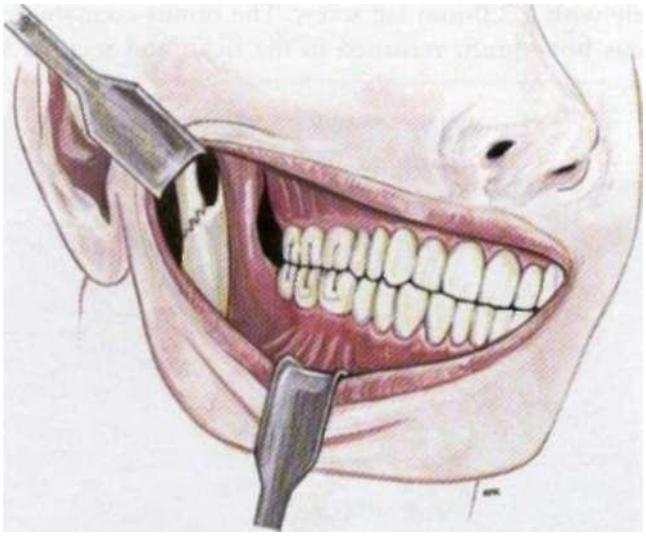
B

A, Access to a subcondylar fracture through a posterior mandibular approach. B, A satisfactory reduction in which a rigid bone plate was used to adequately reduce the proximal and distal fracture segments.

Intraoral Approach

In the intraoral approach an incision is made along the anterior border of the ascending ramus. The incision extends anteriorly along the external oblique ridge, ending in the vestibule adjacent to the second molar. A full-thickness mucoperiosteal flap is reflected, exposing the lateral aspect of the mandible to the posterior border. The subperiosteal dissection is continued superiorly to the level of the sigmoid notch. A retractor can be placed in the sigmoid notch to improve access. The proximal condylar fragment is then identified and reduced. The surgeon may need to distract the mandible inferiorly to locate a medially displaced condyle. The periosteum of the condylar segment is stripped, with care taken to elevate only enough of the periosteum to allow placement of fixation plates or wires. This ensures that the blood flow to the condyle is not compromised more than necessary. The intermaxillary fixation is then applied, with the condyle reduced into its proper position. One advantage of this technique is direct visualization of the condylar segment during the application of the intermaxillary fixation. Proper reduction is confirmed by inspection and palpation of the posterior border with an instrument.

FIG. 6.35

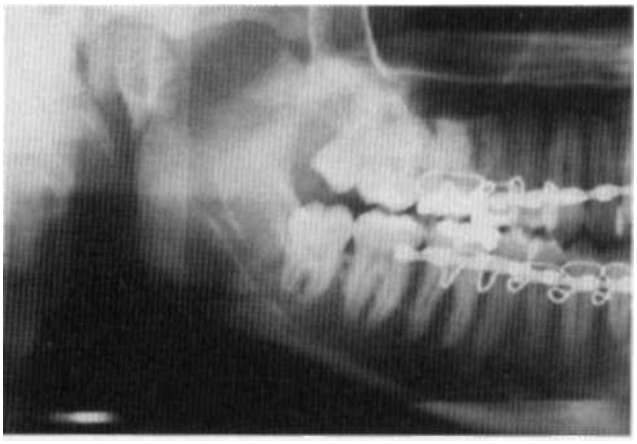


Intraoral approach to condylar fractures. This is not a common approach to condylar fractures, but it does lend itself to lag-screw reduction techniques. (Fonseca RJ, Walker RV: ***Oral and maxillofacial trauma,*** ed 2, Philadelphia, 1997, WB Saunders.)

Methods of Fixation for Condylar Fractures

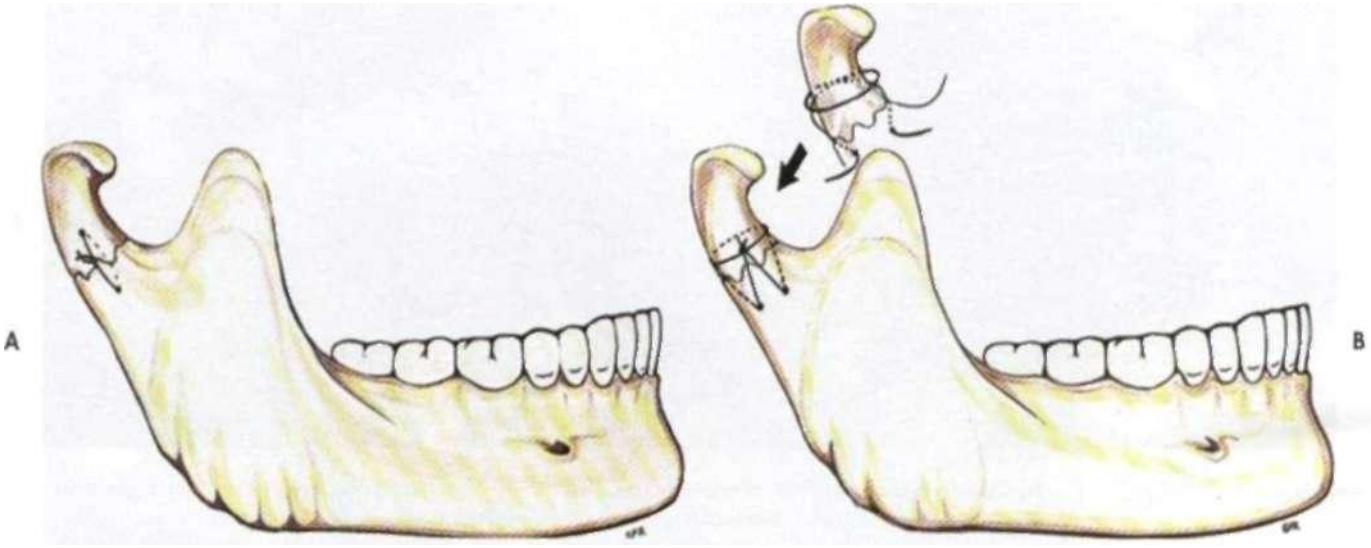
After the fracture site has been adequately exposed, the segments must be reduced to their preinjury position. In the case of minimal displacement, this reduction is accomplished by using a hemostat or other instrument to manipulate the proximal fragment into position. When the condylar segment is more significantly displaced or dislocated from the fossa, reduction becomes more difficult. Because of the pull of the lateral pterygoid muscle, the condylar fragment is usually located anterior and medial to the distal segment. Distraction of the mandible in an inferior direction by use of a clamp, towel clip, or stainless steel wire placed at the angle aids in visualizing and manipulating the condylar segment. The condylar segment is then grasped and reduced into its proper location on the mandibular ramus. Stewart and Bowerman suggest inserting a Moule pin into the condyle to assist in positioning this small fragment. Once the fragment is reduced and secured, the pin is removed before wound closure. With severe medial dislocation of high condylar fractures that cannot be adequately reduced with other methods, Mikkonen et al and Ellis et al recommend a submandibular approach for access to perform a vertical ramus osteotomy with subsequent removal of the posterior ramus. This technique allows increased access and visibility to the medially positioned condyle. The surgeon then grasps and removes the condylar fragment while keeping the capsule and disk intact. The posterior ramus and condyle are taken to the back table, where they are placed into proper anatomic relationship and secured obliquely with a 2.0-mm lag screw. The ramus-condyle is then treated as a free autogenous bone graft, returned to the field, and secured with two small bone plates.

FIG. 6-36



Panorex x-ray image showing a closed reduction for a nondisplaced subcondylar fracture.

FIG. 6.37



Various wiring techniques for condylar fractures. A, "Figure-of-eight" technique. B, "Circum-neck" technique. Stability is sometimes difficult to achieve with a single wire in froctures of a very thin condylar neck, and either circum-neck or figure-of-eight techniques can be helpful. (Fonseca RJ, Walker RV: ***Oral and maxillofacial trauma,*** ed 2, Philadelphia, 1997, WB Saunders.)

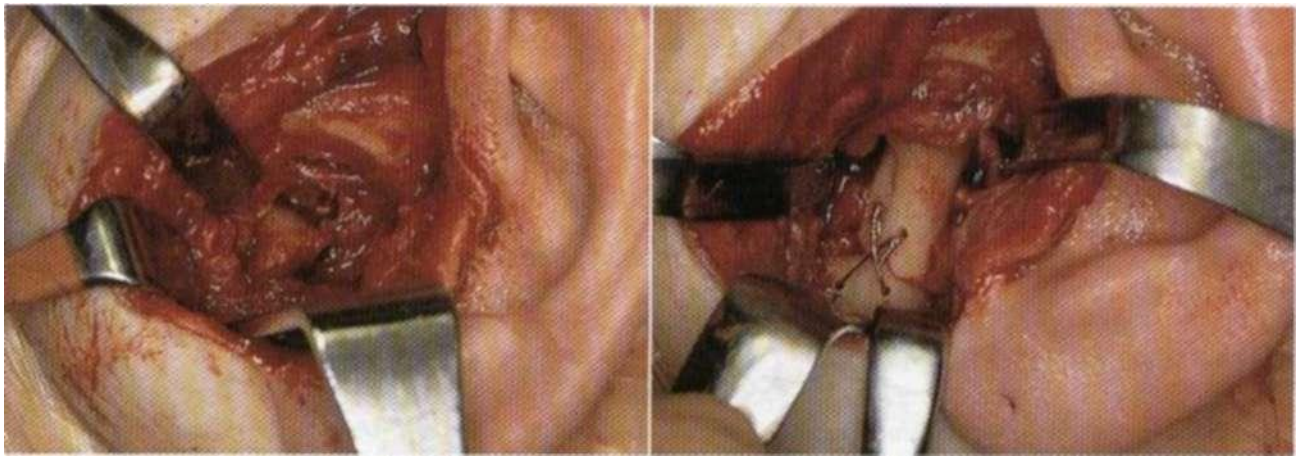
FIG. 6.38



CT scan of wiring technique for a condylar neck fracture. Wiring techniques usually dictate some overlapping of the distal and proximal segments to ensure adequate bone-to-bone contact. This can result in increased joint space with deviation on terminal opening.

FIG. 6-39

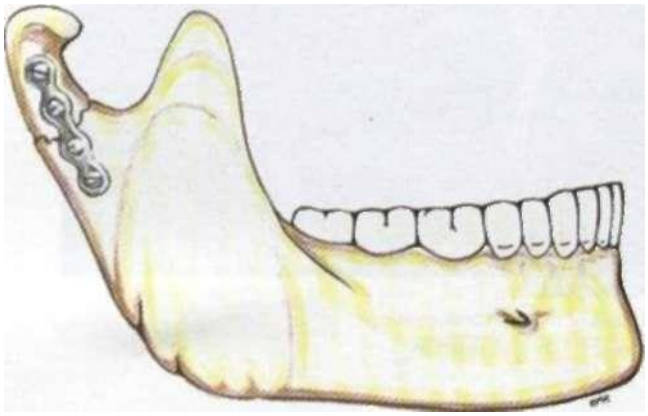
A



B

A, Open reduction of grossly displaced condylar fracture. Note that the condyle is at a right angle to the distal mandibular segment. The proximal fragment must be retrieved with care to prevent damage to the internal maxillary artery during repositioning. B, Figure-of-eight wiring technique to stabilize the fracture segments.

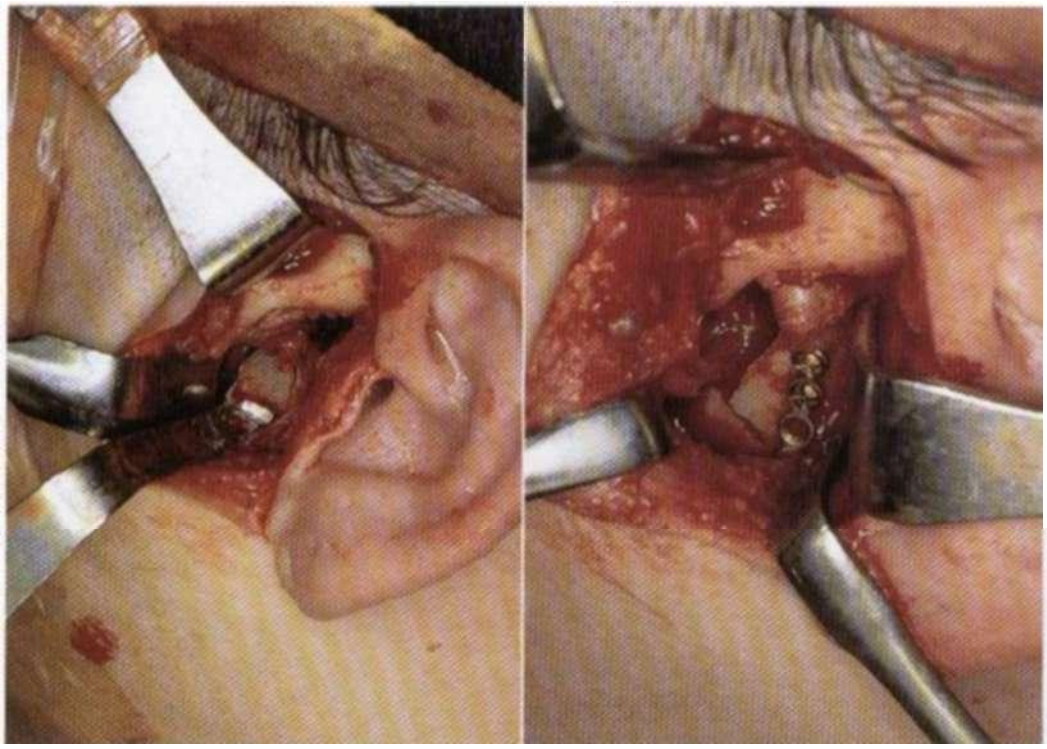
FIGS. 6.40, 6.41



Rigid fixation of condylar fracture. Note the presence of at least two screws in the distal and proximal fragments. (Fonseca RJ, Walker RV: ***Oral and maxillofacial trauma,*** ed 2, Philadelphia, 1997, WB Saunders.)



Rigid fixation (with a four-hole plate) of a condylar neck fracture. Note the wire at the posterior-inferior aspect of the fracture, which is used temporarily to align the fracture segments while the rigid fixation is applied. The wire may then be removed.



Open reduction with plole fixation of displaced condylar fractures.

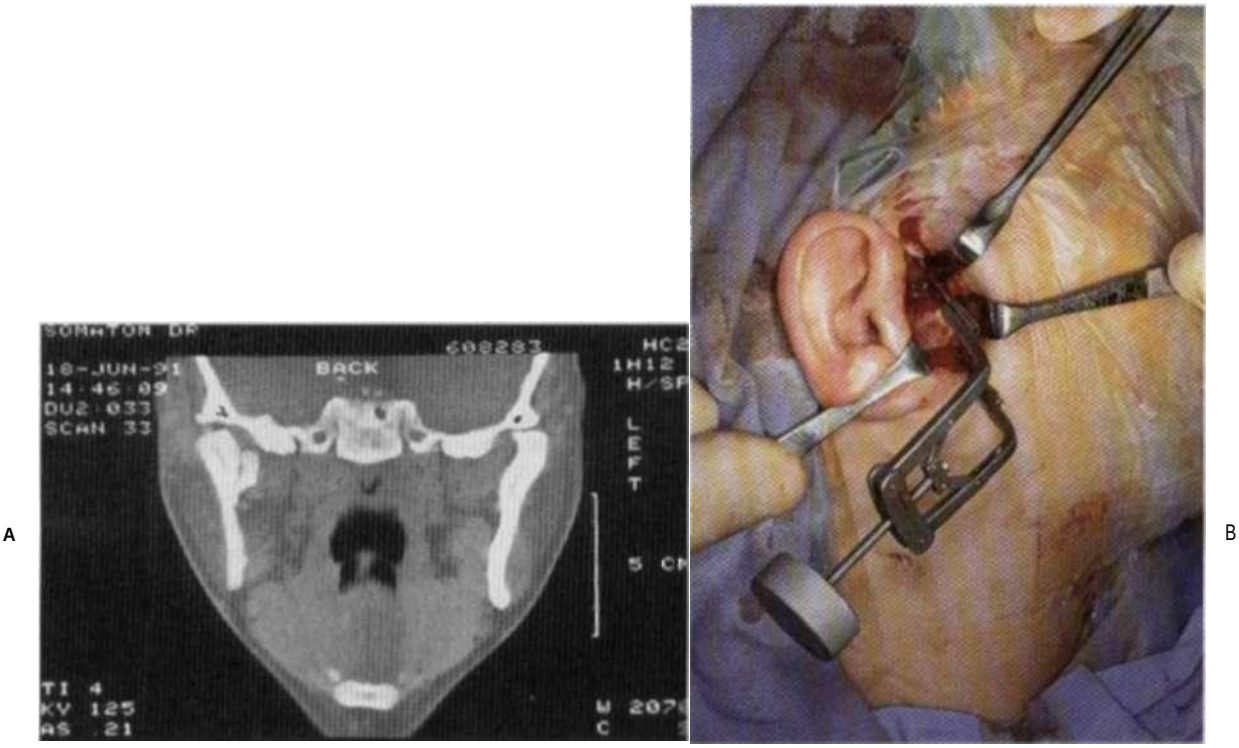
FIG. 6.42

The next step is the selection of a method of fixation to maintain the fracture segments in the reduced position. Some surgeons choose not to apply any fixation after reduction of the condyle. This is not advisable because the same muscular pull that caused the initial displacement or dislocation could again cause displacement of the reduced fragment.

Historically a wide variety of fixation techniques have been employed, including suture ligatures, external fixation, K wires, osteosynthesis wires, axial anchor screws, and rigid plates and screws. Because of advances in biomaterials, downsizing of hardware, and the availability of instrumentation in most operating rooms, rigid fixation with plates and screws is the most common technique. These plates afford stability in three dimensions, and placement can be accomplished through any of the surgical approaches. Percutaneous trocars have been developed to facilitate accurate screw placement in areas where access is difficult.

Text continued on p. 163

FIG. 6.43



A B

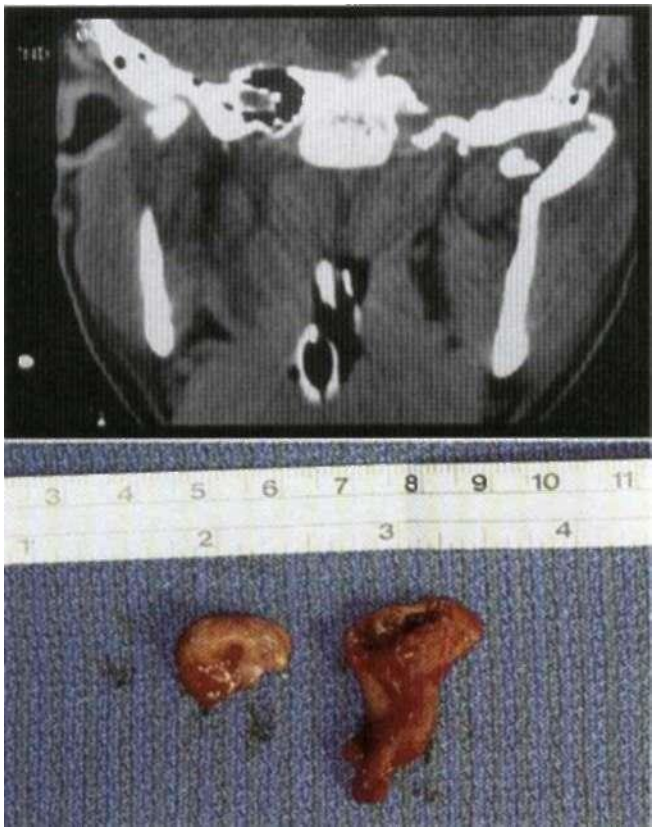
A, Coronal CT depicting a fragment from a previously undetected condylar fracture on the medial surface of the right condylar neck. The patient had been experiencing joint pain and a decreased range of motion. The fragment was not discernible by Panorex x-ray imaging; it appeared only by CT scanning. B, Open arthroplasty technique with distraction of condyle out of the fossa with a Wilkes' retractor to retrieve the displaced fragment.

FIG. 6-44



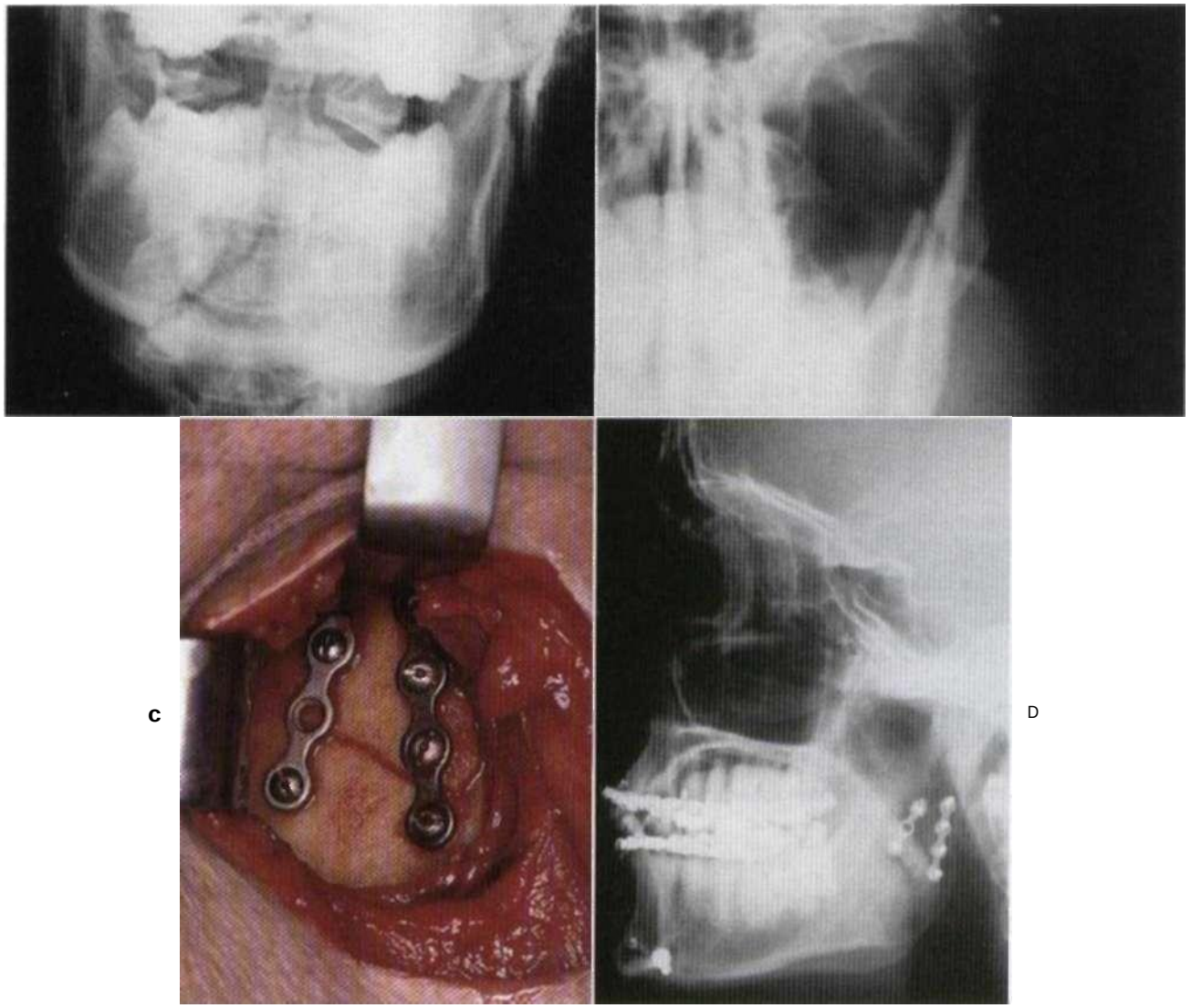
Fractured condyle that had been completely displaced from the glenoid fossa. Note level of fracture at the thinnest portion of the condylar neck.

FIG. 6*45



A, Coronal CT scan showing fragmentation of the condyle. B, Surgical specimen of irreparable condylar fragments (as depicted in Fig. 6-48, A).

FIG. 6.46



A, Right symphyseal fracture in combination with left subcondylar fracture. B, Transcranial view of condylar fracture. **C,** Posterior mandibular incision for rigid fixation of condylar-ramus fracture. D, Lateral skull film showing rigid fixation in place and intermaxillary fixation.

Continued

FIG. 6.46, CONT'D

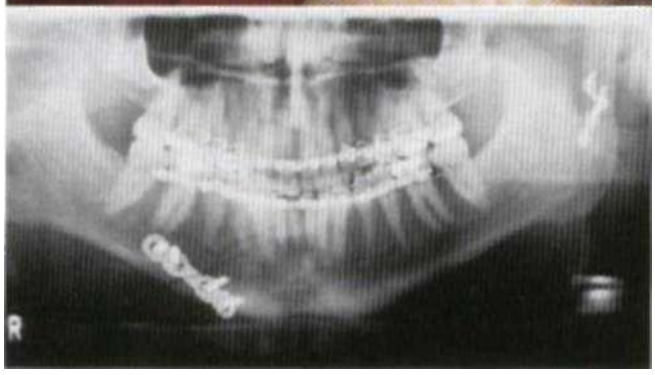
E



F

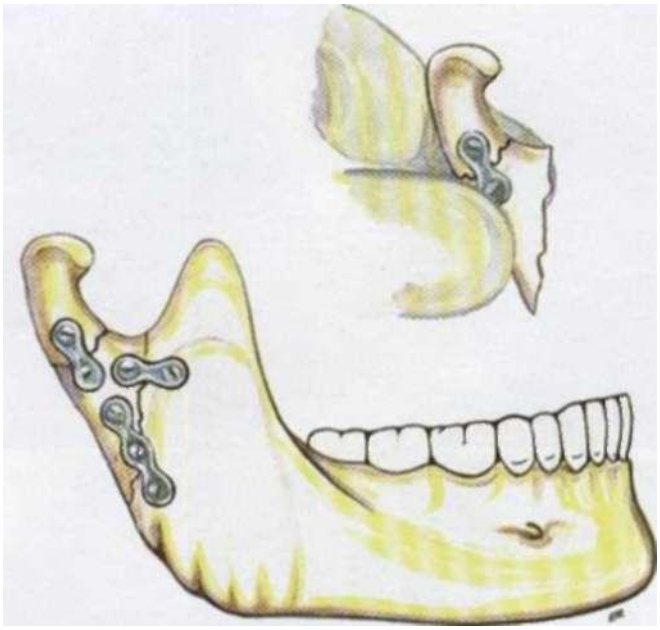


G



E, Palienl 6 weeks after open reduction of condylar-ramus fracture showing excellent cosmesis with posterior mandibular approach. Preoperative **(F)** and postoperative **(G)** Panorex x-ray images showing rigid fixation and intermaxillary fixation for combination body-condylar fracture. This allows for rigid fixation of the fractures with early mobilization.

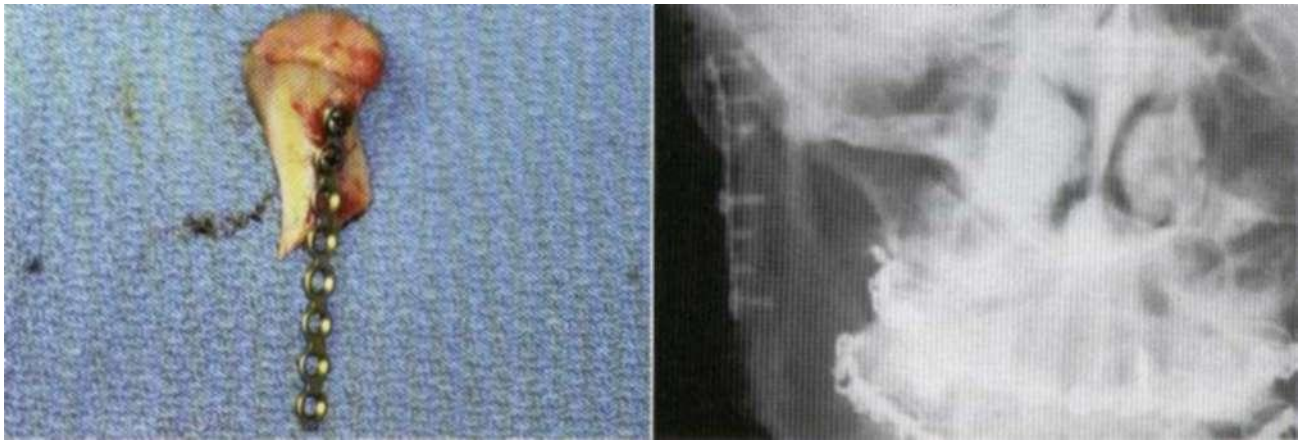
FIG. 6.47



Extraoral technique for complicated condylar fracture reduction with completely avulsed condylar segments in complex fracture patterns or fractures that are difficult to visualize. The rigid plate is placed on the proximal Iragment and reinserted into the wound through a posterior mandibular incision.

FIG. 6.48

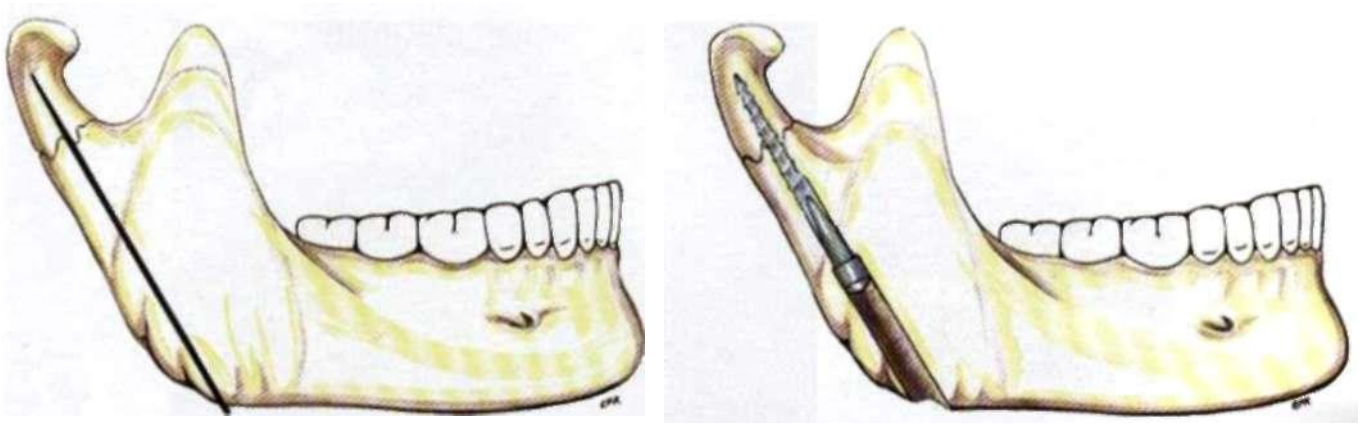
A



B

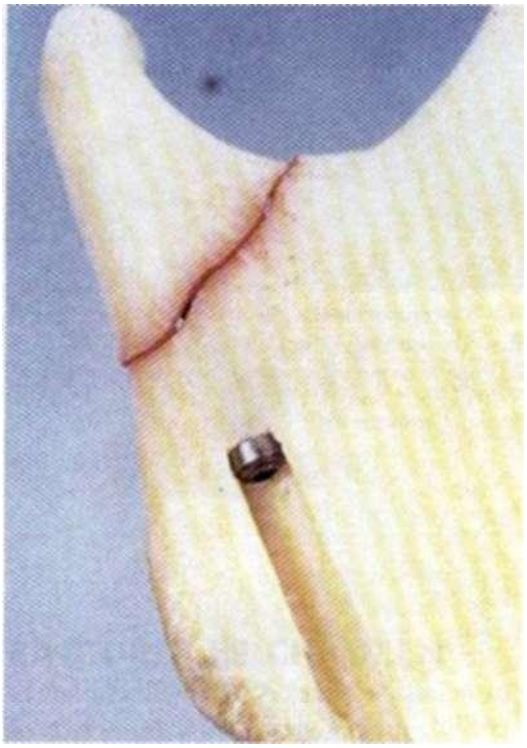
A, This fractured condyle was so grossly displaced from the fossa that it was almost completely severed from its soft tissue attachments. The superior screws were placed out of the body, and then the entire complex was inserted into its proper position from the posterior mandibular incision. This allowed better control over the final reduction and easier placement of the inferior screws. B, Postreduction anteroposterior skull film depicting proper positioning of condylar fragment.

FIG. 6.49



Various alternative techniques (or condylar fracture reduction: A, K-wire placed from inferior approach through body of posterior ramus for reduction of nondisplaced condylar fracture. B, Lag-screw-washer technique as advocated by Krenkel. (Fonseca RJ, Walker RV: ***Oral and maxillofacial trauma,*** ed 2, Philadelphia, 1997, WB Saunders.)

FIG. 6-50



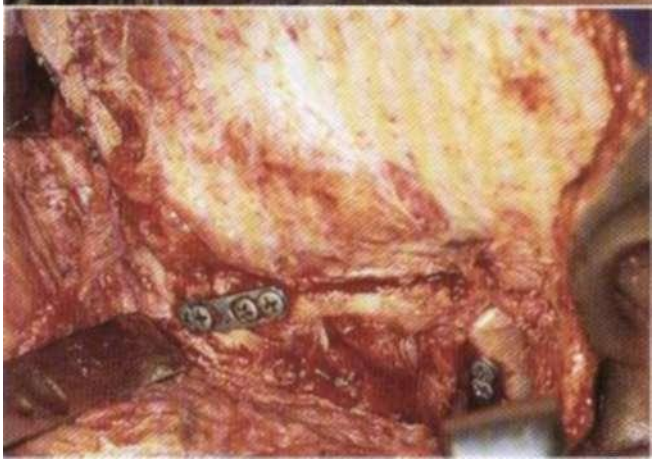
Example of the lag-screw technique for reducing condylar fractures as described by Krenkle. Note the bony channel that is drilled to allow perpendicular access to the plane of the fracture for screw placement.

FIG. 6.51

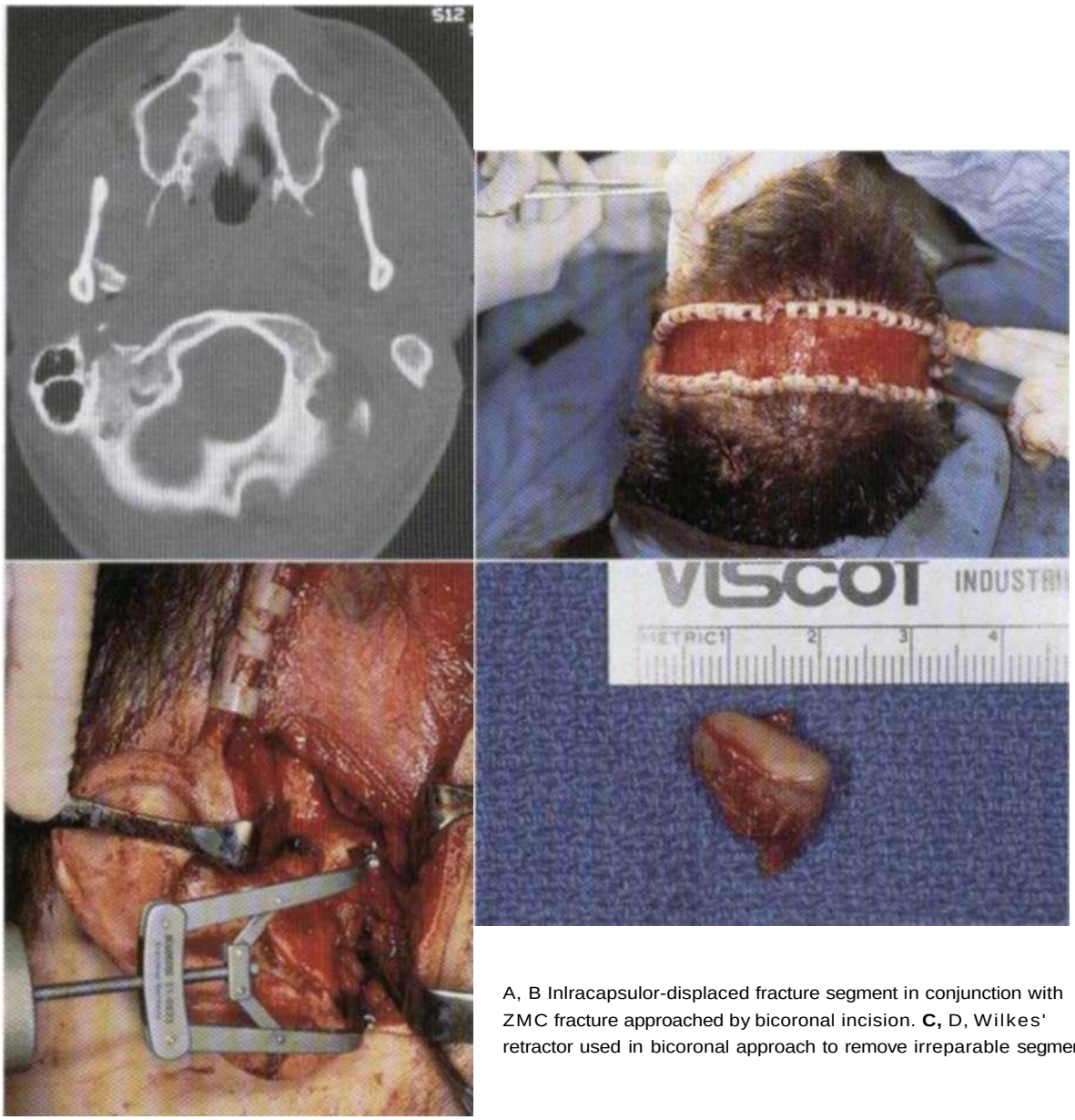
A



B



A, Bicoronal approach for midface and condylar trauma. The standard endaural-rhytideclomal incision can simply be extended from a bicoronal incision. B, Access to the temporomandibular joint in conjunction with a bicoronal incision. The subcondylar fracture plate is evident in the lower right. The plate in the middle portion of the photograph is on the zygomatic process of the maxilla.



A, B Inlracapsulor-displaced fracture segment in conjunction with ZMC fracture approached by bicoronal incision. **C,** D, Wilkes' retractor used in bicoronal approach to remove irreparable segment

FIG. 6.52

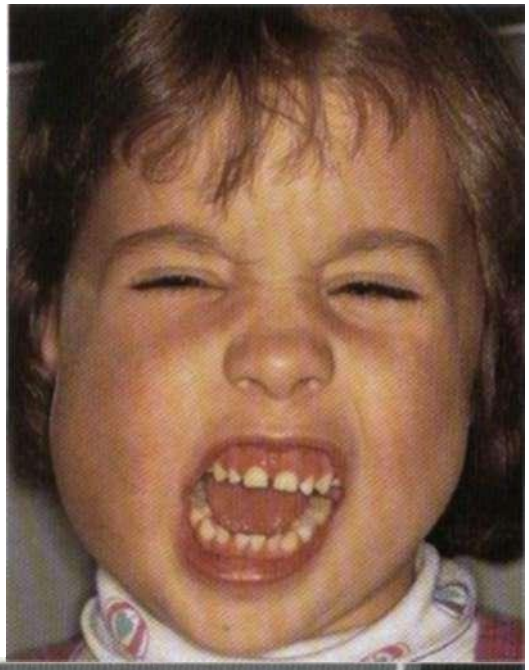
CONDYLAR FRACTURES IN CHILDREN

Condylar fractures in children involve mechanisms similar to those of adult injury. However, the incidence of condylar fracture among children is higher, reportedly between 40% and 60%. Falls from heights and bicycles are the most common causes of condylar fracture in children, with an incidence of between 30% and 50% of cases. Motor vehicle accidents are second in frequency (26% to 34%), followed by sports-related injuries (15%) and assault (3%). In most series, boys are affected more than girls by a ratio of 2 to 1. Carroll et al. also noted a seasonal variation in the number of fractures sustained by children; not surprisingly, the increase occurred during the summer months, when children are more active outdoors.

Condylar fractures are more difficult to detect in children. First, children with acute injuries are often frightened and intimidated by the busy emergency room and doctors who often are unused to dealing with children. Second, children are less able to convey subjective symptoms of their injuries. Finally, physical and radiographic examination is often very difficult. Children are frequently uncooperative, making the detection of an already subtle injury even more difficult. The advent of more rapid CT scanners and the use of sedation techniques have simplified the radiographic examination somewhat. The signs and symptoms of condylar fracture in children are similar to those of adults.

Numerous studies have examined the effects of condylar fractures on the masticatory system, growth, and facial aesthetics. The Chalmers J. Lyons Academy, MacLennan, Blevins and Gores, I.indahl, Lund, and several animal studies conducted by Walker and Boyne are several of the more notable. The conclusions reached by these authors confirm the concept that regardless of the type of injury, the degree of fracture displacement, or the specific treatment used, children have an incredible ability to regenerate a morphologically, anatomically, and functionally normal condylar articulation. Moreover, the younger the individual (up to approximately 12 years of age), the more complete and rapid the restitution of the condyle. In adolescents the potential for significant regeneration and remodeling is present but to a lesser degree than in younger children. These authors also overwhelmingly support the use of conservative measures in the treatment of these injuries, with a very brief period of intermaxillary fixation (approximately 7 to 10 days) being common. This is followed by active movement of the joint, which reduces the formation of scar tissue and prevents ankylosis. These studies also confirm the paucity of clinically significant signs or symptoms of masticatory dysfunction after fracture healing. As with adults (and possibly more important), a closely supervised follow-up program is an absolute requirement because growing children face an increased risk of ankylosis and growth disturbance with resultant facial asymmetry.

FIG. 6.53



A



B



C

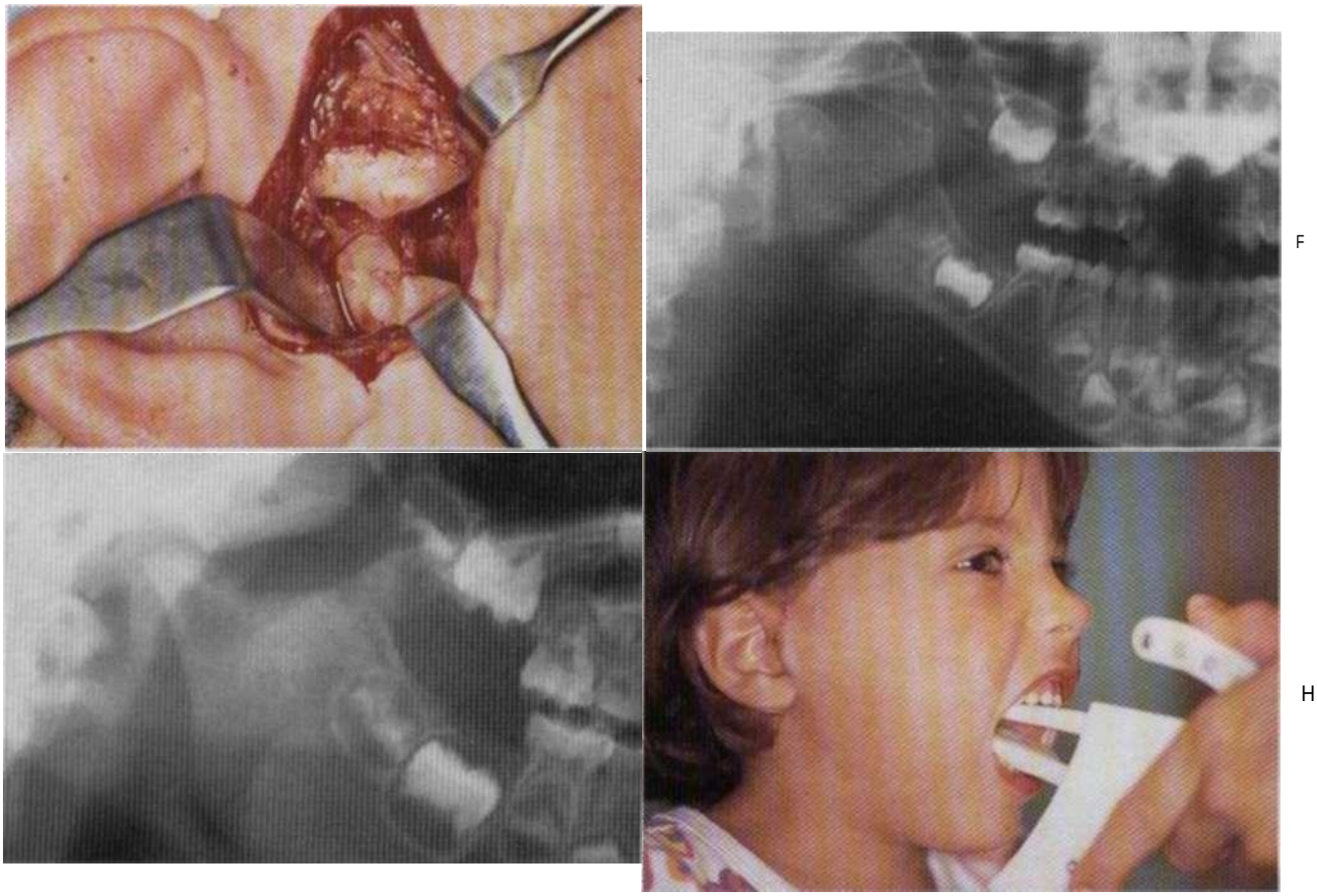


D

A, A 5-yearold girl with deviation to the right side secondary to an untreated condylar fracture. **B,** Axial CT scan of same girl. Note radiopacity anterior to condylar stump on the left joint. This represents fusion of the proximal fracture segment to the articular eminence. **C,** Coronal CT scan showing position of fracture segment fused to articular eminence. **D,** Open arthroplastc view showing fusion of condyle and coronoid notch to eminence and increased range of motion of the condyle after removal of the bony obstruction.

Continued

FIG. 6.53, CONT'D



E, Another open arlhroplastic view showing fusion of condyle and coronoid notch to eminence and increased range of motion of the condyle after removal of the bony obstruction. **F,** Panorex x-ray film showing posttraumatic ankylosis of left condyle. Note fusion of coronoid process to the articular eminence. **G,** Postsurgical panorex x-ray image of patient in **F** showing increased joint space secondary to removal of bony fragment between articular eminence and coronoid notch. **H,** Parent using jaw exerciser after removal of displaced condylar fracture segment with lysis of adhesions. Note placement of modified rhytidectomy incision on right side.

FIG. 6.54



A



B



C



D



E

A, A 5-year-old girl with grossly displaced left condylar fracture. Note symphyseal abrasion secondary to a blunt injury. **B,** Towne's view of left condylar fracture. Note the condyle is medially displaced at a 90-degree angle, but green sticking of the medial cortex prevents complete displacement of the condyle out of the glenoid fossa. **C,** MRI depicting gross displacement of condylar fracture in 5-year-old girl. Note the complete separation of the cortical plate on the lateral surface and green sticking of the medial cortical plate. The meniscus can be visualized in a relatively normal position suspended in the joint space. This fracture was manually reduced by making a sagittal split type of incision intraorally to manually push the condylar segment bock into the fossa. **D,** Anterior nasal spine wire for skeletal fixation of condyle fracture in 5-year-old patient. **E,** Skeletal fixation using a single circum-mandibular wire and an anterior nasal spine wire connected by an interpositional loop of wire that is 1 gauge smaller than the skeletal wires.

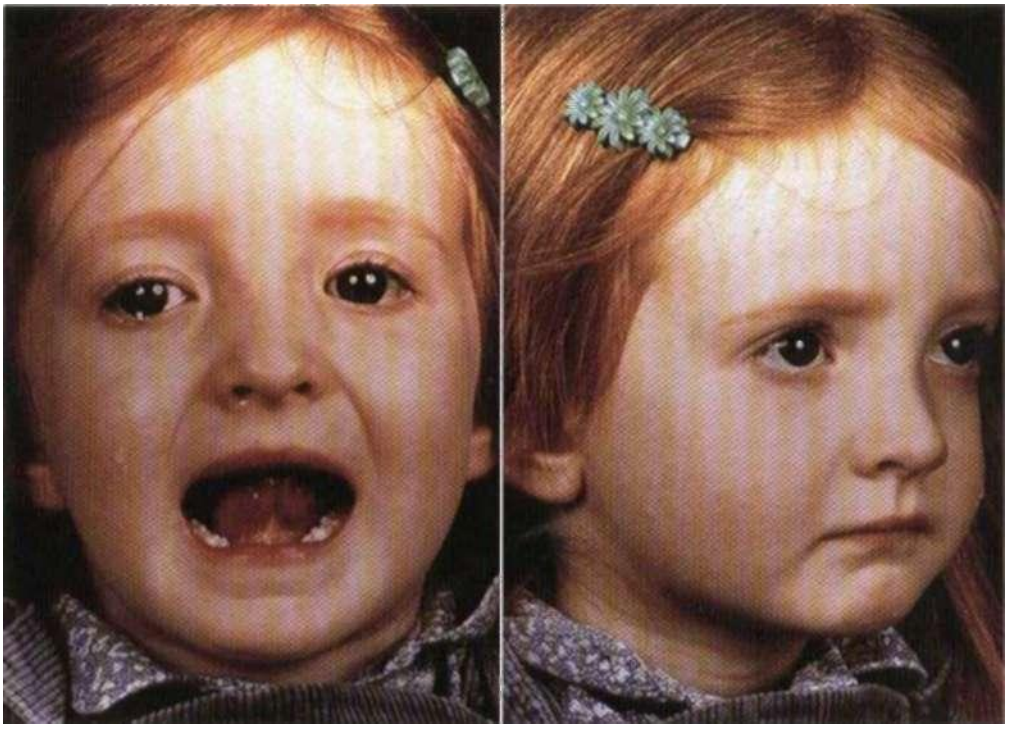
FIG. 6.55



A, A 4-year-old girl with panfacial injuries from blunt vehicular injury. Note symphyseal laceration. B, Lateral view of same patient. Patient sustained bilateral condylar fractures with resultant retrognathia. **C,** Lateral view of a 5-year-old girl with bilateral condylar fractures. Note use of a pediatric sports face mask to allow anterior traction. The child had also sustained a Le Fort fracture, which precluded using the maxilla for intermaxillary fixation.

Continued

D



E

D, A 5-year-old girl after reduction of bilateral condylar fractures by external distraction. Note that the mandibular range of motion is within acceptable limits. Also note that she exhibits epiphora secondary to traumatic obstruction of the right nasolacrimal duct. **E,** After reduction of bilateral condylar fractures. An extracranial halo appliance was used for simultaneous anterior distraction and reduction of Le Fori and bilateral condylar fractures.

FIG. 6.55, CONT'D

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CHAPTER SEVEN

AUTOGENOUS AND ALLOPLASTIC RECONSTRUCTION OF THE TEMPOROMANDIBULAR JOINT

Reconstruction of the temporomandibular joint can be a vexing problem. Currently the accepted indications for joint reconstruction are as follows:

- Severe degenerative joint disease
- Recurrent ankylosis
- Irreparable condyle fracture
- Avascular necrosis
- Neoplasia requiring extensive resection
- Congenital disorders (e.g., hemifacial microsomia, Treacher Collins syndrome)

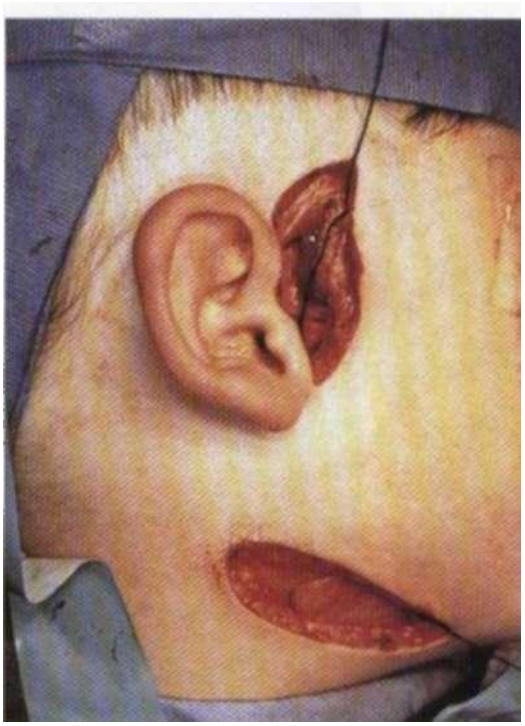
A predictably successful autogenous joint replacement would obviously be the procedure of choice rather than an alloplastic implant. An autogenous joint replacement obviates the need for the inevitable revision surgeries indicated for currently available alloplastic replacements. Autogenous joint replacement, particularly costochondral grafts, are always preferred for growing patients. The chief disadvantages associated with autogenous grafts are donor-site morbidity and the variability of biologic responses (e.g., resorption, ankylosis, excessive growth). Autogenous tissues used to reconstruct the temporomandibular joint include rib grafts (costochondral), iliac crest, sternoclavicular, and metacarpal joints. Use of costochondral grafts in both pediatric and adult patients has been extensively documented in the literature. The costochondral graft is most adaptable to the temporomandibular joint because of its native dimensions. Its cartilaginous cap is composed of hyaline cartilage rather than fibrocartilage, but it appears to withstand the biomechanical stresses of joint function relatively well. The current indications for the use of a costochondral graft include the following:

- Congenital joint deformaties (e.g., aplasia, hypoplasia)
- Irreparable condylar trauma
- Recurrent ankylosis
- Status postneoplasia resection
- Advanced osteoarthritis or rheumatoid arthritis
- Failed alloplastic implants
- Multiple failed arthroplastic procedures

Costochondral grafts can be expected to grow spontaneously in pediatric patients (i.e., those less then 15 years of age). Anklyosis of costochondral grafts is rare in the pediatric age group but can be problematic in adult patients, especially those who have undergone multiple operations with extensive fibrosis at the recipient site; in these patients the risk of heterotopic bone formation is high.

A

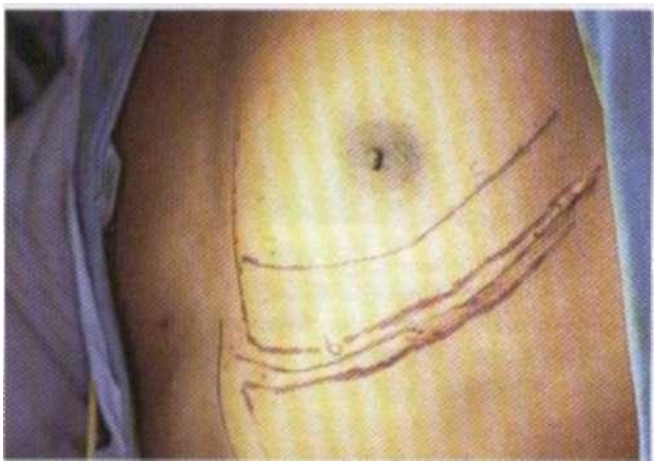




B

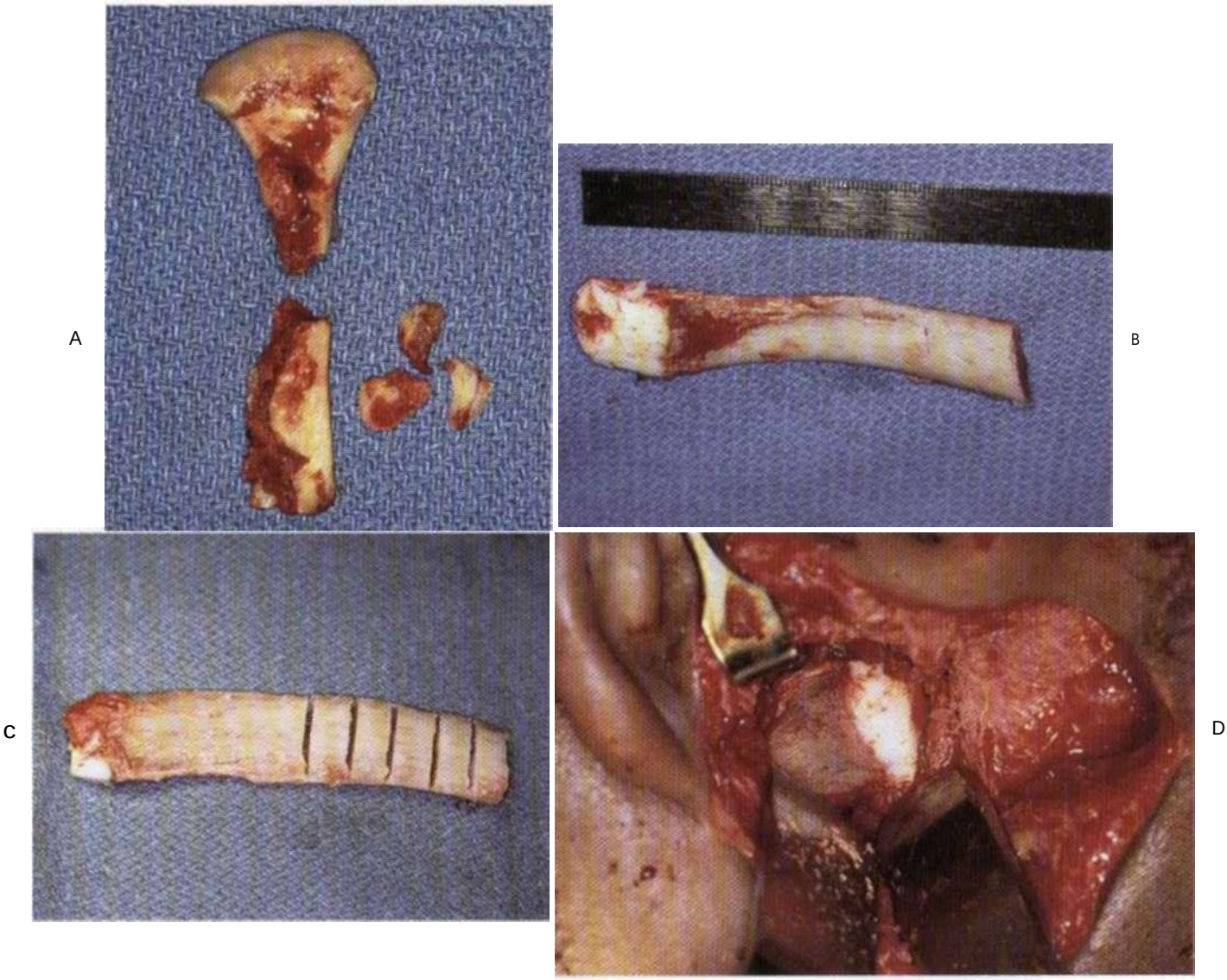
A, Coslochondral graft after the hyaline cartilage has been carved to leave approximately a I-cm cap of cartilage. B, A 5-year-old patient showing extensive incisions for placement of costochondral graft.

FIG. 7.2

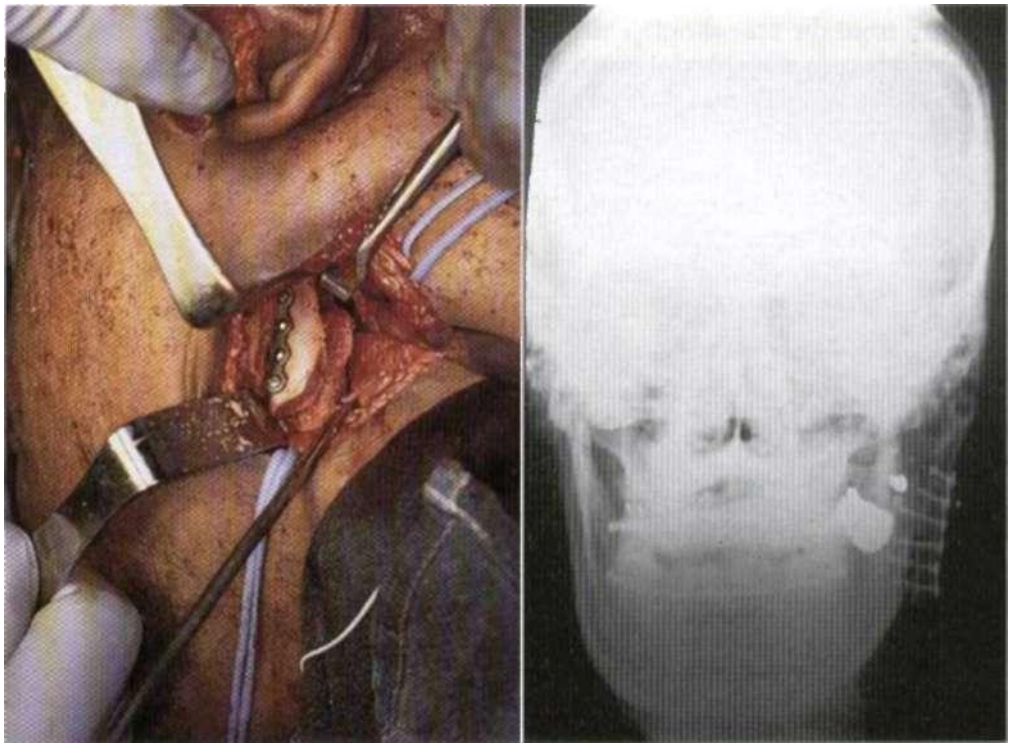


A skin marker used to indicate position of sixth rib on contralateral side before harvesting. Note relative position to areolar markings. This is of special import in female patients because an attempt is made to place the incision for rib harvesting in the inframammary fold.

FIG. 7.3



A, Multiple fragments of irreparable condylar fracture secondary to bullet wound injury. **B, C,** Costochondral graft after harvesting that shows scoring of the surface. This allows for some bending to optimize conformity of the rib with the lateral ramus. **D,** Endaural incision showing placement of costochondral graft into glenoid fossa. Note that the costal cartilage is contoured with a #15 blade to simulate the space of the natural condyle. The cartilage is approximately 8 to 10 mm in its midpoint dimension.



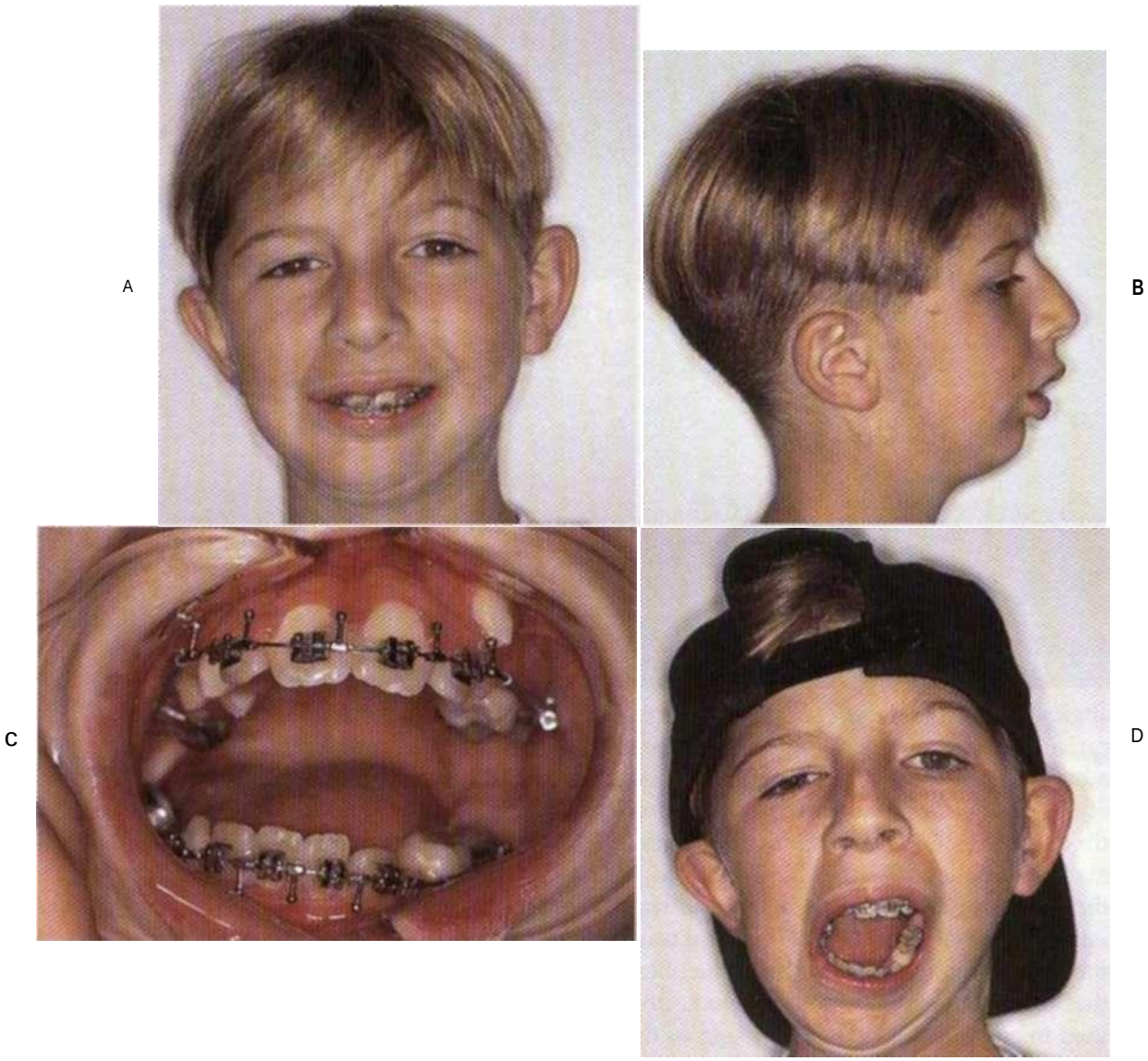
E, Posterior mandibular incision showing excellent access to the posterior ramus with four-hole plate being used to fixate the costochondral graft to the lateral ramus. **F,** Anterior-posterior film showing rigid fixation used to secure costochondral graft to lateral ramus.

FIG. 7.3, CONT'D

In most cases, the contralateral rib is harvested for joint reconstruction. The ribs most commonly used for joint reconstruction are the fifth, sixth, and seventh ribs. The rib is harvested through a horizontal incision in the inframammary fold. If two ribs are needed, they should be harvested on the same side (e.g., the fourth and sixth ribs or fifth and seventh ribs) to prevent bilateral pneumothorax. Ribs from the ipsilateral side require more contouring because they do not have the ideal angulation. After dissecting through skin and subcutaneous tissue, the surgeon carefully excises the periosteum on the undersurface of the rib to prevent a pneumothorax. Leaving a strip of periosteum and perichondrium overlying the junction of the rib and the costal cartilage helps prevent separation of the cartilage from the rib during function. Approximately 1 cm of cartilage and 3 to 4 cm of bone is normally sufficient. After the rib is removed, the wound can be filled with saline and the anesthesiologist can maximally inflate the lungs to look for bubbling in the saline, an initial indication of a pleural tear. Small pleural tears can be closed at that time. An upright chest film should be obtained immediately after surgery to ensure that pneumothorax has not occurred. Once the rib is harvested, a scalpel blade is used to contour the hyaline cartilage so that it simulates the shape of the condylar head and fits in the fossa as well as possible. Decorticating the graft or the medial surface of the ramus is unnecessary. The graft can be secured to either the lateral ramus or the posterior ramus with circumferential wires, bone screws, or a combination of plates and screws. The surgeon should be careful not to tighten the screws excessively because this can induce a longitudinal fracture in the rib. A small fixation plate is sometimes used with the screws to act as a "washer," dispersing the

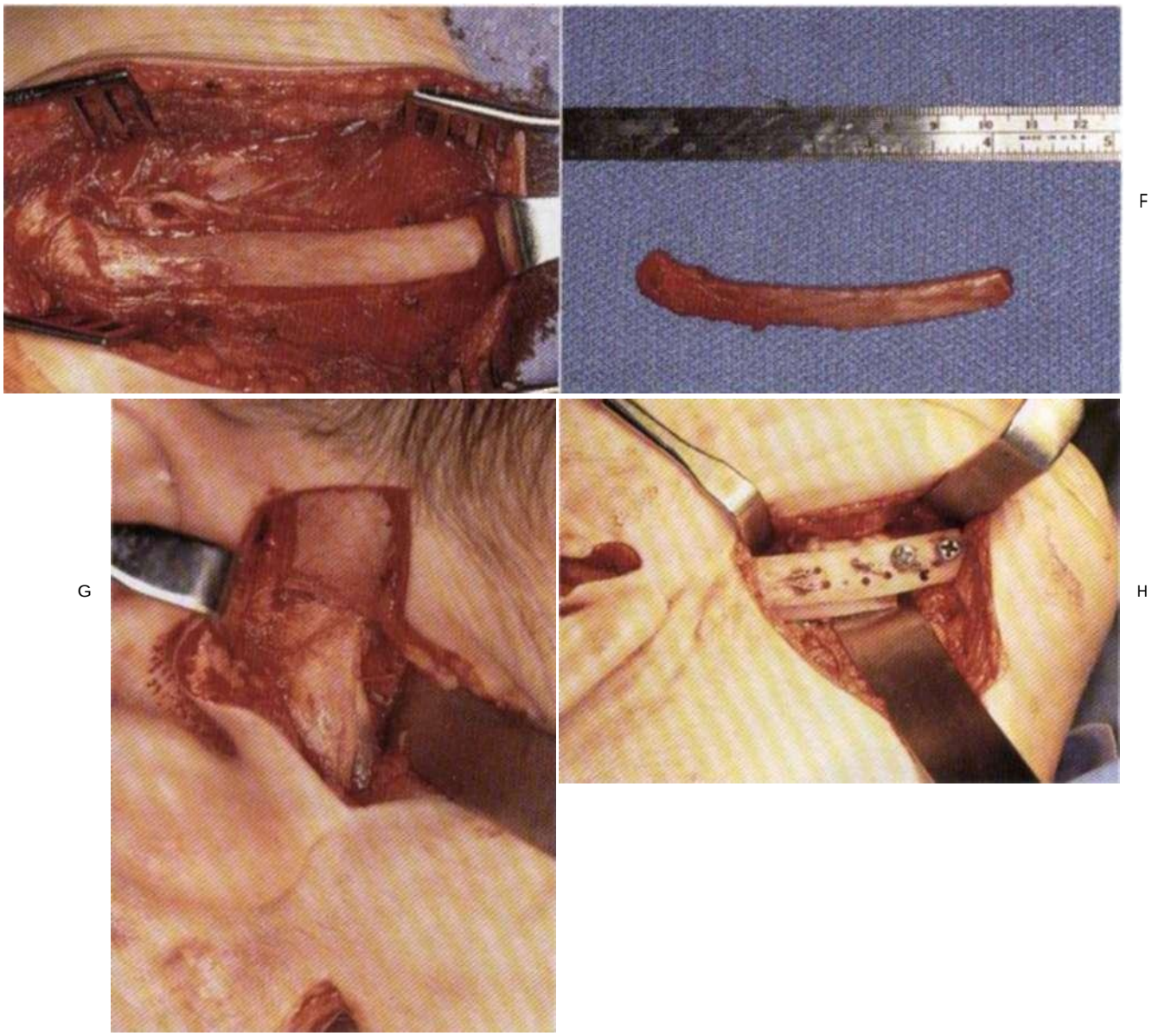
pressure from the screwhead. The superior-lateral edge of the condylectomy margin should be contoured so that the rib is not displaced laterally by ramal bone. A combination of an endaural incision and a posterior mandibular incision is necessary to properly position and secure the rib graft. Intermaxillary fixation is necessary to allow for initial consolidation of the graft and usually appropriate for a period of 4 to 6 weeks. In addition, most clinicians use an acrylic splint that opens the vertical dimension 2 to 3 mm to prevent early loading of the costochondral graft. Conversely, because prolonged intermaxillary fixation can lead to early ankylosis of the graft, several authors recommend that dermal or temporomyofascial grafts be used in concert with the costochondral graft.

FIG. 7.4



A, Frontal view of 9-year-old boy after ligation of a high-Row arteriovenous malformation in the condyle-ramus region. **B,** Lateral view of same patient with marked condylar-ramal deficiency. **C, D,** Open-mouth view of same patient with a marked mandibular deficiency secondary to bony destruction of condyle-ramus complex from a high-flow arteriovenous malformation.

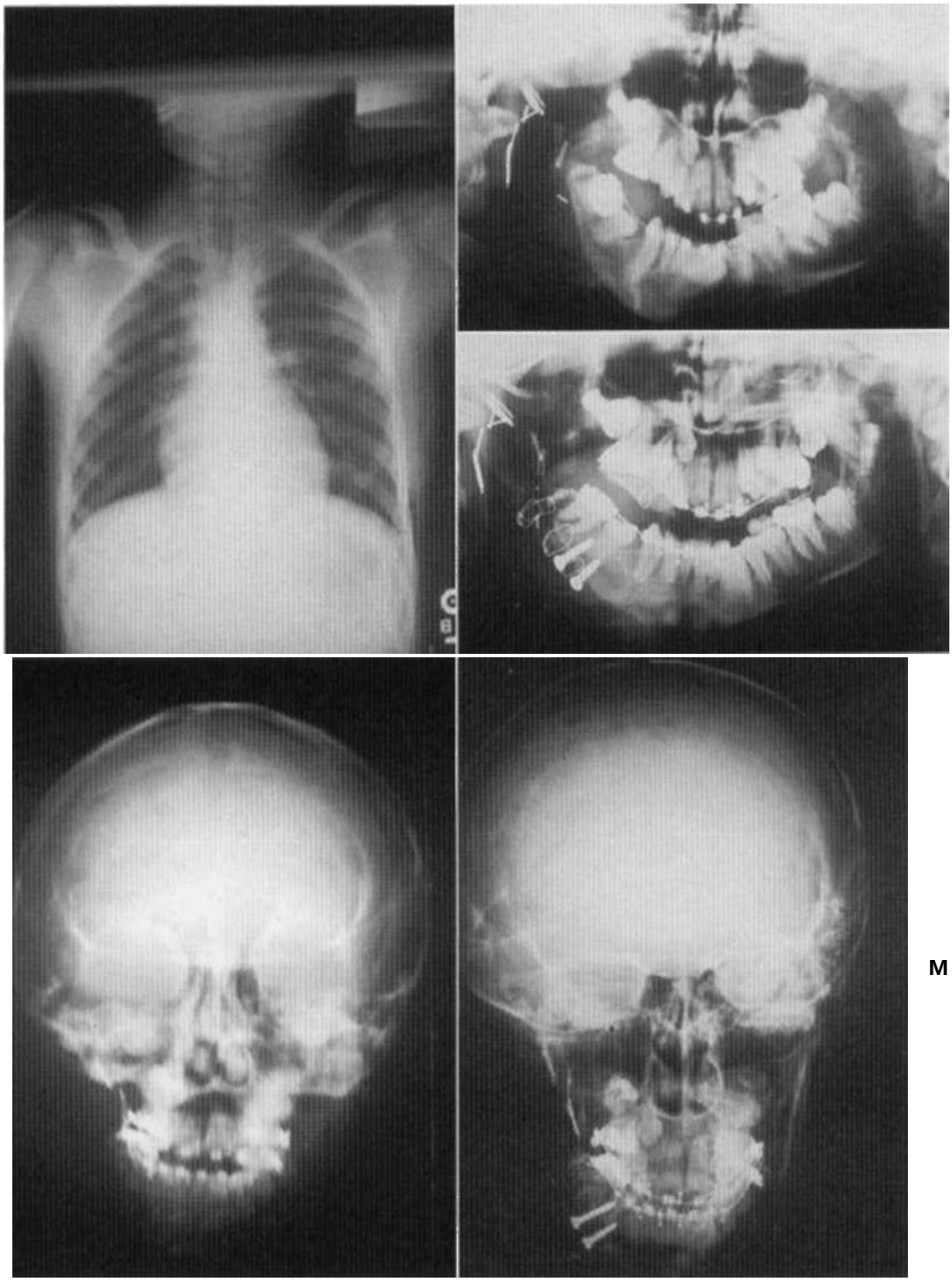
FIG. 7.4, CONT'D



E, Harvesting of the fifth rib on the contralateral side. Note the attempt to retain the perichondrium over the surface of the harvested rib at the junctior of the bony rib and the costal cartilage. This helps reduce the incidence of spontaneous separation at the junction point. **F,** Costochondral graft harvested from contralateral side. **G,** Lateral view of the costochondral graft in place. Note again that the perichondrium is used to provide a cap to cover the graft, preventing potential ankylosis. **H,** "Double-slacked" costochondral graft being secured to mandibular body.

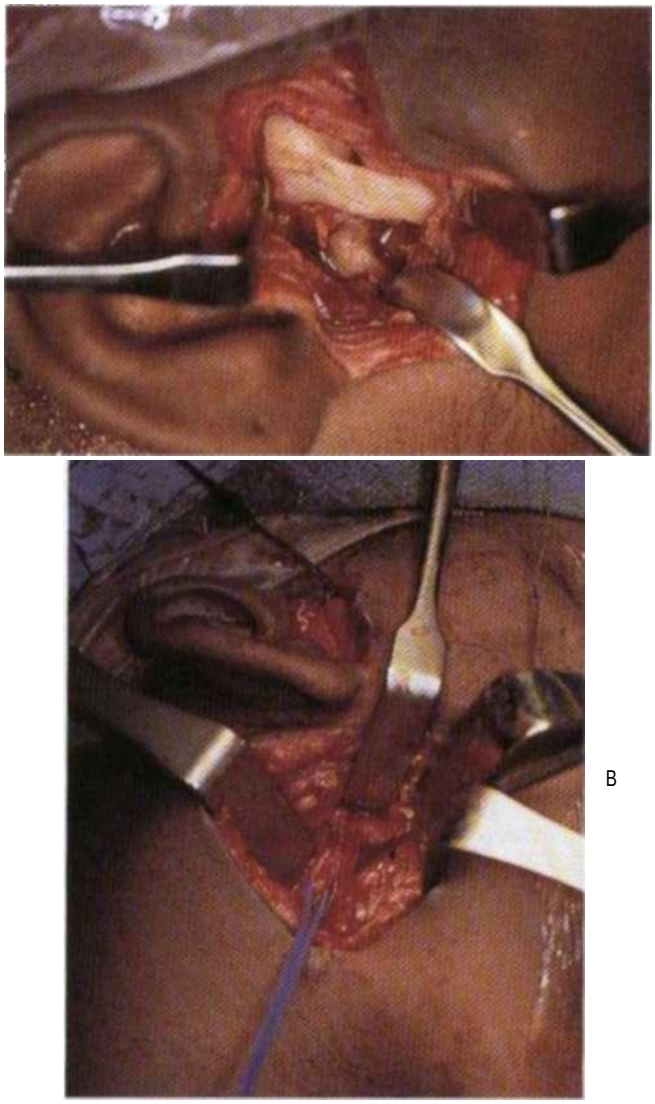
Continued

FIG. 7-4, CONT'D



I, Postoperative chest x-ray film taken immediately in recovery room to ensure that no pneumothorax resulted from costochondral ha-vesting. Preoperative (J) and postoperative (K) panorex films showing placement of costochondral graft to the right side of the body and the ramus. Note the acrylic wedge appliance used postoperatively that opens the bite on the shortened side and unloads the costochondral graft for a 4- to 6-week period after placement. Preoperative (L) and postoperative (M) anterior-posterior skull films.

FIG. 7.5



A, Open orthroplastic view of ankylosed joint in 9-year-old girl. Brisk hemorrhage occurred during the attempt to perform gap arthroplasty before rib grafting. B, After local attempts failed to slow the hemorrhage, the right external carotid artery was identified and clamped. While the external carotid artery was clamped, the gap arthroplasty was completed without incident.

Theoretically a successful alloplastic prosthesis for joint replacement would offer the following advantages for the adult patient:

- Lack of donor-site morbidity
- Occlusal stability (compared with autogenous grafts, which have variable resorption rates)
- No need for intermaxillary fixation
- Early range of motion with attendant dietary improvement
- Decreased risk of ankylosis from heterotopic bone formation
- Decreased surgical and anesthetic time

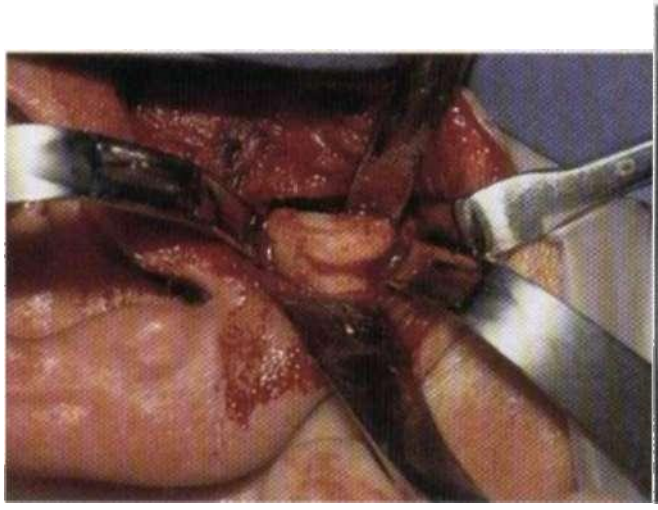
FIG. 7.6

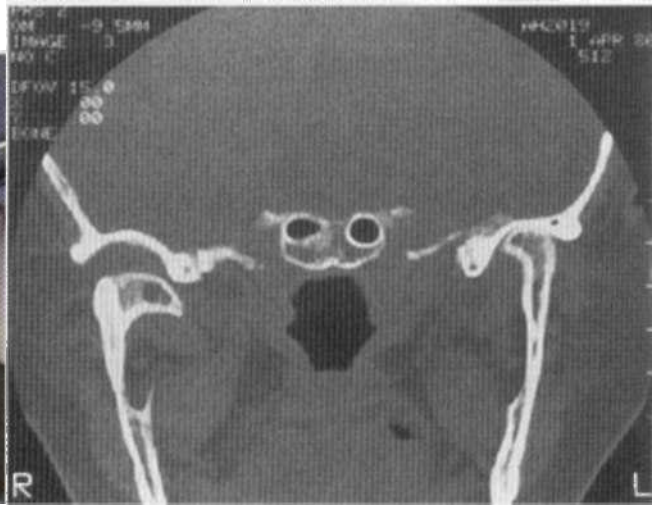


Alloplastic condylar prostheses. ***Left to right:*** Kent-Vitek, Synthes, Delrin-Timesh, Type I-Christensen, Type II-Christensen, and Biomel-Lorenz.

FIG. 7 7

A





B

A, Grossly deformed condylar head secondary to untreated fracture. This is an indication for total prosthetic joint replacement. B, Malunited, deformed condylar head in coronal CT scan.

The unique mechanics of the temporomandibular joint and its proximity to the temporal lobe of the brain make fitting a stock prosthesis difficult. Custom-designed prostheses generated from Cad-Cam technology offer clear advantages, but they arc costlier. These custom prostheses are especially useful in adult patients who have undergone multiple operations in which autogenous grafts have failed.

Initially, alloplastic materials were used almost exclusively for recurrent ankylosis. Eggers used tantalum foil in 1946 as an interpositional implant. In 1960, Robinson used a stainless-steel fossa prosthesis and Christensen used an array of cast Vitallium fossae that were secured to the zygomatic arch.

FIG. 7.8

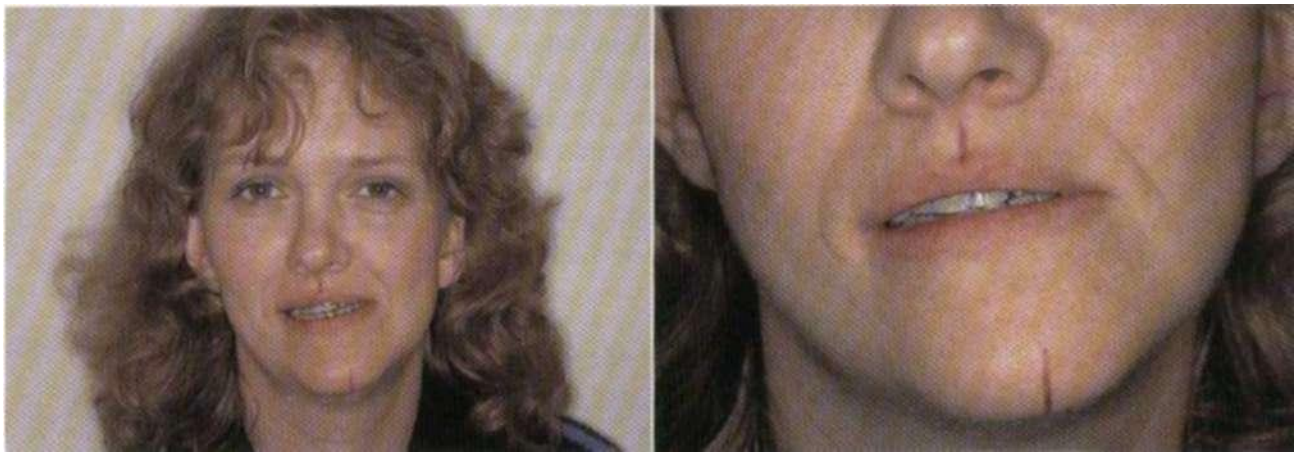


A

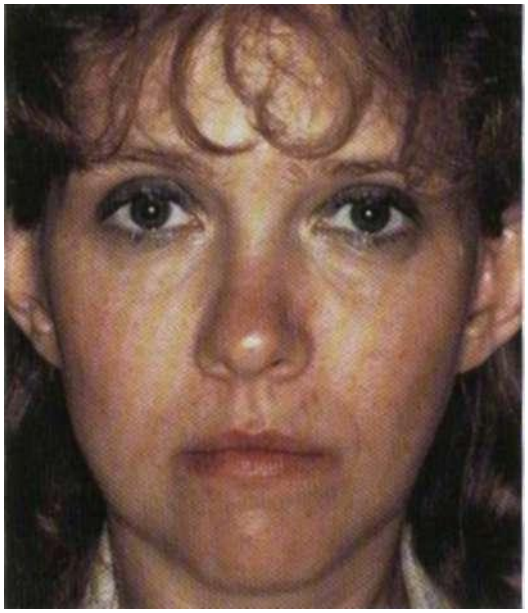
B

Axial **(A)** and coronal **(B)** CT scans showing Iraumatically induced ankylosis of the right mandibular joint. This is an indication for total alloplastic joint replacement.

FIG. 7.9



A B



C

A, B, A 35-year-old women with marked facial asymmetry secondary to undetected early condylar injury. **C,** After total left alloplaslic joint reconstruction with simultaneous Le Fort-I osteotomy.



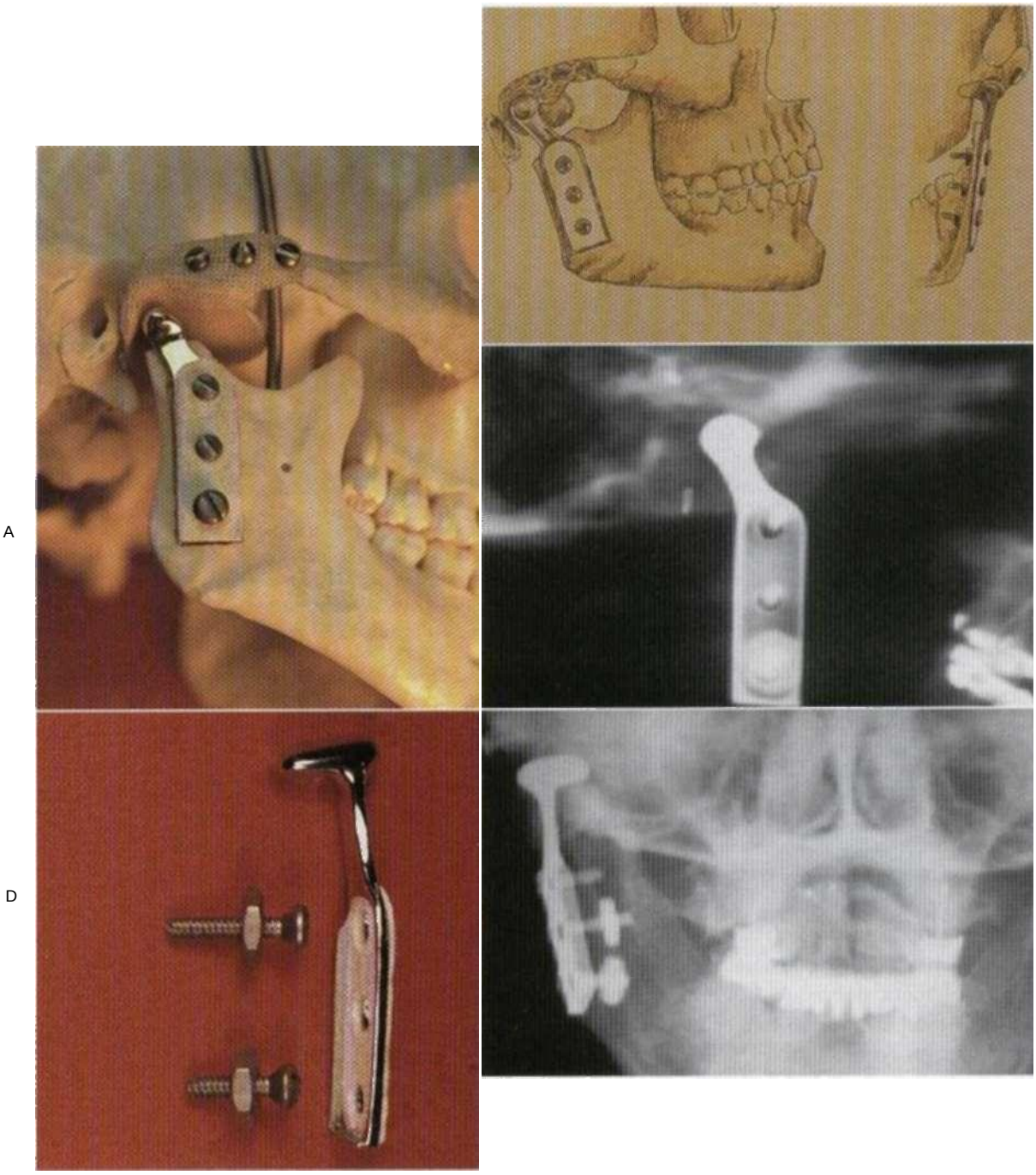
A, Patient with parafunctional habit displaying marked hypertrophy of masseter muscles. This results not only in hyperplasia of the muscle but also in a "lipping" of the inferior border of the mandible at the site of insertion of the masseter. **B,** MRI of same patient showing marked hypertrophy of masseter muscles with thickening of the inferior border and flaring at the site of the tendinous attachment of the masseter muscle. Alloplastic or autogenous joint replacements in patients with muscle hyperfunction have higher failure rates.

FIG. 7.10

Although several attempts were made to create a condylar prosthesis, the most commonly used ones were the AO-ASIF prostheses marketed by Synthes. This type of prosthesis was essentially an extended reconstruction plate with a rounded condylar head. It was used without a matching glenoid fossa implant. Surgeons did use the prosthesis in combination with a Kent-Vitek (K-V) fossa. The K-V fossa was developed in concert with the K-V condylar prosthesis. Because both these components used Proplast as a laminant, they were prone to foreign-body reaction from polymeric debris. Although several authors reported long-term successes with the K-V system, it is no longer manufactured, largely because of problems associated with polytetrafluoroethylene. When removing this implant system, surgeons should be aware that the ramal prosthesis was secured with a bolt-and-nut fixation, with the nuts being placed on the medial surface of the inferior ramus. Surgeons must be especially careful to remove all the Proplast, both from the superior surface of the fossa implant and from the medial surface of the condylar strut.

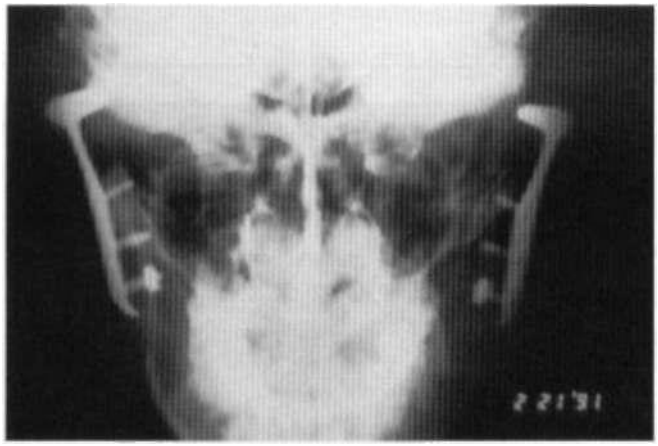
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FIG. 7.11



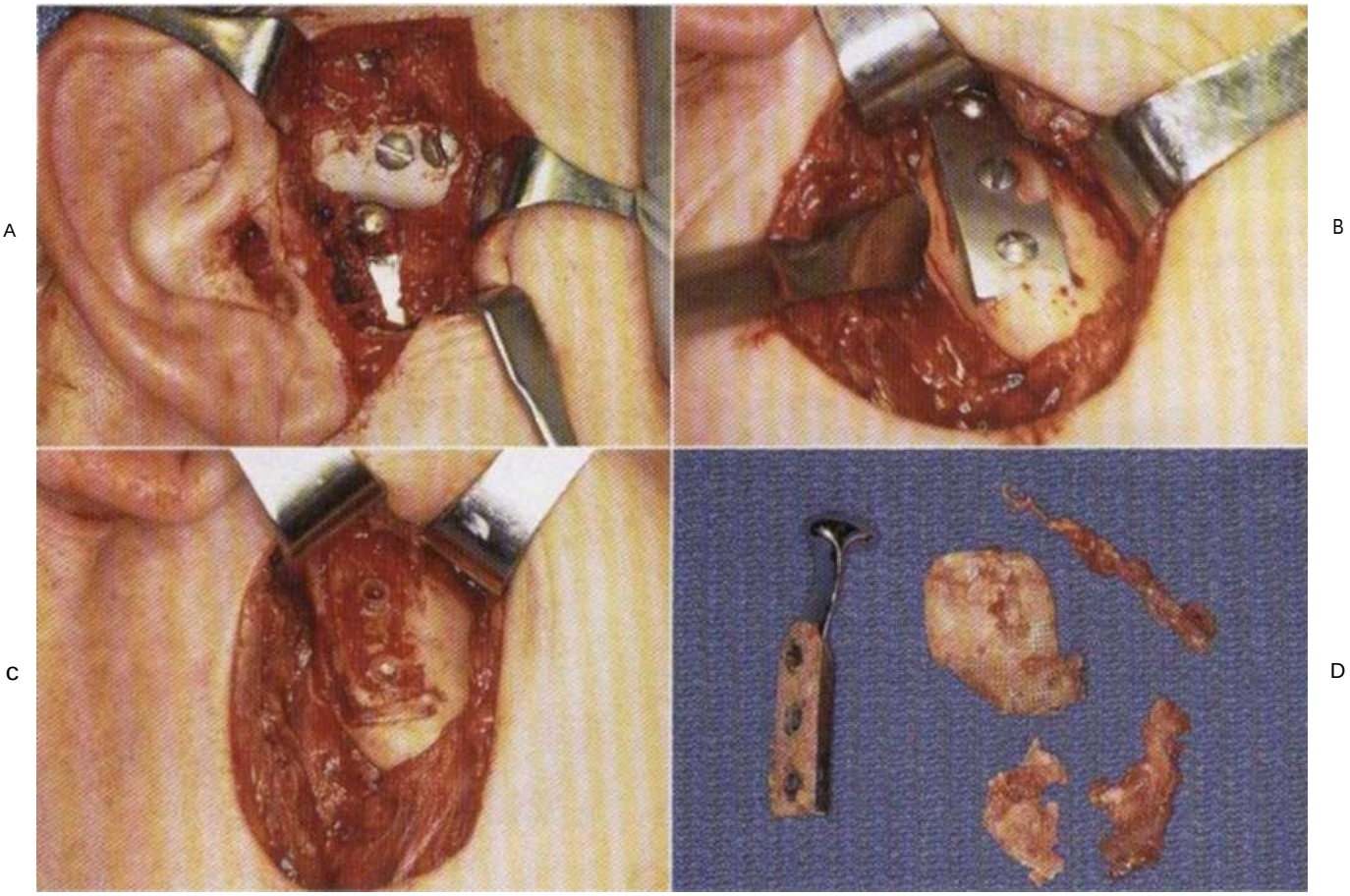
A, B, Kenl-Vitek total joint prosthesis. Note that Proplast was used for the lining of the glenoid fossa prosthesis on the fossa side and also on the surface of the condylar prosthesis itself. The prosthesis was secured with a nul-and-bolt type of fixation. **C, D,** The original Kent prosthesis, showing the Proplast-lined ramal strut with its nut-and-bolt fixation. **E,** Anterior-posterior view of a Kent-Vitek prosthesis showing the bolls on the medial surface of the ramus.

FIG. 7.12



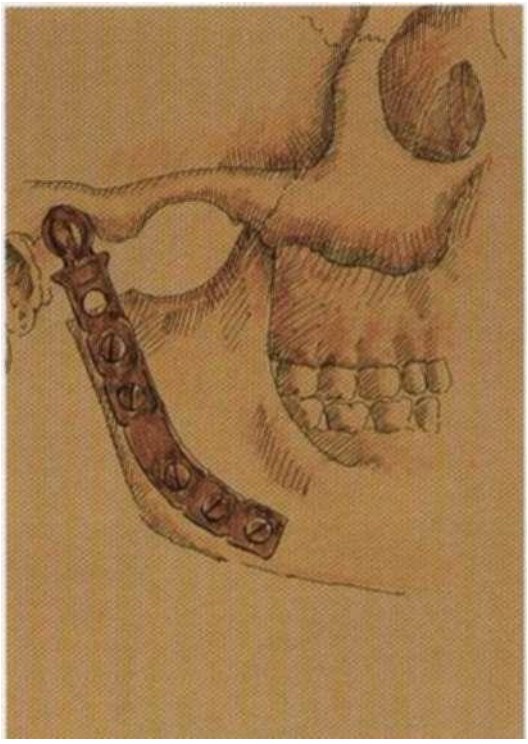
Posterior-anterior skull film of bilateral Kent-Vitek prosthetic joints.

FIG. 7.13



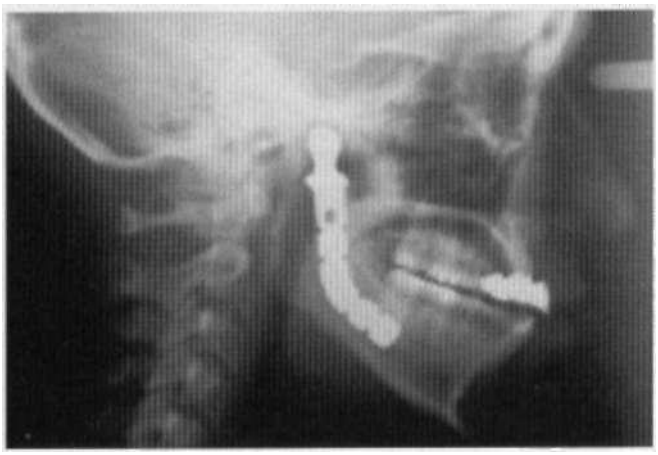
A, Kent-Vitek prosthesis after approximately 7 years of function. The patient was relatively asymptomatic for approximately 6 years but started to develop episodic preauricular swelling, which was secondary to mobility of the Kent-Vitek fossa with fragmentation of the Proplast and a foreign body giant-cell reaction. **B, C,** Removing a Kent-Vitek condylar prosthesis. Note in **B** that the bone has grown over the surface of the prosthesis in several areas. On removal of the ramal prosthesis, extensive bony destruction is sometimes seen. It is caused by the Proplast, which was in direct contact with the lateral cortical bone. **D,** A Kent-Vitek prosthesis after removal. Note fragmentation of the Proplast lining from the glenoid fossa prosthesis.

FIG. 7.14



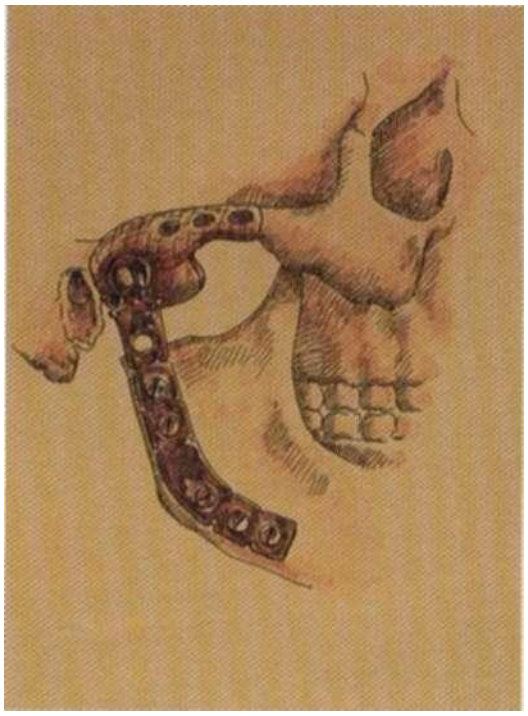
Synlhes reconstruction plate without a fossa prosthesis. Condylar head serves as a free-standing prosthesis.

FIG. 7.15

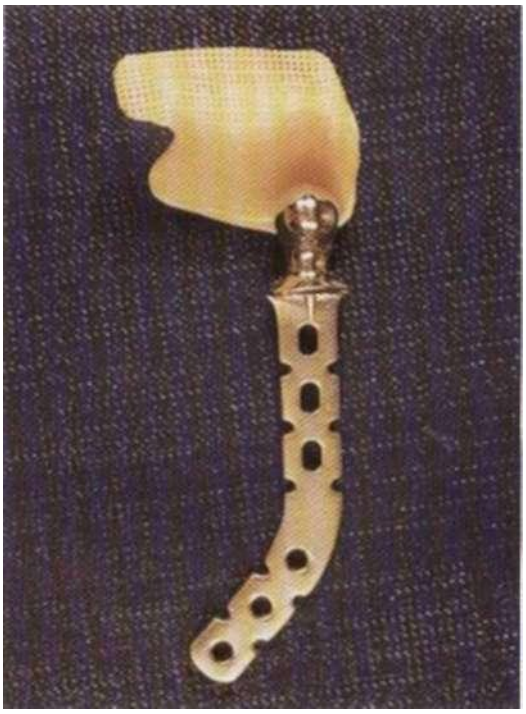


Lateral cephalogram showing Synthes reconstruction plate with condylar head against natural fossa

FIGS. 7.16, 7.17



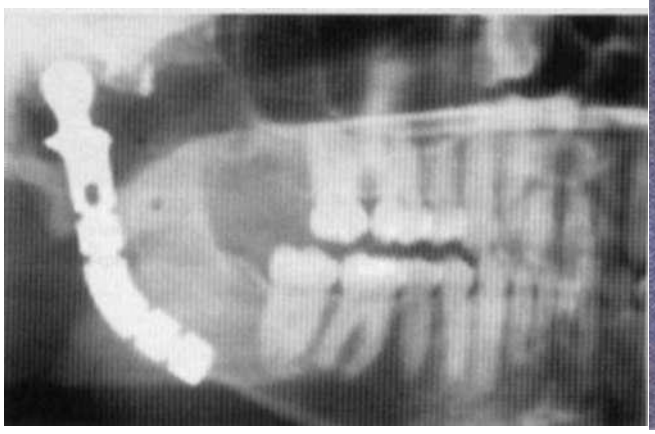
Synthes reconstruction plate with condylar prosthesis articulating with a Kent-Vitek fossa.

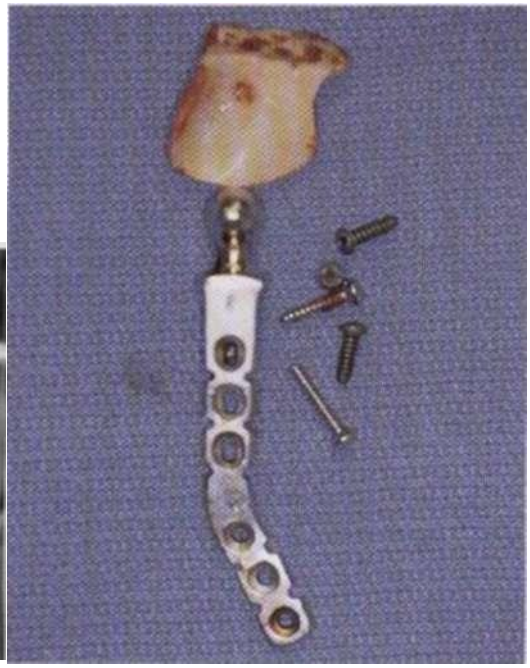


Synthes reconstruction plate with condylar head mated with a Kent-Vitek fossa. The round shape of the condylar head allows for excellent mating of the condylar prosthesis with the alloplastic fossa.

FIG. 7-18

A





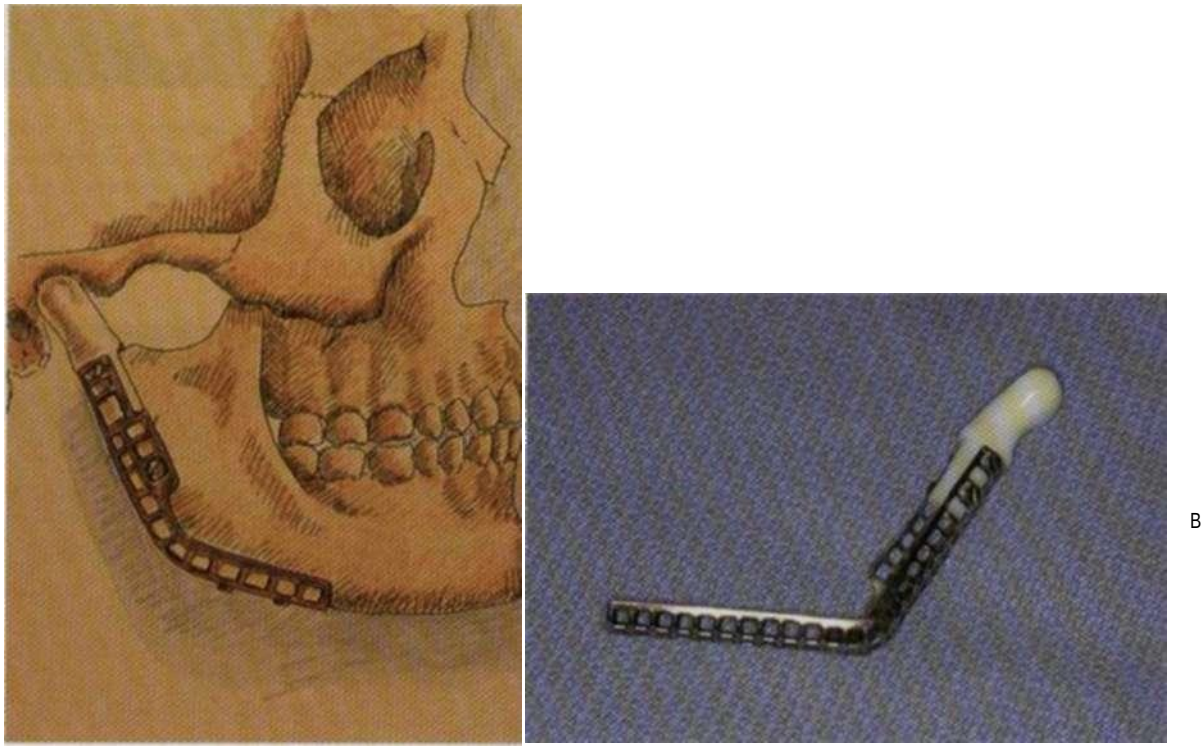
B

A, Panorex x-ray film showing a Synthes reconstruction plate with a condylar head articulating agoinst a Kent-Vitek fossa. **B,** Prosthesis after removal. The prosthesis had functioned extremely well for over 9 years but had to be removed because of mobility of the fossa prosthesis.

In the late 1980s, Boyne reported a series of joint replacements using a Delrin (polyoxymethylene) head secured to a titanium mesh plate. Although this method did not require a glenoid fossa prosthesis, some experts were concerned that the Delrin induced excessive heterotopic bone formation, leading to ankylosis. Currently the most extensively used alloplastic prosthesis is the Christensen prosthesis produced by TMJ, Inc. The Vitallium fossa implants are 0.5 mm thick and available in approximately 40 sizes for the right and left sides. The implants are secured to the eminence and lateral border of the zygomatic arch with 2.0-mm screws. The original matching condylar prosthesis was Vitallium with a methylmethacrylate head. Extensive experience with this prosthesis has shown excellent success rates overall. The Type I-Christensen condylar was associated with a 6% to 7% incidence of fracture; however, since the advent of the Type II-Christensen condylar prosthesis, which has an increased thickness and offset screw holes to avoid horizontal placement of the screws, the risk has lessened. Recently, TMJ, Inc., has made the condylar prosthesis in an all-metallic version.

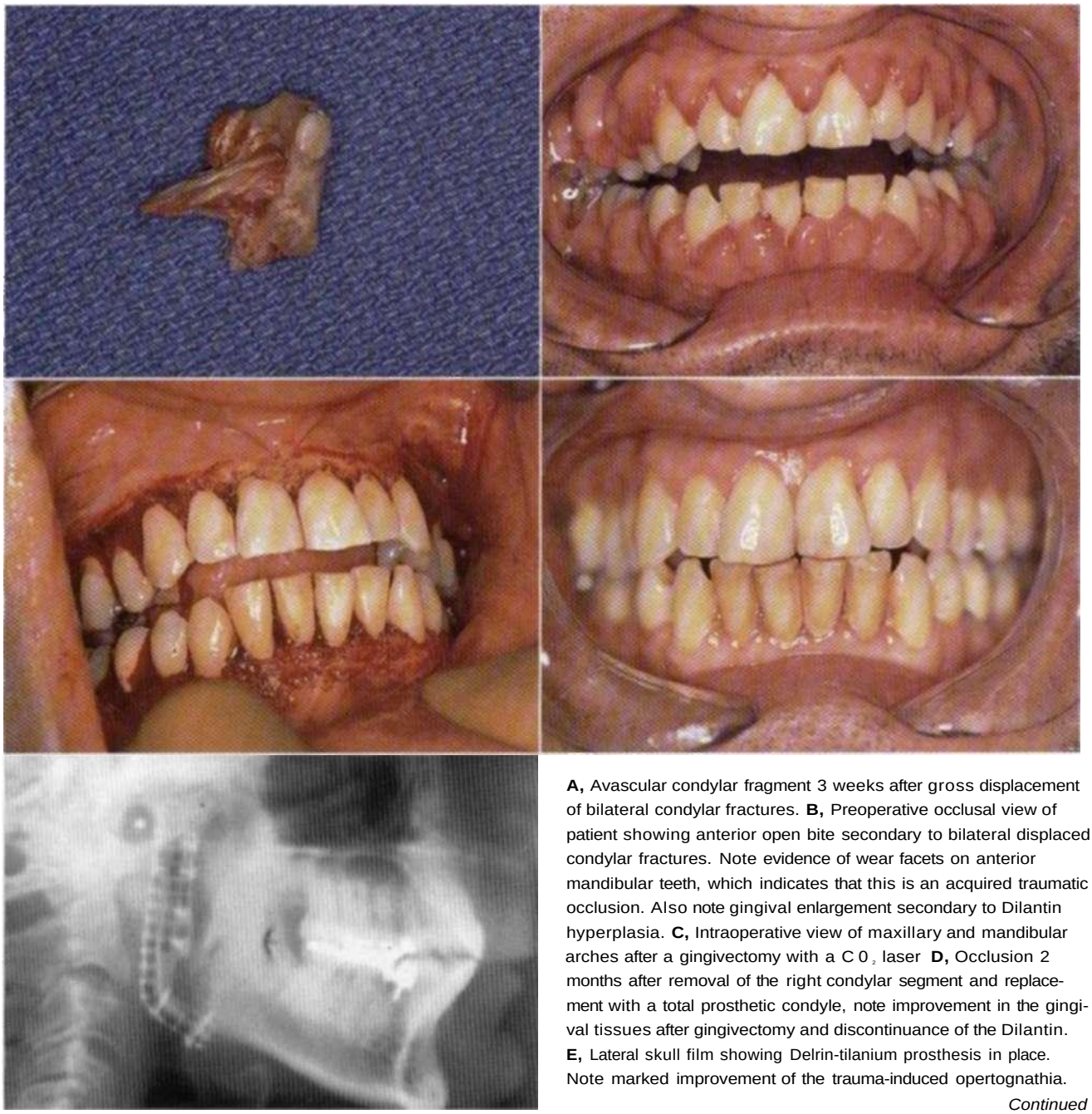
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FIG. 7.19



A, B Delrin-Timesh condylar prosthesis. Titanium-mesh tray is secured directly to the posterior-inferior border of the mandible with self-tapping screws. A step osteotomy is performed ot the posterior-superior ramal border to allow for seating of the Delrin-Timesh condyle.

FIG. 7.20

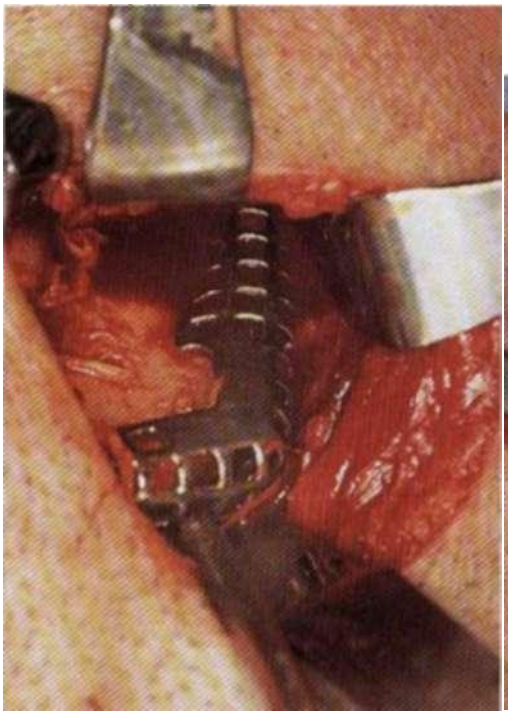


A, Avascular condylar fragment 3 weeks after gross displacement of bilateral condylar fractures. **B,** Preoperative occlusal view of patient showing anterior open bite secondary to bilateral displaced condylar fractures. Note evidence of wear facets on anterior mandibular teeth, which indicates that this is an acquired traumatic occlusion. Also note gingival enlargement secondary to Dilantin hyperplasia. **C,** Intraoperative view of maxillary and mandibular arches after a gingivectomy with a CO_2 laser **D,** Occlusion 2 months after removal of the right condylar segment and replacement with a total prosthetic condyle, note improvement in the gingival tissues after gingivectomy and discontinuance of the Dilantin. **E,** Lateral skull film showing Delrin-tilanium prosthesis in place. Note marked improvement of the trauma-induced opertognathia.

Continued

FIG. 7.20, CONT'D

F



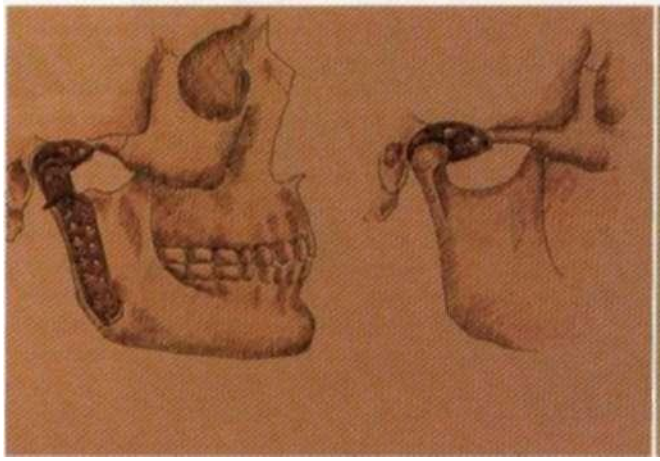


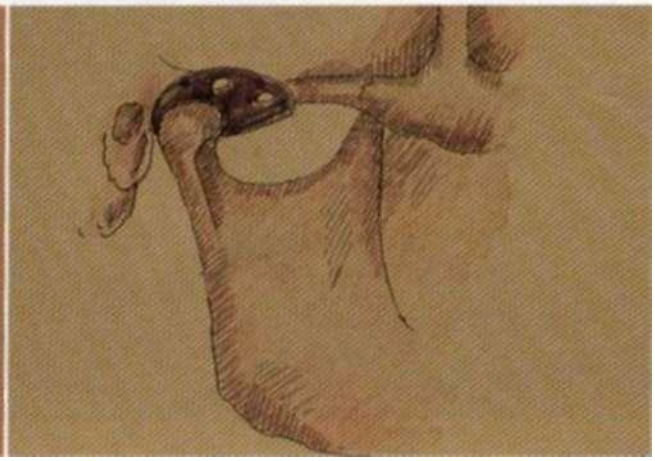
G

F, Posterior mandibular incision with a view of the posterior ramus and angle of the mandible showing adaptation of the titanium-mesh to the mandible. **G,** Delrin prosthetic condyle seated in the glenoid fossa. The patient is in intermaxillary fixation while the prosthesis is seated to ensure proper occlusion.

FIG. 7.21

A





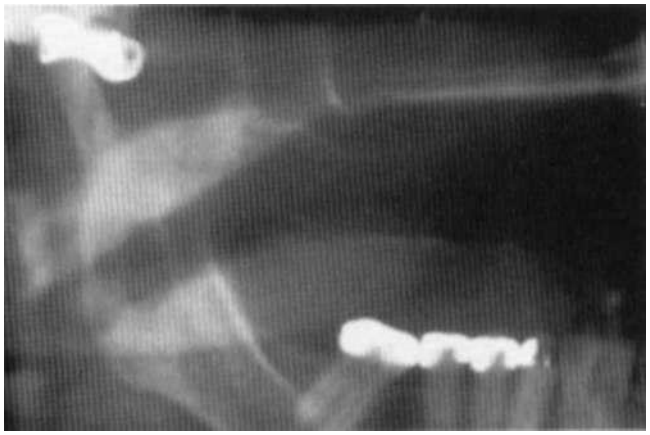
B

A, Chrislensen total and partial alloplastic joint system. **B,** A natural condyle articulating with a Christensen fossa

FIG. 7.22



A



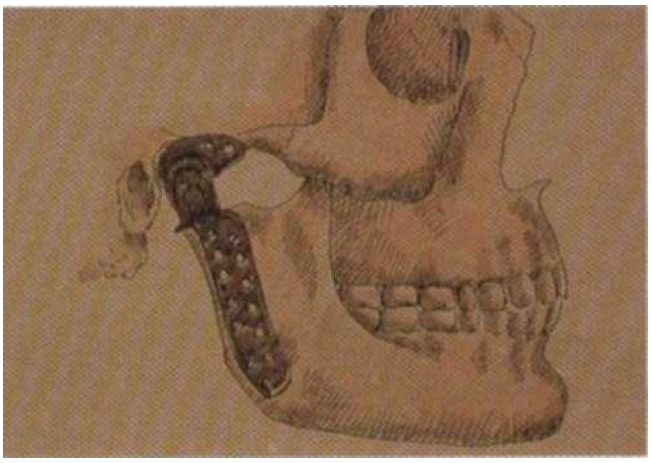
B

A, Christensen fossa prosthesis placed against a natural condyle. Experience showed that if significant condylar degenerative changes existed during inilal placement of the fossa, the degeneration rapidly progressed and placement of a condylar prosthesis was usually necessary. **B,** A panorex x-ray image showing a Christensen fossa prosthesis against a natural condyle.

FIGS. 7.23, 7.24



Christensen glenoid fossa prosthesis articulating against a meniscus. The prosthesis had been used against the natural disk in an attempt to prevent adhesions of the disk to the articular eminence.



Christensen total joint prosthesis.

FIGS. 7.25, 7.26

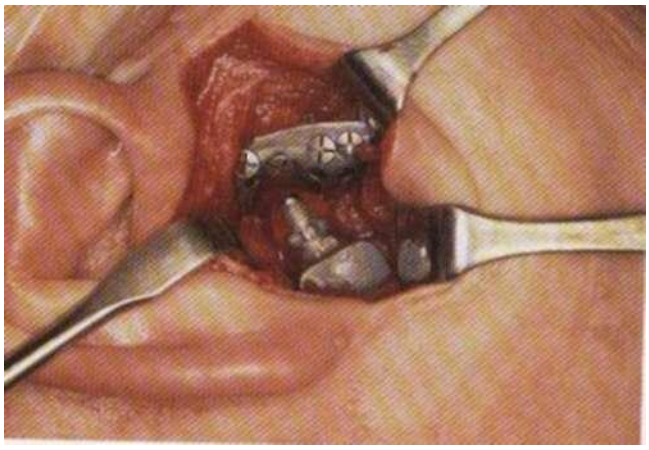


Christensen cast-Vifallium glenoid fossa implant with the Type I-Christensen condylar prosthesis.



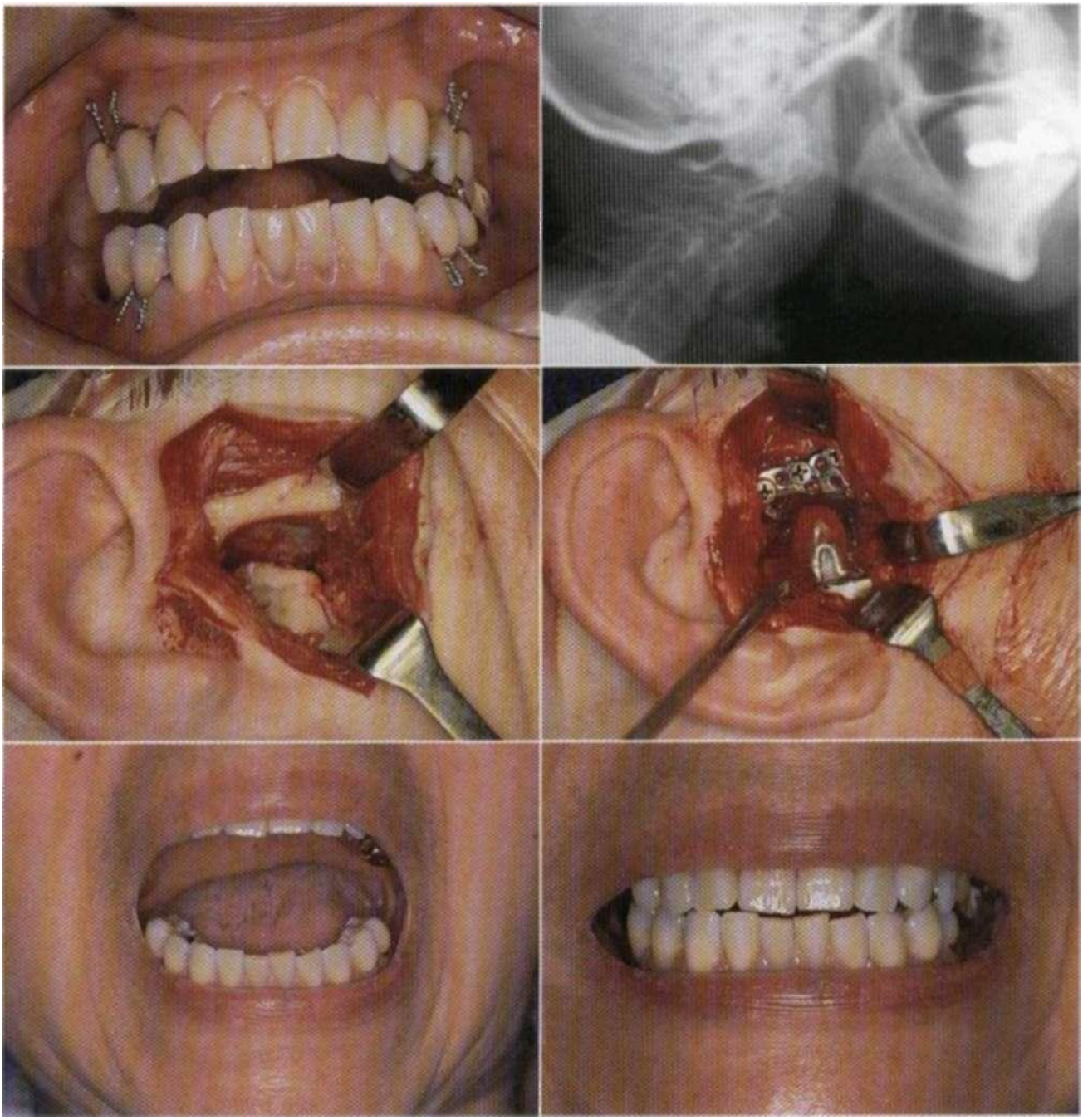
Anterior-posterior view of Christensen prosthesis in position. Note centric relation of the condylar head to the Vilallium glenoid fossa.

FIG. 7.27



Christensen total joint prosthesis in proper position. Note that the condylar prosthesis is placed approximately at a 30- to 40-degree angulation to optimize functional rotation.

FIG. 7.28

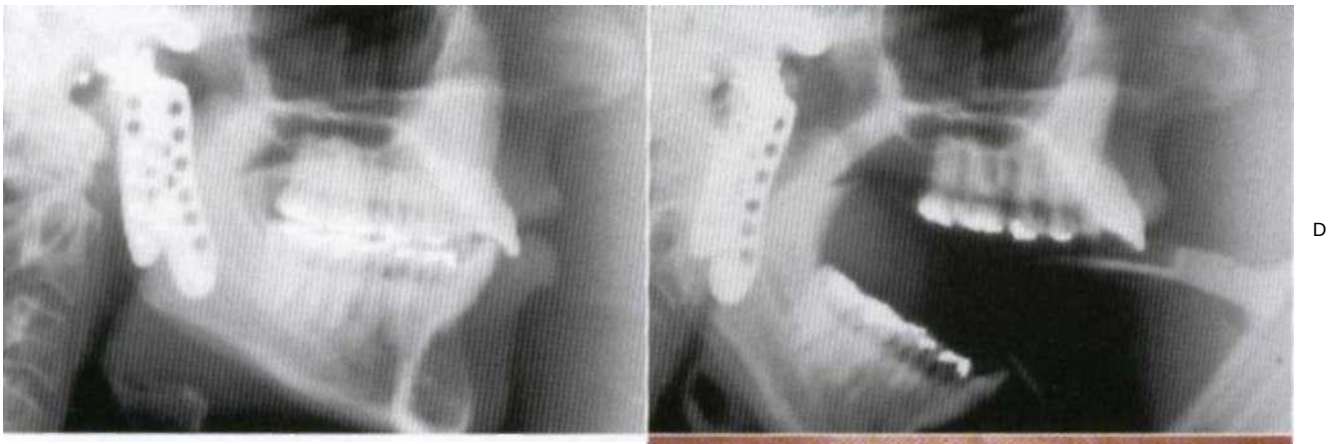


A, Anterior open bile secondary lo progressive bilateral condylar resorption in a patient with advanced rheumatoid arthritis. **B,** Lateral skull film showing a swan-neck deformity in a 63-year-old woman with advanced polyarticular rheumatoid arthritis. **C,** Open view of the joint after bilateral removal of adhesions and placement of the patient in intermaxillary fixation. This allows the surgeon to assess the true vertical deficiency in the condylar head. Note the flattened condylar head, which suggests advanced degenerative joint disease **D,** Chrislensen total joint prosthesis positioned during intermaxillary fixation. Once the condylar prosthesis is secured, the intermaxillary fixation is removed and the patient is put through a complete range of motion to ensure that the prosthesis has a 30- to 35-mm rotational range of motion and does not dislocate. **E, F,** Postoperative occlusion of patient in **A.**

FIG. 7.29



A B



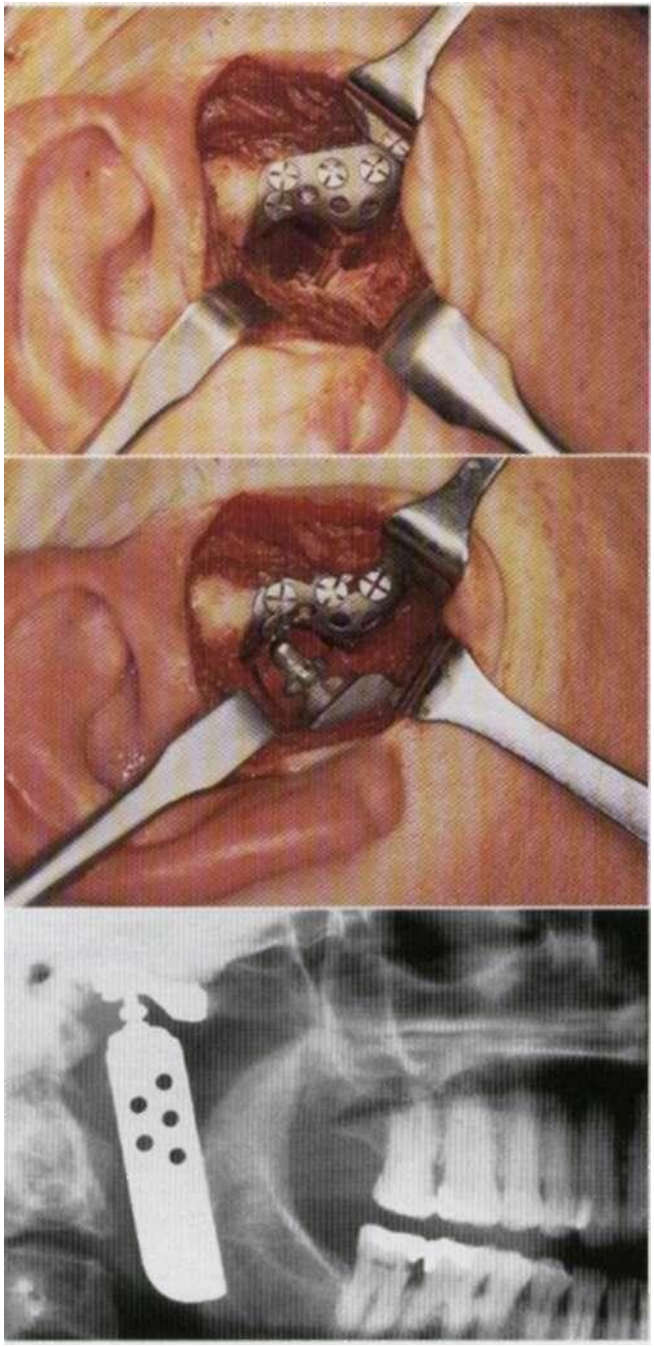
C D



E

A, B, A 34-year-old woman after bilateral placement of Christensen total joint prostheses. Note excellent appearance of endaurol and posterior mandibular incisions. **C, D,** Lateral cephalogram showing bilateral Christensen total joint prostheses in closed and open position. In the open position the patient is using a hand-held jaw exerciser, which is recommended for the first 4 to 6 weeks after surgery to attain an interincisional opening of 30 to 35 mm. **E,** Postoperative occlusion in patient with bilateral Christensen joint prostheses.

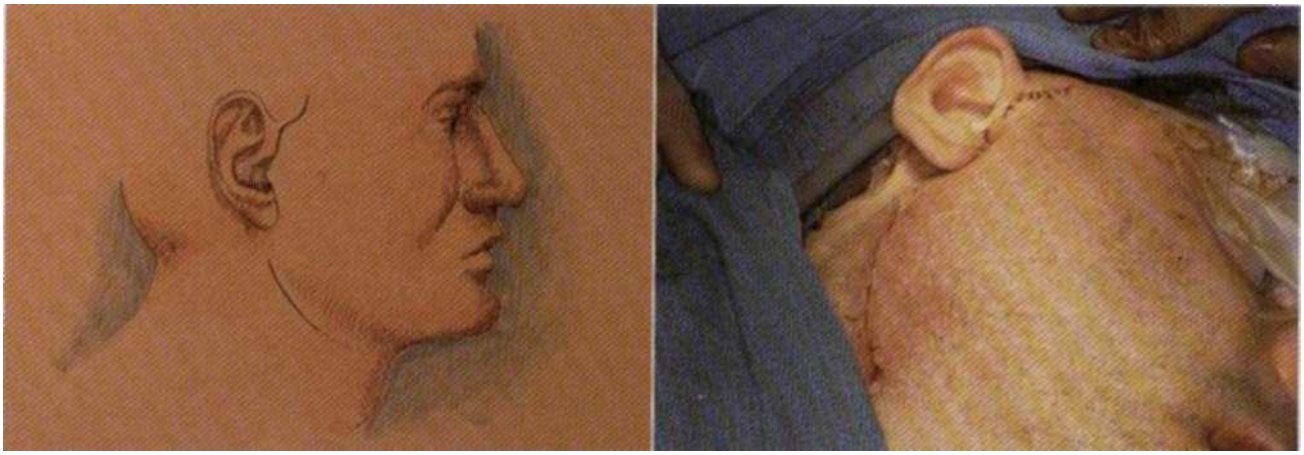
FIG. 7.30



A, Christensen condylar proslhesis in position, secured with four self-tapping screws. **B,** Placement of the conventional Christensen condylar prosthesis against the fossa prosthesis. **C,** Panorex image of Christensen total joint prosthesis in position.

Because of its potential effect on the occlusion, proper positioning of any alloplastic joint prosthesis is extremely important. The patient must be placed in stable intermaxillary fixation when the condylar prosthesis is being placed. The prosthesis should be secured with two screws initially, and then the mandible should be manipulated through a range of motion to ensure that centric occlusion can be achieved and the prosthesis does not subluxate or dislocate. Condylar prostheses are available in stock lengths of 45, 50, and 55 mm. The prosthesis should be secured with six to eight 2.7-mm screws, and care must be taken not to violate the neurovascular bundle in the inferior alveolar canal during placement of the anterior ramal screws. In general, the use of a stock prothesis such as the Christensen can present disadvantages. Because of variability in the contour

FIG. 7.31



A, Endaurol and modified Risdon incisions necessary for placemen! of total joint prosthesis. **B,** Placement of the incisions for optimal cosmesis.

of glenoid fossae, multiple fossa prostheses are available. Even with this selection, surgeons often experience difficulties in achieving proper fit in patients who have undergone multiple operations and have gross distortion of the normal joint anatomy. In light of this fact, a custom-made prosthesis would be preferable. The well-designed Techmedica system was modeled from a plastic skull fabricated on the basis of three-dimensional computer tomographic scans. A titanium-mesh backing is custom-fitted against the glenoid fossa, and a polyethylene articulating surface is mated to the titanium mesh. A custom-made metallic condylar prosthesis is then secured to the lateral ramus. T M J , Inc., is also producing a custom fossa and condylar total joint prosthesis from three-dimensional computer tomographic data.

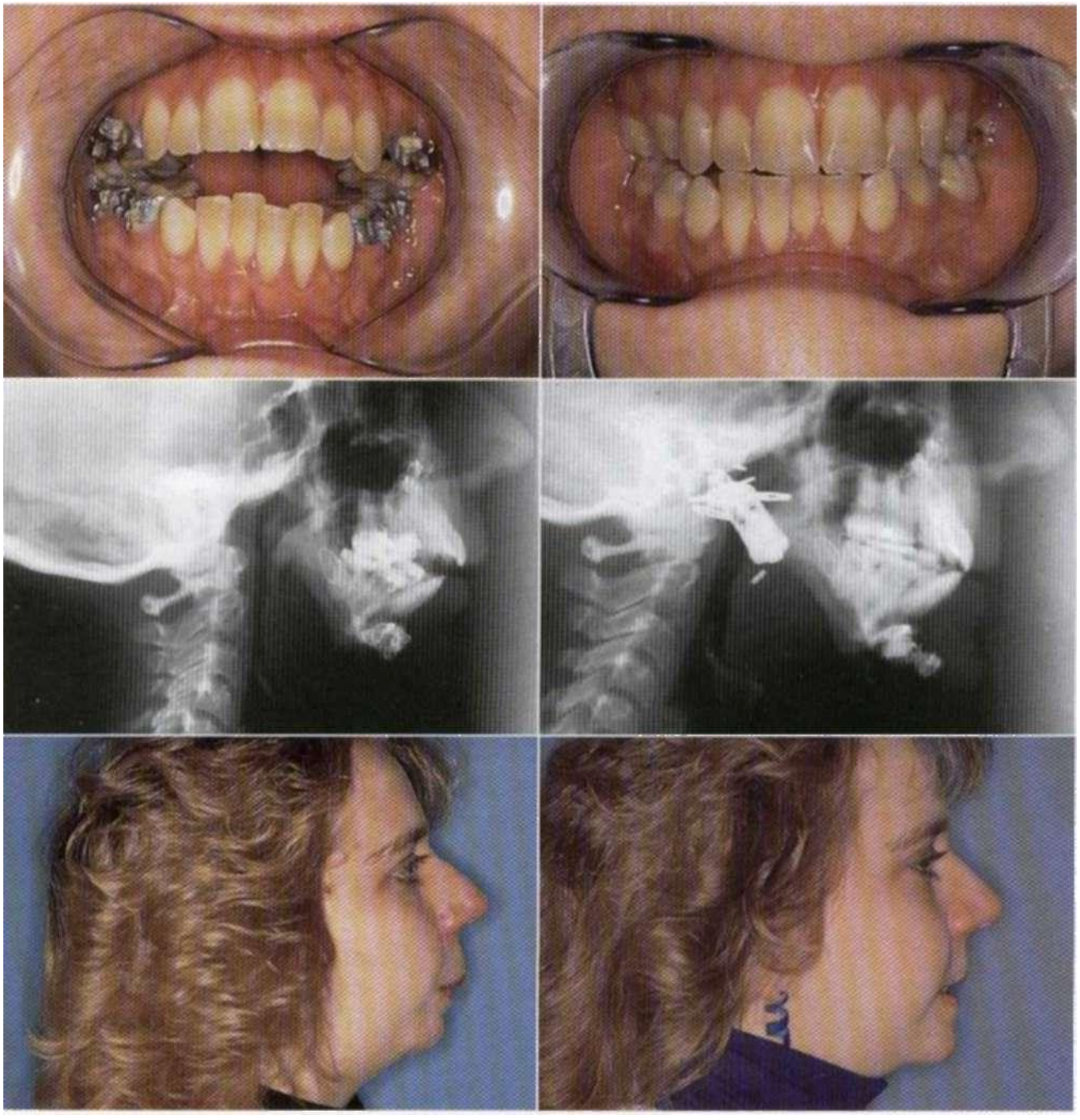
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FIG. 7-32



Coronoid processes after coronoideclomy for total joint replacement. This is often necessary to gain an adequate range of motion,

FIG. 7.33



A, Preoperative occlusion showing gross aperlognalhia in patient with idiopathic condylar resorption. **B,** Postoperative occlusion after bilateral prosthetic joint replacement. **C, D,** Cephalograms taken before and after bilateral prosthetic joint replacement. The patient had bilateral idiopathic condylar resorption and underwent several unsuccessful orthognatic surgical procedures to correct her apertognathia before the joint replacements. **E, F,** Lateral views of the patient before and after bilateral joint replacement.

FIG. 7.33, CONT'D

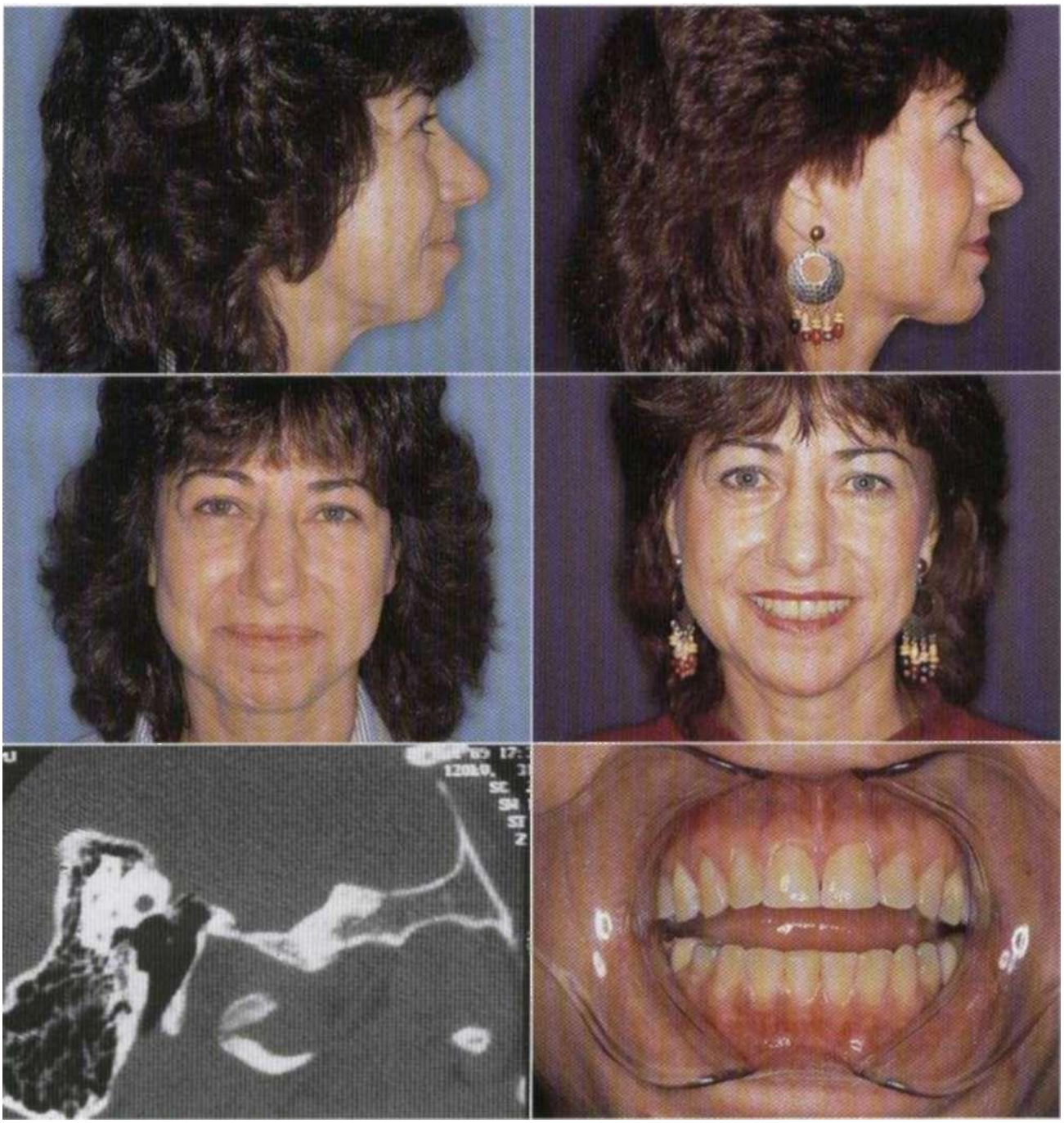


G

H

G, H, Frontal views of the same patient before and after joint replacement.

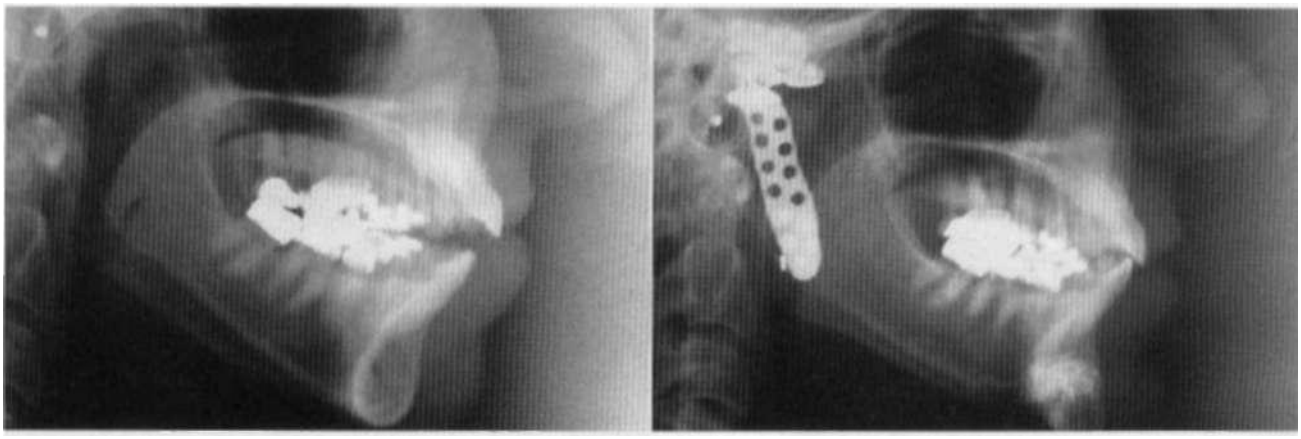
FIG. **7.34**



A, B, Lateral views showing mandibular projection before and after bilateral joint replacement in a 36-year-old woman with advanced condylar resorption caused by rheumatoid arthritis. C, D, Posterior-anterior views of the same patient after bilateral joint replacement. E, CT scan showing marked degeneration of the condylar head in the same patient. F, Acquired apertognalhia secondary to condylar resorption. Note wear facets on mandibular anterior teeth, indicating that this was an acquired malocclusion.

FIG. 7-34, CONT'D

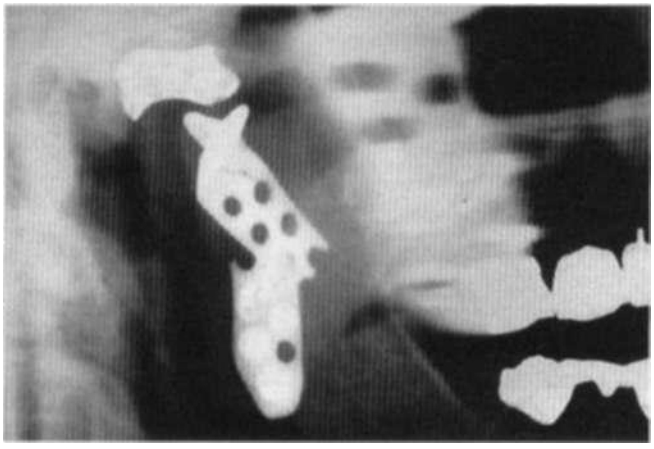
G



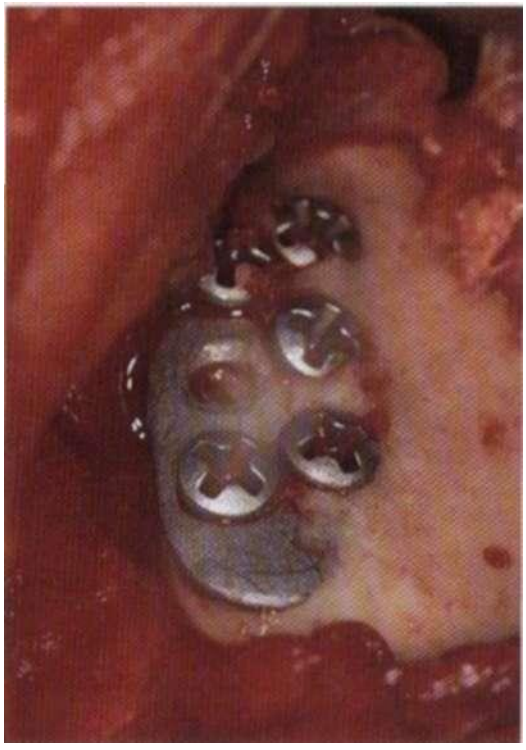
H

G, H, Lateral cephalograms before and after surgery to correct apertognathia. The mandible was repositioned in an anterior position and supported by the total joint prosthesis. Augmentation-advancement genioplasly was also performed.

FIGS. 7.35, 7.36



Fracture of type I- Christensen condylar prosthesis



Fracture type I-Christensen prosthesis being submerged by heterotopic bone formation. This fixation of the prosthesis by bone served to create a stress point on the condylar prosthesis at the point where the bone formation ceased just above the last ramal screw. Fractures usually occurred at this point of metal fatigue on the prosthesis.

FIGS. 7.37, 7.38



Type I-Christensen condylar prosthesis after removal because of fracture. The prosthesis fractured at the point where the screw holes were not as offset as in the other positions on the condylar strut.



Note design difference between Type I-Christensen condylar prosthesis *(fourth from the left)* and Type II-Christensen condylar prosthesis *fifth from the left).* The increosed thickness of the ramal strut with the offset design of the screw holes eliminated the problem of fracture associated with the Type I-Christensen prosthesis.

FIGS. 7.39, 7.40

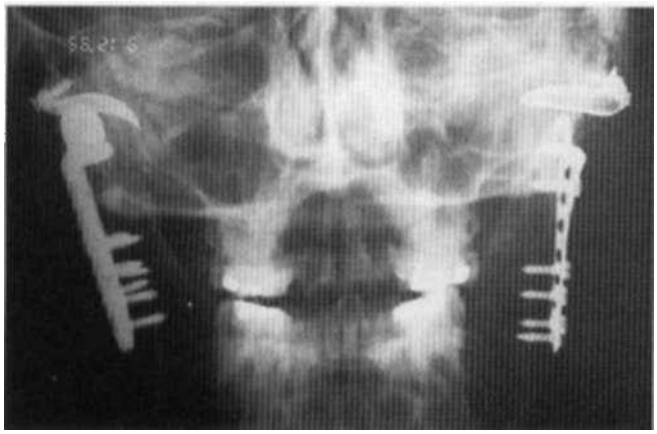


A panoramic x-ray image of a Christensen total joint prosthesis with a Type II condyle.



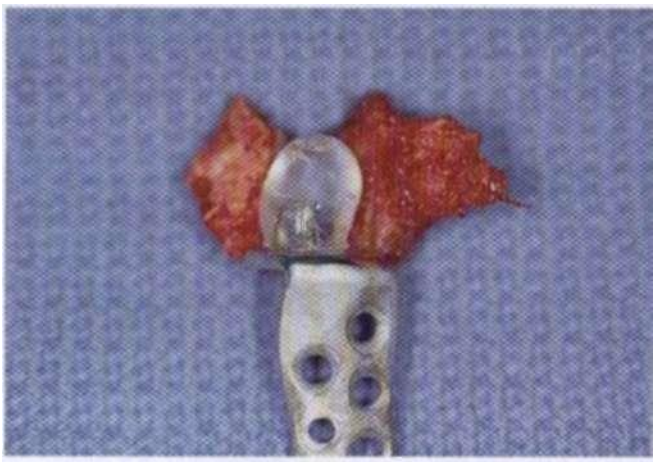
Comparison of the Type II-Chrislensen prosthesis with an all-metal head versus a methyl methacrylale head.

FIG. 7.41



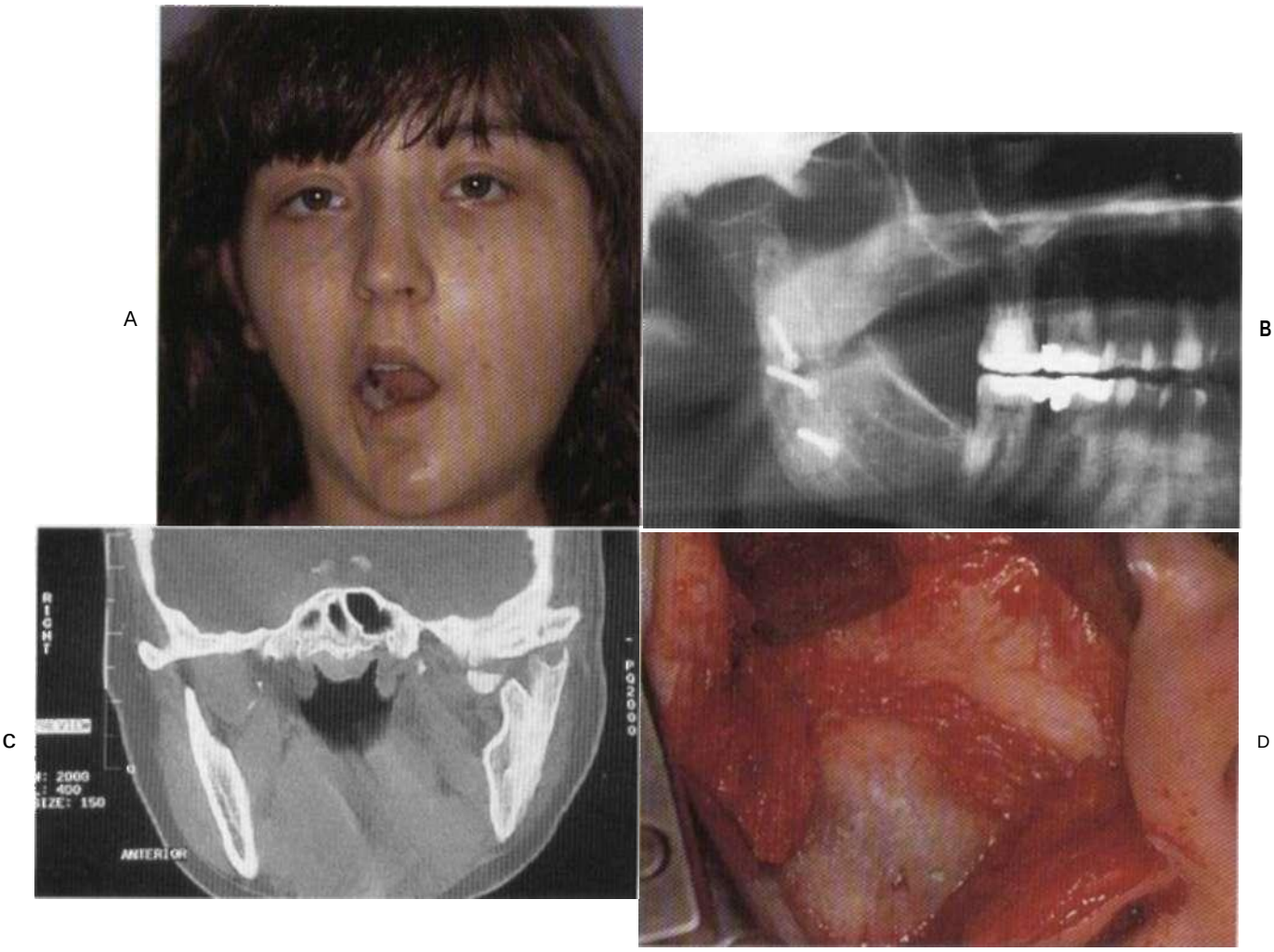
Posterior-anterior skull film showing patient with Type I prosthesis *(right side)* and a Type II all-metallic prosthesis *(left side).* Note that the Type II prosthesis is reinforced, which decreases the risk of fracture.

FIG. 742



Type I-Christensen condylar prosthesis after removal because of ankylosis. Note heterotopic bone that had formed circumferenlially around the melhyl-melhacrylale condylar head.

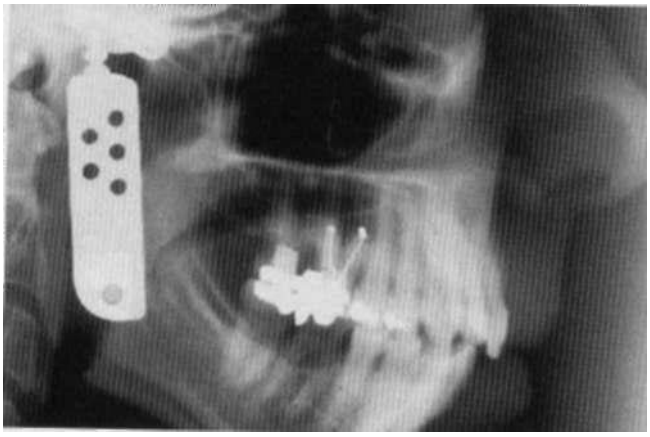
FIG. 7.43

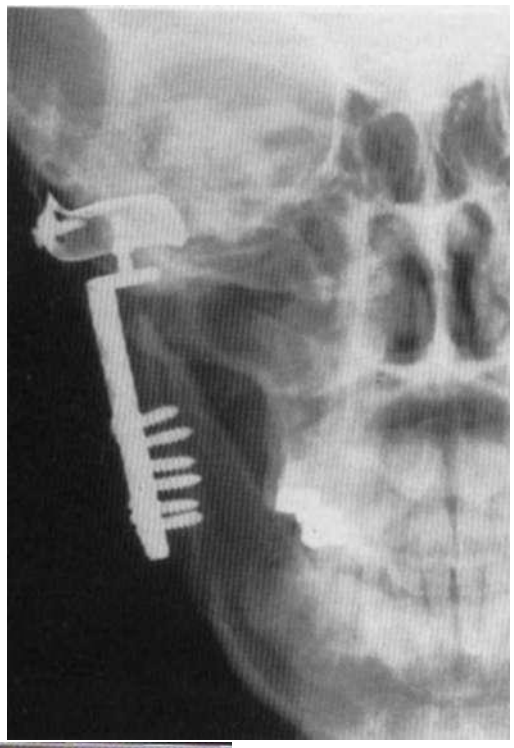


A, A 29-yeor-old woman who underwent multiple joint procedures before reconstruction of the left joint with a costochondral graft. One year after the unsuccessful operations, she still had chronic pain, swelling, limited mouth opening, and facial palsy. B, A panorex x-ray film shows placement of the costochondral graft, which is secured to the lateral ramus with three screws. **C,** A coronal CT scan shows the costochondral graft positioned laterally with heterotopic bone formation adjacent to the medial stump of the condylar head. D, Ankylosed rib graft pictured in **C.**

FIG. 7.43, CONT'D

E





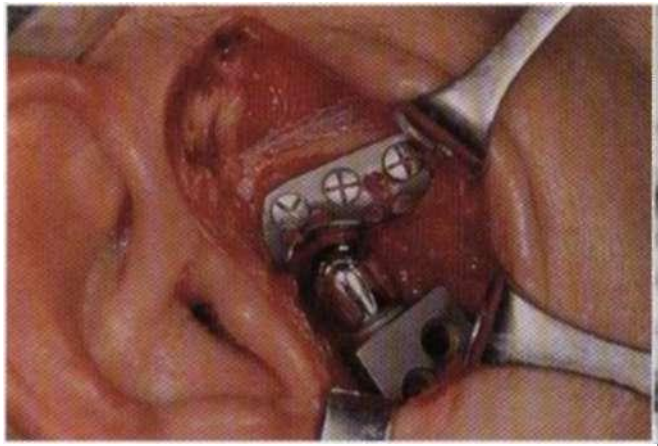
F



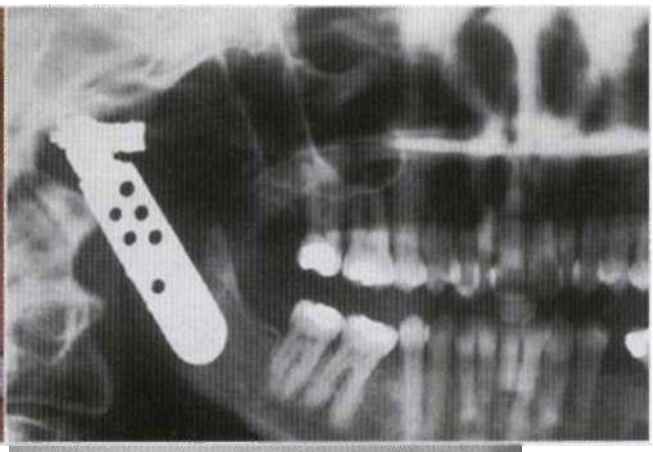
G

E, F, Anterior-posterior skull and lateral skull views of the Christensen total joint prosthesis placed after removal of the nonfunctioning costochondral graft. G, Patient 6 months after placement of alloplastic joint prosthesis.

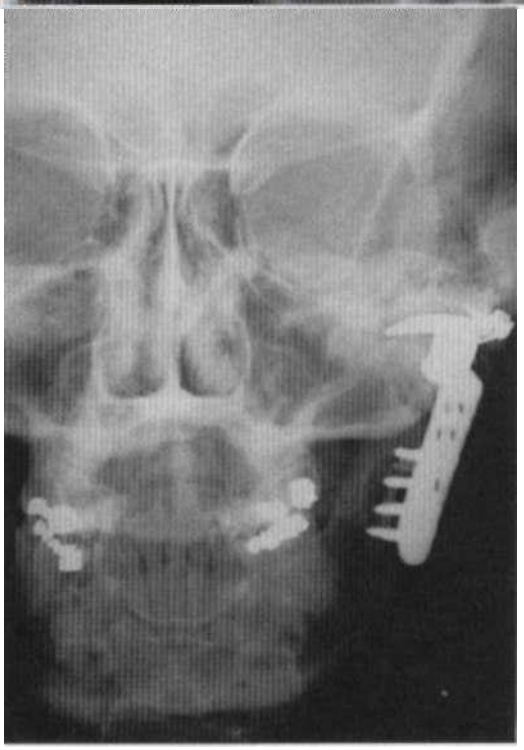
FIG. 7.44



A



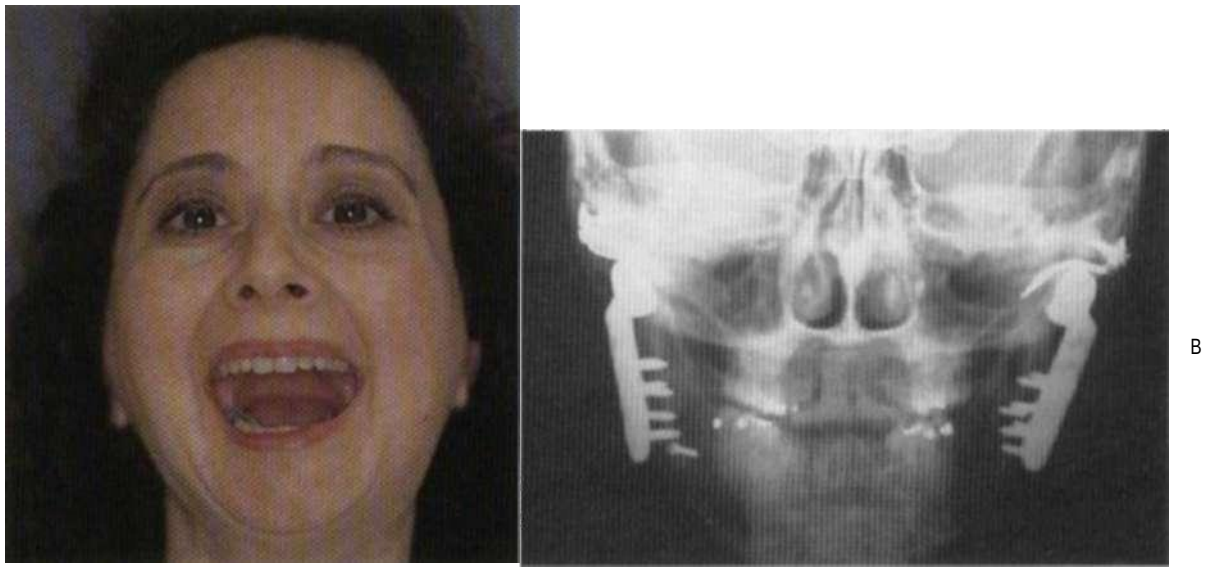
B



C

A, Christensen all-metal condylar prosthesis articulating with Christensen fossa. Both components ore made of Vitallium. **B,** A panorex x-ray film showing all-metal Christensen prosthesis in position. **C,** Posterior-anterior skull film of an all-metal Christensen condyle articulating with Vitallium Christensen glenoid fossa.

FIG. 7.45



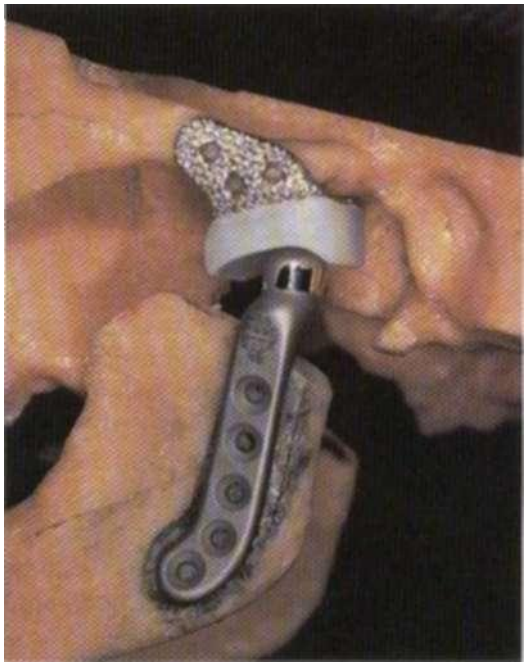
A B

A, A 31-year-old woman who underwent bilateral total joint replacement with all-metal Christensen prostheses after several unsuccessful arthroplasties. The inlerincisional opening is 32 mm, with a marked reduction of presurgical pain level **B,** Anterior-posterior skull view of all-metal Christensen prosthesis.

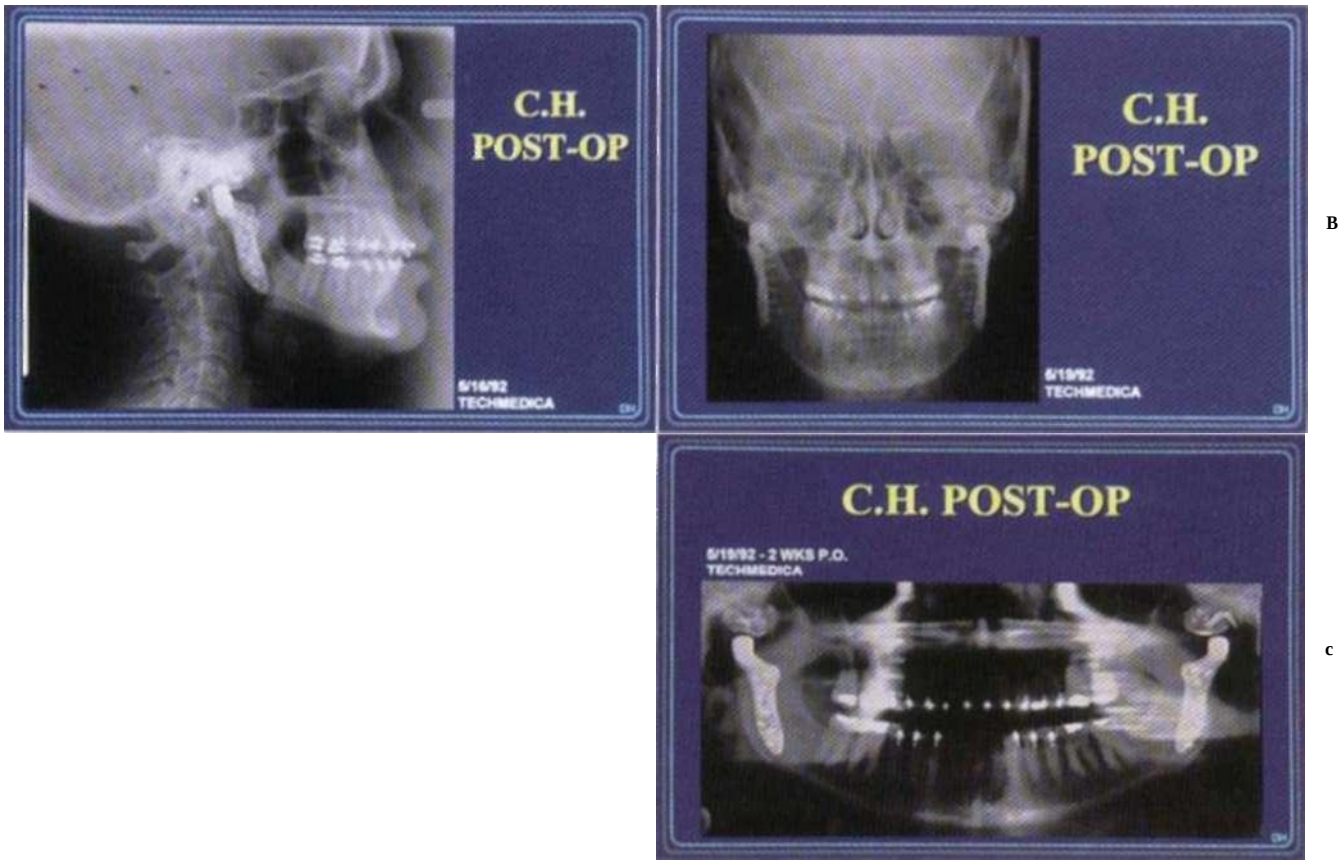
FIGS. 7.46, 7.47



Custom-made Christensen condylar and fossa prostheses. These prostheses are fabricated from a Cad-Cam plastic model produced from CT data. This provides an excellent way to create a stable joint prosthesis in patients who have distorted anatomy and who have undergone multiple operations.



Custom Techmedica prosthesis positioned on Cad-Cam model generated from CT data.



Postoperative x-ray images of Techmedica total joints. **A,** Lateral view. **B,** Frontal view. **C,** Panorex.

FIG. 7.48

With any total joint alloplastic system the patient is capable of only rotational motion because no lateral pterygoid insertion exists to provide protrusive movement. Between 32 and 35 mm of intraincisal opening is a reasonable expectation for range of motion with a total joint prosthesis. Unilateral replacement causes deviation to the side of the prosthesis on terminal opening. Pain reduction for patients who have undergone multiple operations is also a reasonable expectation; a direct correlation exists between the number of previous surgical procedures and the likelihood that presurgical symptoms will be reduced. At this point, no long-term data have been compiled on the subject of currently available alloplastic implant systems. Orthopedic experience suggests that these implants systems may have a useful life span of approximately 7 to 10 years. With advances in both biomaterials and clinical understanding of necessary design modifications, this figure should increase. Complications that are specific to alloplastic joints include the following: prosthesis displacement or fracture, foreign-body reaction to polymeric or metallic debris, heterotopic bone formation (which causes ankylosis of the prosthesis), and damage to the inferior alveolar nerve by screw placement. The facial nerve can be damaged during placement of the prosthesis, but this risk is inherent in all joint procedures. This author is currently involved in a clinical trial



Endotec joint—condyle and fossa.

FIG. 7.49



Endotec condyle component showing the "antimicromovement" locking screw. Two screws are in place, and the third screw is off to the side, with the locking screw above the regular screw. The locking screw inserts in the large hole in the prosthesis.

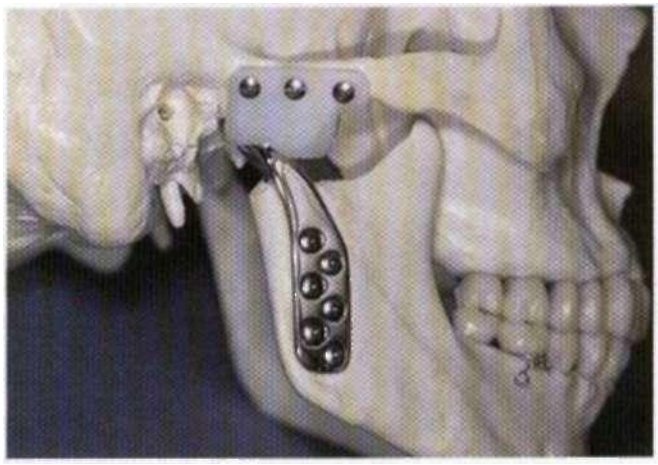
FIG. 7.50

of a prosthesis developed by Biomer-I.orenz. The prosthesis is composed of a high-molecular-weight polyethylene fossa that is secured to the zygomatic arch by four self-tapping 2.0-mm screws. The fossa prosthesis is a stock prosthesis, and the articular eminence surface is flattened before fitting begins. A clear Lucite template is used to achieve a tripod effect, imparting stability to the fossa prosthesis. Once the prosthesis is stable, a small amount of methacrylate cement is used to fill the voids between the fossa prosthesis and the glenoid fossa. The cement should never

be used as a load-bearing surface. It is mechanically locked to the fossa with a small dowel projecting from the inner surface of the fossa. The methyl methacrylate is cured outside the body to avoid any excessive heat against the glenoid fossa. Once the fossa is fitted, the patient is placed in intermaxillary fixation and the chrome-cobalt condylar prosthesis is fitted. The components are designed to optimize contact between the condyle and the fossa. The point of rotation is moved inferiorly, and the deep concavity in the glenoid fossa is designed to allow for pseudotranslation of the condylar prosthesis during opening. This design modification has improved the maximum intraincisal opening by approximately 15% to 18%. Early results are very encouraging but far from conclusive at this stage.

Experienced surgeons can achieve satisfactory results with autogenous reconstruction or alloplastic reconstruction of the temporomandibular joint. Costochondral grafting is clearly the procedure of choice in growing patients, but a predictably successful, safe, and effective alloplastic prosthesis offers great advantages for reconstruction of the severely altered joint in adult patients. When sound data confirm the effectiveness of an available model or one that is yet to be developed, surgeons will have a choice between equally effective autogenous and alloplastic techniques. The ultimate decision will be based on the particular needs of the patient.

FIG. 7.51



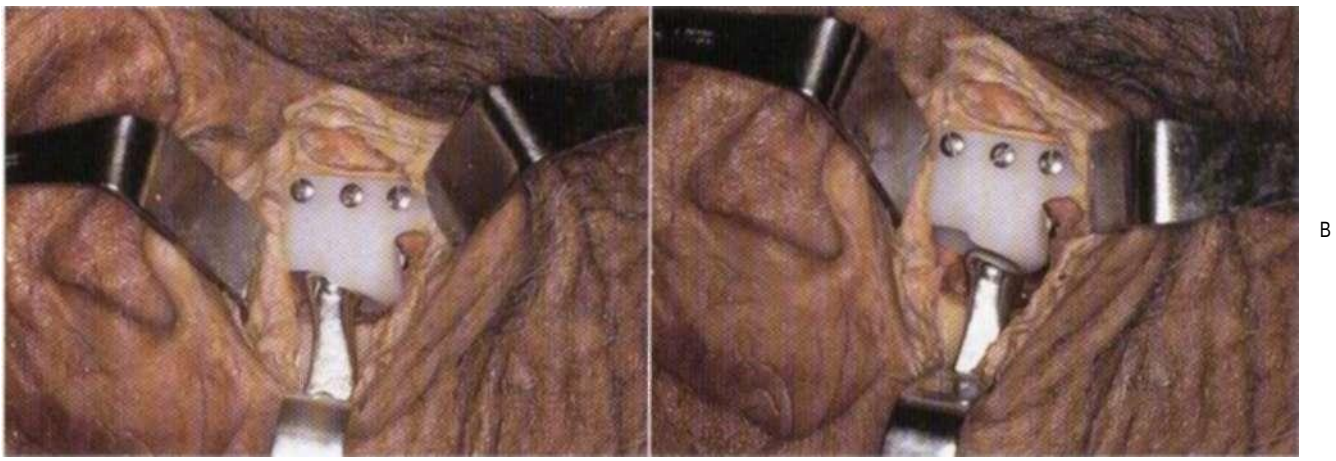
Biomet-Lorenz temporomandibular joint prosthesis. The fossa is high-molecular-weight polyethylene that is secured to the zygomatic arch with **2.0**-mm screws. The Vitallium condylar prosthesis is designed to optimize the noting between the condylar and fossa components.

FIG. 7.52



A, Biomet-Lorenz prosthesis placed in a cadaver to show the shielding effect of the polyethylene fossa, which protects against ankylosis from heterotopic bone formation. Also, note that since the polyethylene can be no thinner than 4 mm, the point of rotation (condylion) is moved inferiorly. B, Note the thickness of the polyethylene fossa and the presence of o dowel on the fossa surface. The polyethylene fossa is fit initially so that it has a tripod stability on bone with the polyethylene alone. Orthopedic methyl melhacrylote cement, used as nonloading filler, has been dyed brown in this example to show the demarcation between the components.

FIG. 7.53



A, B, Biomet-Lorenz prosthesis in a cadaver depicting passive translation of condyle in the glenoid fossa prosthesis. Note that the condyle tends to glide anteriorly within the fossa during translation, which tends to increase the range of motion approximately 15% to 18%.

FIG. 7.54

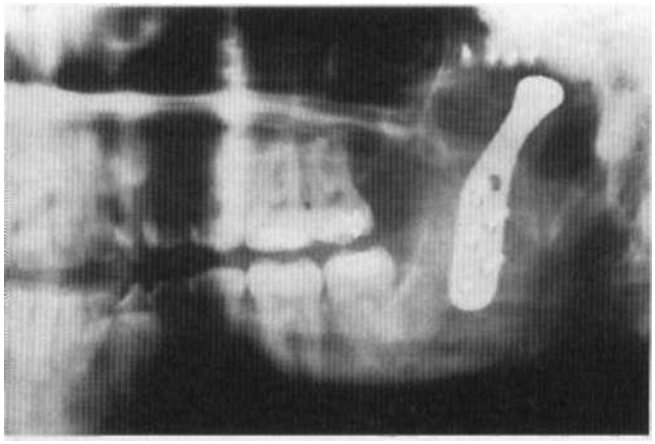
A



B

A, Biomet-Lorenz prosthesis in position. **B,** Fossa prosthesis with the dowel of methyl methacrylate cement, which is cured outside the body and trimmed with a #15 blade before conplete setting. This ensures that the load-bearing contact against bone is with polyethylene and not with the cement, which is simply used to fill the voids.

FIG. 7.55

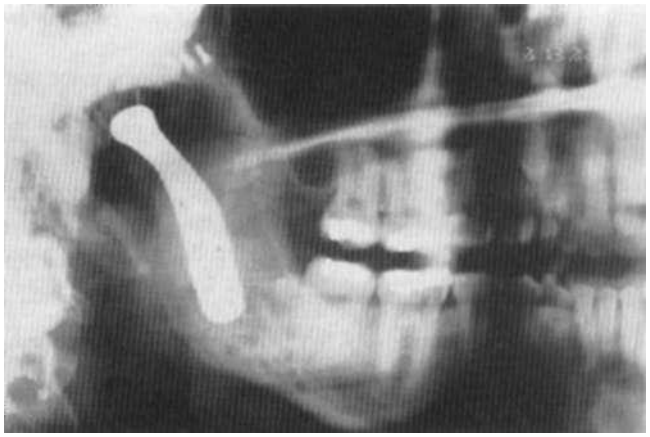


A panorex x-ray film showing a Biomet-Lorenz prosthesis in position. Care is taken to note the position of the inferior alveolar artery and nerve during placement of the screws for the condylar prosthesis. When placing the anterior row of screws, the surgeon should drill through the buccal cortex only initially. This precaution allows the surgeon to abandon that site if brisk bleeding occurs.

FIG. 7.56



A



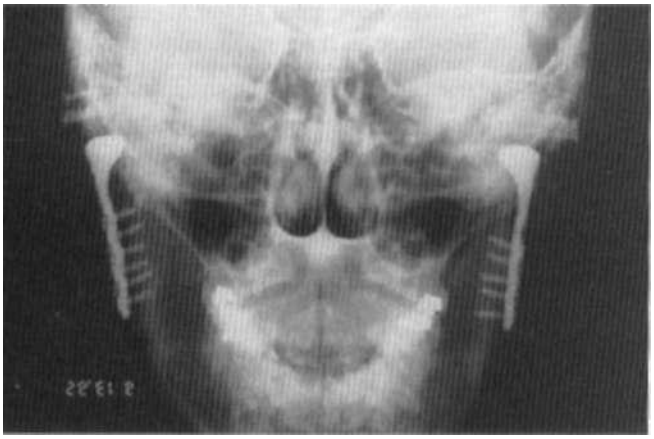
B

A, Excellent view of the condylar prosthesis through a modified posterior mandibular incision. Five or six self-tapping 2.7-mm screws are used to secure the prosthesis to the lateral ramus. **B,** A panorex film shows the angulation of the condylar neck and the convex surface of the condylar head.

FIG. *7.57*



A



B

A, A 22-yeor-old woman who underwent multiple joint surgeries before joint reconstruction with custom-made titanium Biomet-Lorenz prostheses. These were selected because of a documented sensitivity to nickel. **B,** Postoperative anterior-posterior skull view of same patient.

CHAPTER EIGHT

PATHOLOGY OF THE TEMPOROMANDIBULAR JOINT

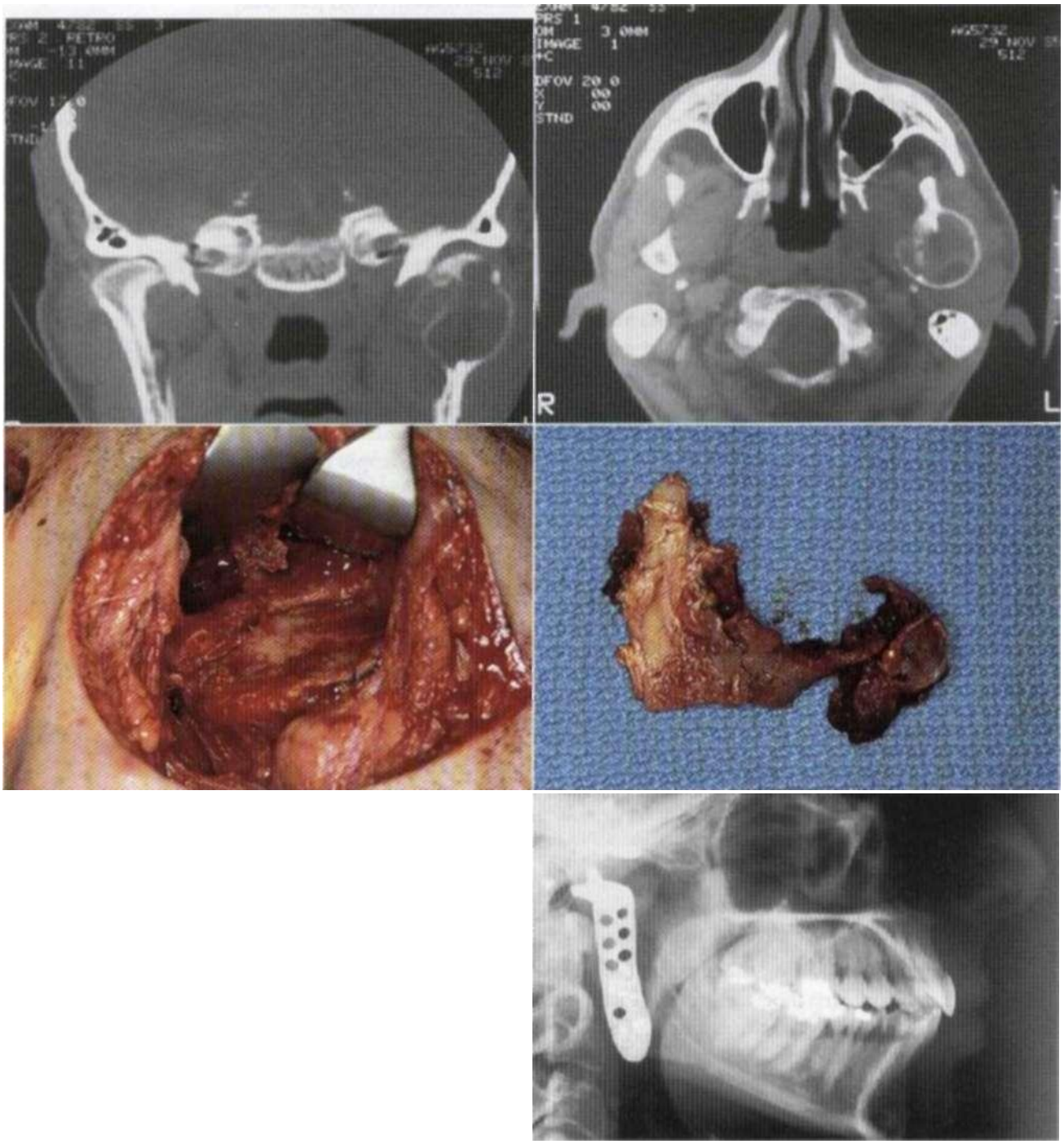
Benign and malignant tumors can affect the structures of the temporomandibular joint. Although tumors are rare compared with disorders of internal derangement and osteoarthritis, the surgeon must always be on the alert for signs of neoplasia. Space-occupying lesions of the joint may present with preauricular swelling, pain, trismus, limitation of opening, and malocclusion. If clinical and radiographic examinations suggest the presence of a tumor, arthroscopic biopsy or open arthrotomy is most helpful. All the various tissues of the temporomandibular joint can serve as a nidus for tumor formation. Tumors and lesions affecting the temporomandibular joint include the following:

BENIGN TUMORS AND LESIONS	MALIGNANT TUMORS
Osteoma	**Osteogenic sarcoma**
Osteochondroma	**Chondrosarcoma**
Chondroma	**Synovial cell sarcoma**
Chondroblastoma	**Synovial fibrosarcoma**
Giant cell granuloma	**Multiple myeloma**
Giant cell tumor	**Lymphoma**
Neurofibroma	**Aggressive fibromatosis**
Hemangioma	
Arteriovenous malformation	
Synovial chondromatosis	
Osteochondrosis dissecans	
Villonodular synovitis	
Ganglion cyst	

If the initial biopsy shows the joint lesion is benign, it may be approached with a standard arthroplasty. For example, central giant cell granulomas have been known to affect the head of the condyle. They typically appear as solitary, radiolucent lesions of the mandible or maxilla. These lesions tend to involve the jaws anterior to the molar teeth, but they occasionally involve the mandibular ramus and condyle. They usually produce a painless expansion; however, when a space-occupying lesion affects the mandibular condyle, it causes a malocclusion and sometimes a preauricular swelling. Biopsy reveals a stroma of spindle-shaped fibroblasts in the presence of multinucleated giant cells. In the body of the mandible or maxilla, curettage followed by peripheral ostectomy is an acceptable initial approach. When the lesion completely destroys the condylar head, a standard condylectomy can be performed before immediate reconstruction with either autogenous tissues (costochondral graft) or an alloplastic prosthesis.

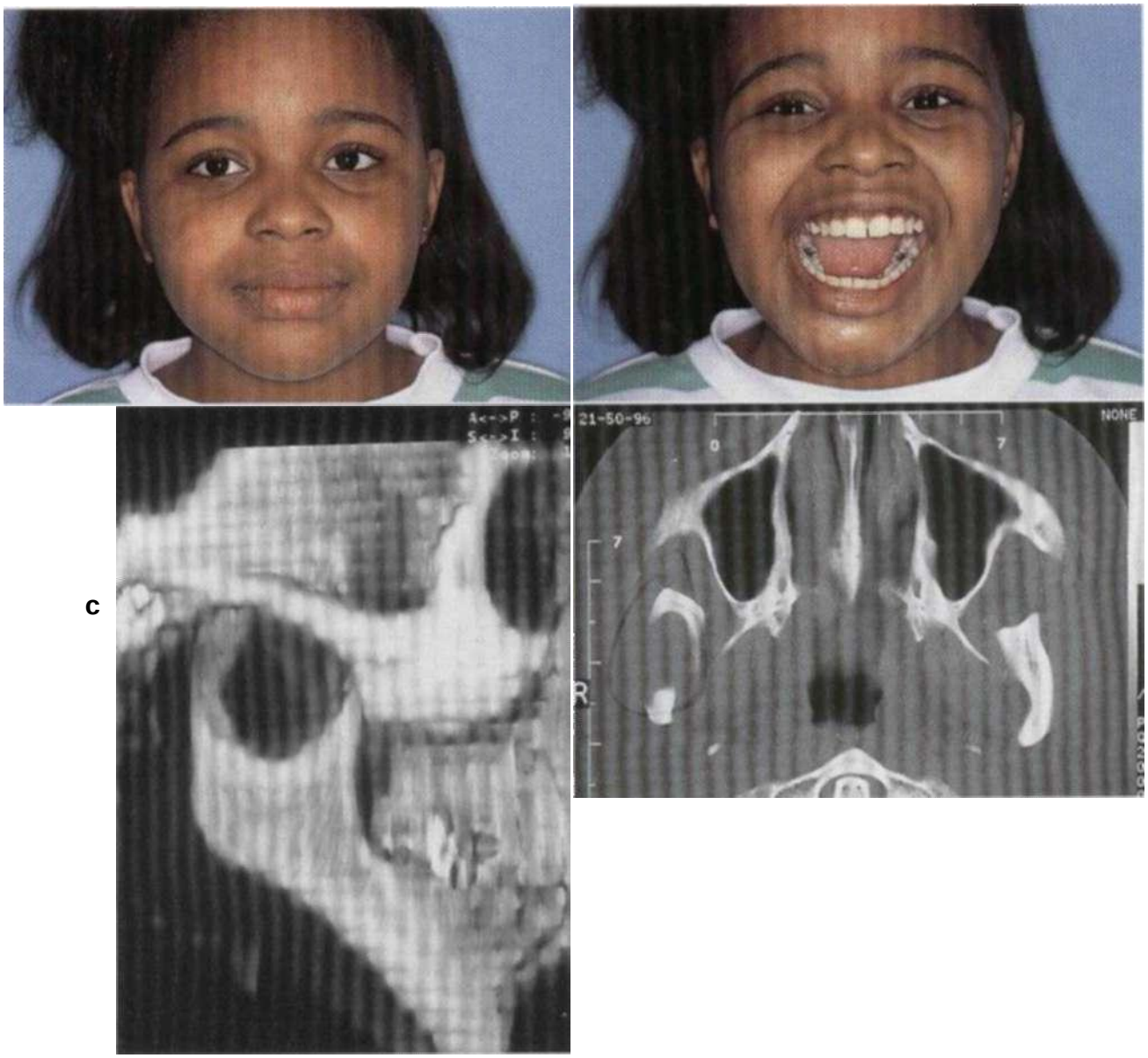
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FIG. 8.1



A, Giant cell tumor of left temporomandibular joint on axial and coronal CT scans. Note almost complete destruction of condylar head to a level approximately 1 cm below the sigmoid notch. **B,** Axial CT depicting giant cell granuloma of left condylar head. **C,** Extended modified Risdon incision for wide access to ramus-condyle complex. **D,** Surgical specimen showing excision of condylar head and portion of coronoid notch for removal of giant cell granuloma. **E,** Lateral skull film depicting Christensen prosthesis in position.

FIG. 8.2



A, B An 1 1-year-old girl displaying deviation of the mandible on terminal opening. This asymmetry is secondary to a compressive growth disturbance in the right condyle-ramus region secondary to neurofibromatosis. C, Three-dimensional CT scan showing marked distortion of ramus in the coronoid notch area. D, Soft tissue mass on axial CT scan showing lesion depicted in C. Biopsy proved the lesion to be neurofibromatosis.

FIG. 8.3

A

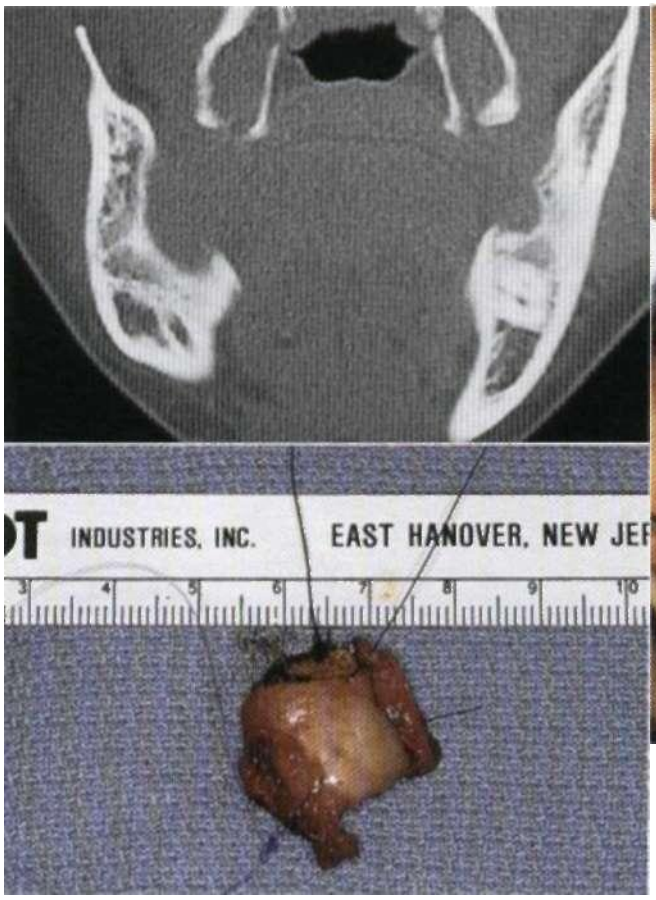


B

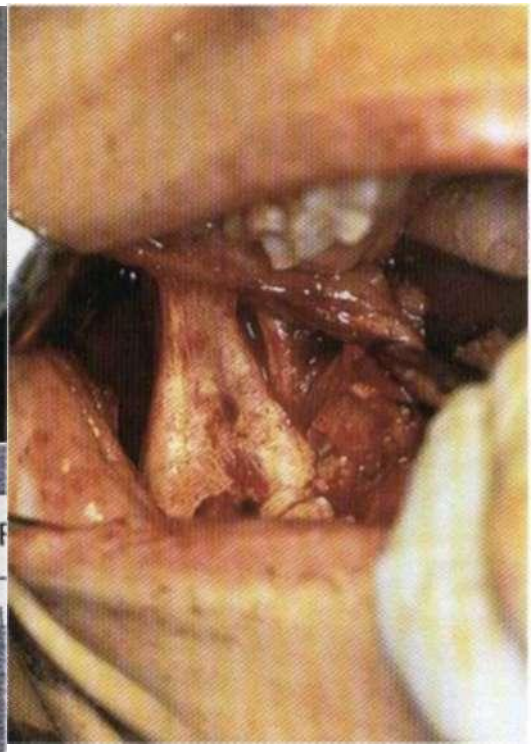


A, B, Rapidly enlarging neurofibromatosis lesions of the ear infiltrated the temporomandibular joint space, causing decreased range of motion. A debulking of the lesion was performed with use of a temporary Silastic pullout implant.

FIG. 8.4



A



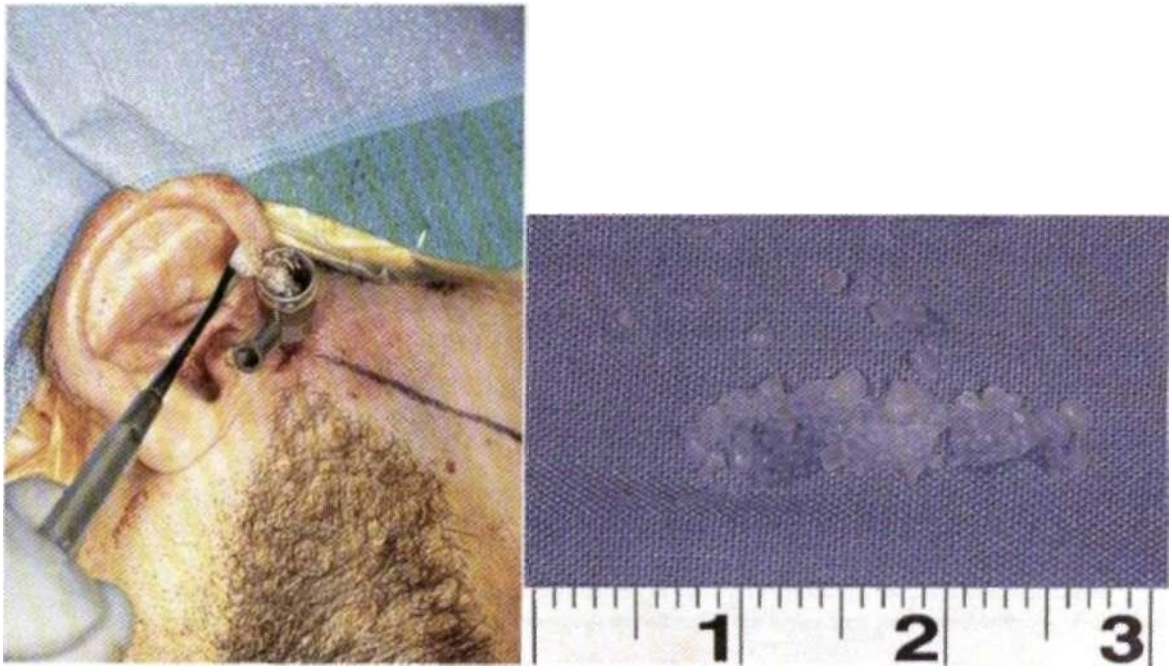
B

A, Coronol CT scan showing well-defined lytic lesion at posterior edge of the mylohyoid ridge. Biopsy proved the lesion to be neurofibromatosis. B, C, Inlraoral ramal approach for excision of neurofibromatosis.

Another benign lesion that requires surgical intervention is synovial chondromatosis. Synovial chondromatosis is a cartilaginous metaplasia that results in the proliferation of abnormal synovia. The hypertrophied synovial tissue produces multiple foci of hyaline cartilage. These cartilaginous nodules can eventually become detached from the synovial membrane and produce loose bodies in the joint. These have been referred to in the past as "joint mice." Patients with this condition usually show signs of a space-occupying lesion that causes preauricular swelling, pain, decreased range of motion, and malocclusion. Pressure resorption from collections of these loose cartilaginous bodies can cause perforation of the middle cranial fossa, with leaking of cerebral spinal fluid and resorption of the condyle. Computer tomographic scans and magnetic resonance imaging are extremely helpful in identifying loose bodies in the joint space. The cartilaginous nodules arc radiopaque only if they are sufficiently calcified at the time of the imaging study. The metaplastic synovial can initially be visualized and biopsied by arthroscopy. Once the diagnosis of synovial chondromatosis is made, the treatment is open arthroplasty for removal of the loose bodies and a synovectomy. Although complete removal of all the synovial membrane is extremely difficult, attempts should be made to excise the hypertrophied synovial tissue wherever possible. A meniscectomy may be necessary to gain access to the metaplastic tissue in advanced cases. In joints where only several loose bodies are identified and the synovial tissue appears to be grossly normal, the loose bodies may be composed of dead cancellous bone and fibril la ted cartilage. These characteristics are consistent with osteochondrosis dissecans. This condition does not require an extensive synovectomy, and removal of the loose body (or bodies) alone should be sufficient.

Text continued on p. 225

FIG. 8.5



A, Arthroscopic cannula in place with spontaneous egress of hundreds of small, loose cartilaginous bodies.
B, Specimen of loose cartilaginous bodies ("joint mice").



C



D



E



F



G

C, Sagittal MRI view of gross distension of capsule with expansion of lateral capsular wall beyond the articular eminence. Note the position of the displaced meniscus anterior to the condyle and the presence of sclerosis and "bird's beaking" of the condyle. **D,** Arthroplasty approach to synovial chondromatosis. Note massive amount of loose cartilaginous bodies. **E,** Perforated meniscus removed during synovectomy for synovial chondromatosis. **F,** After total synovectomy and meniscectomy for synovial chondromatosis. Note erosion through fibrocartilage on lateral pole of the condyle secondary to pressure from intracapsular synovial chondromatosis. **G,** Sagittal MRI view of capsule distended laterally by synovial chondromatosis. This was easily palpable on examination.

FIG. 8.6



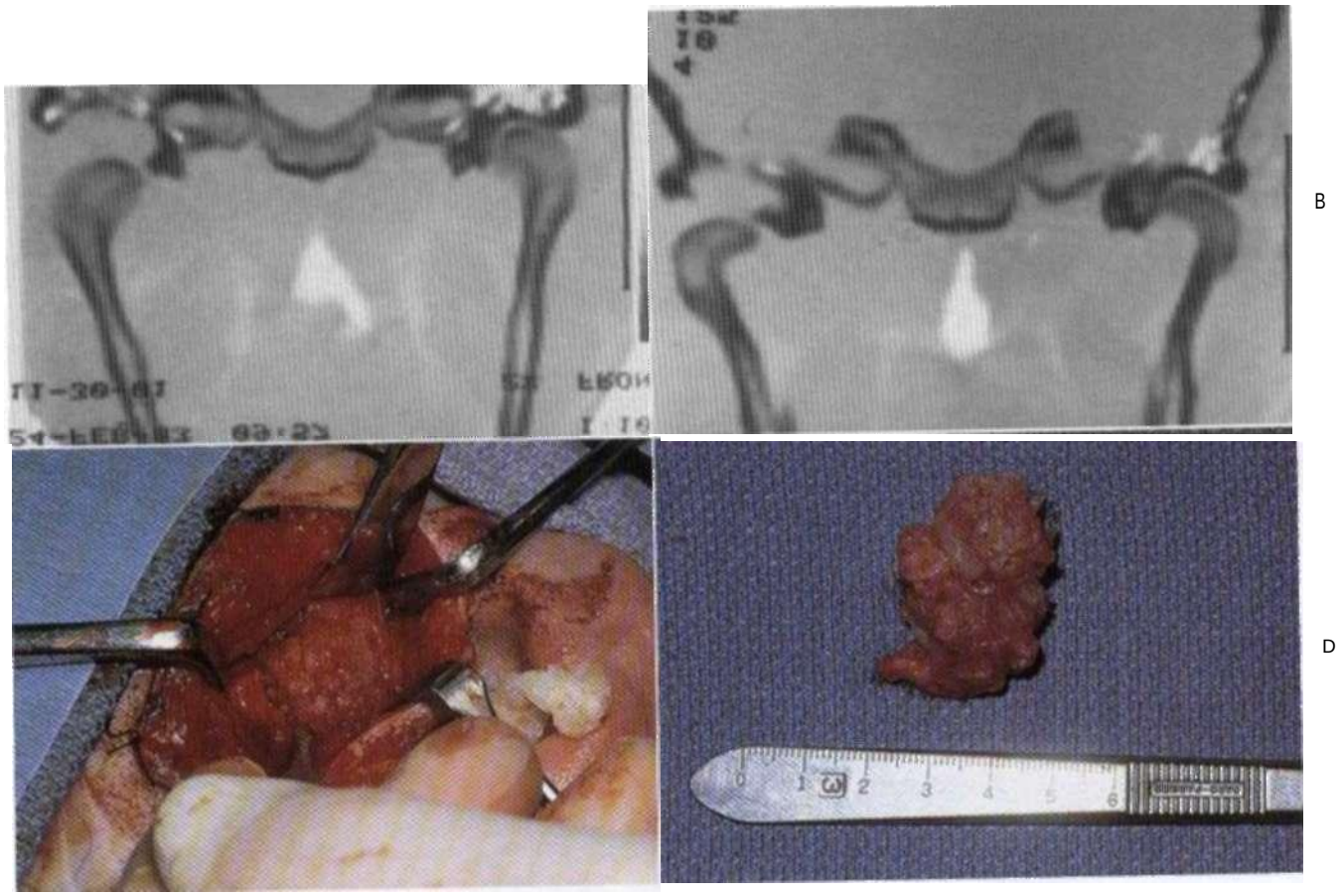
A



B

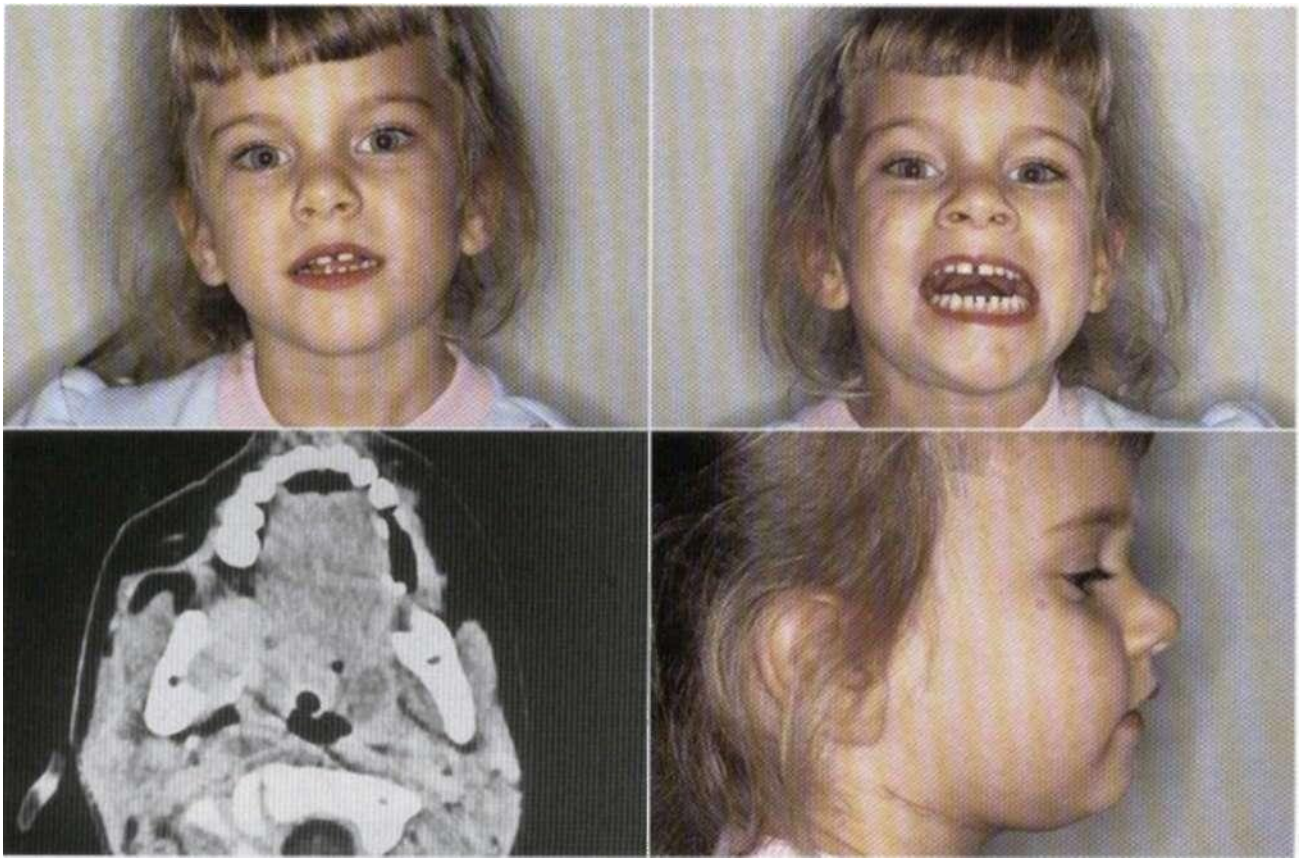
A, A variant of synovial chondromatosis in which a single collection of fused cartilaginous body was displacing the condyle from the right fossa and causing decreased range of motion, pain, and posterior ipsilateral open bite. B, Surgical specimen of condensed mass of synovial chondromatosis.

FIG. 8.7



A, Coronal CT scan showing gross displacement of the condyle from the left fossa. **B,** Erosion through the roof of the glenoid fossa into the middle cranial fossa. **C,** Surgical specimen being removed. **D,** Specimen on biopsy was read as synovial chondromatosis.

FIG. 8.8



A, B, A 5-year-old girl exhibiting progressive ankylosis and asymmetry. C, CT scan showing soft tissue mass eroding the medial surface of the mandible on the right side. D, Postsurgical lateral view of the patient showing position of the inferior mandibular incision used to excise the aggressive fibromatosis lesion on the medial surface of the mandible.

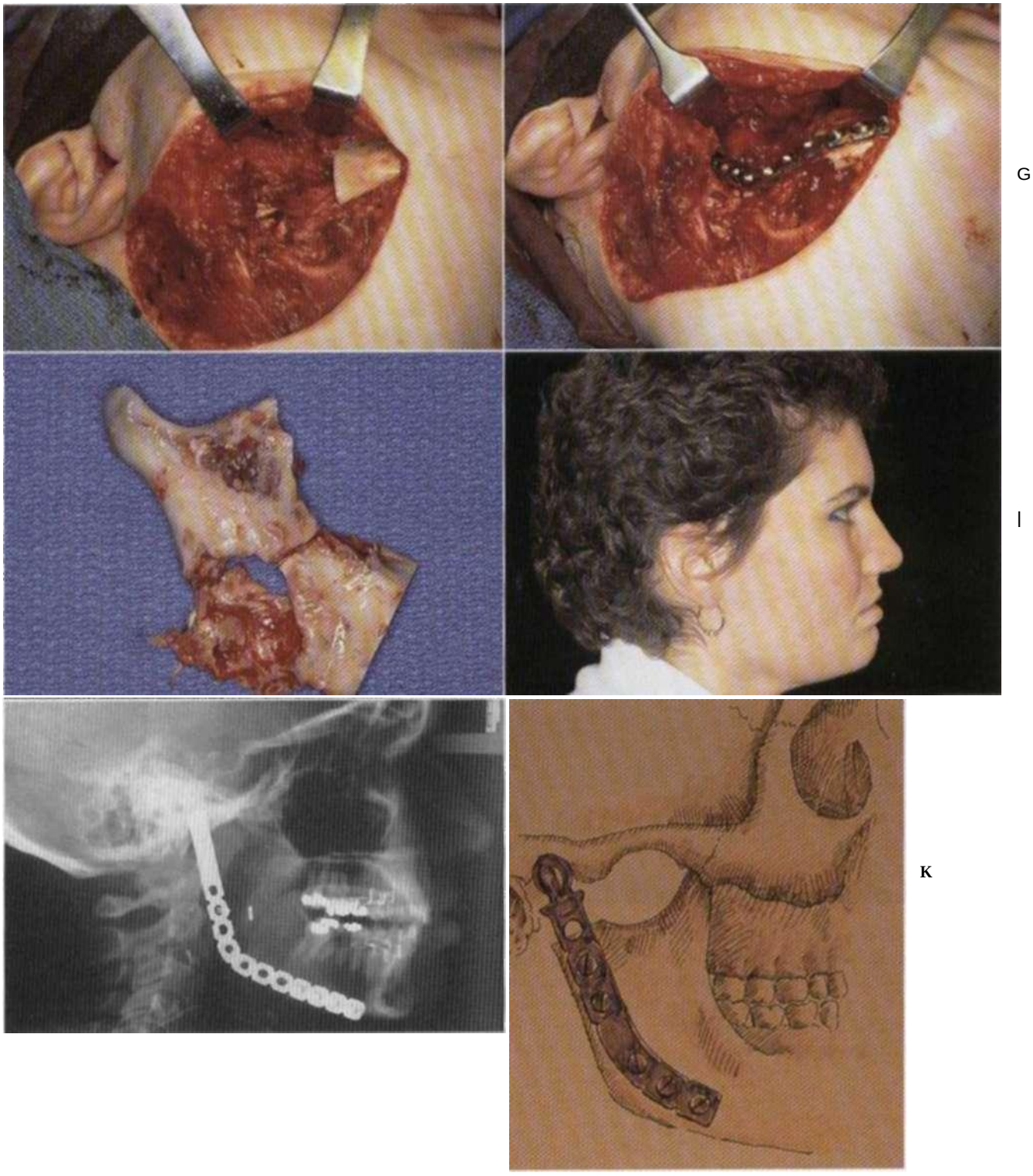
FIG. 8.9



A, B, A 26-year-old woman who had undergone five previous surgical procedures (with sacrifice of the right facial nerve) for excision of "recurrent tumor" of parotid. Biopsy proved the lesion to be aggressive fibromatosis. The axial CT scans in C and D show the two distinct lesions causing bone destruction: one is at the base of the sigmoid notch and the other at the posterior and inferior border of the mandible. E, Panorex x-ray film showing a large lytic lesion of the posterior-inferior angle of the mandible with a smaller radiolucenl lesion at the junction of the coronoid notch and coronoid process.

Continued

FIG. 8.9, CONT'D



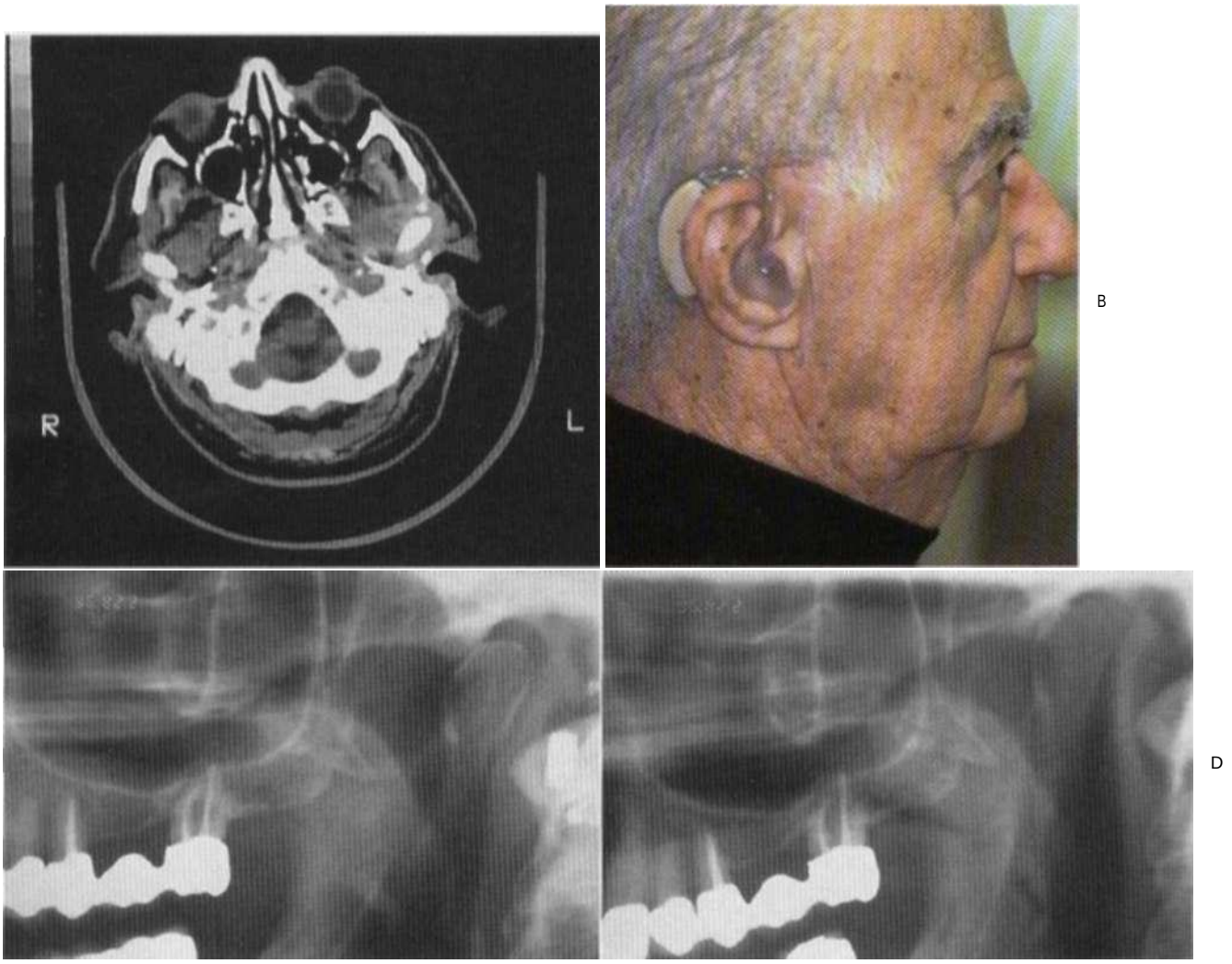
F, View of the resected mandible from a neck incision. **G,** Synthes reconstruction plate with a condylar prosthesis. **H,** Surgical specimen after resection of the mandible showing both the aggressive fibromatosis lesions depicted in the x-ray image. **I,** Lateral view of the patient showing excellent cosmesis of the surgical incision 1 year after surgery. **J,** Lateral cephalogram of prosthesis in position. Patient was scheduled for autogenous reconstruction of mandibular defect but refused further treatment because she fell that she was functioning well. **K,** Synthes reconstruction plate with condylar head.

A lesion that is classified as benign histologically but extremely aggressive clinically is aggressive fibromatosis. Also called *extraabdominal desmoid,* or *desmoplastic fibroma,* this lesion can occur in the head and neck. The mandible and perimandibular tissues are frequently involved. In some cases, the condition initially presents as trismus because the lesion expands within the masseteric space. This lesion may be extremely difficult to diagnose because it is composed of highly differentiated connective tissue with uniform fibroblasts in a collagen stroma. The lesion shows no nuclear atypia, hyperchromatism, or mitotic figures. Diagnosis of aggressive fibromatosis is often based more on the aggressive clinical behavior of the lesion than on histopathologic factors. Recurrences after conservative surgical excision are reported to be as high as 60%. Therefore the lesion should be approached surgically as a malignancy; adjuvant chemotherapy has effectively been used in recurrent cases.

The malignant lesions affecting the temporomandibular joint can originate in various articular tissues. Osteosarcoma, chondrosarcoma, and synovial sarcoma have been reported. Painful, rapidly enlarging lesions with irregular borders suggest malignant neoplasms. Erosion into the middle ear and base of the skull may have occurred at the time of initial diagnosis. The clinician must be especially careful in differentiating chondrosarcoma from synovial chondromatosis because these conditions are frequently mistaken for one another. Chondrosarcomas usually appear as lytic lesions with random areas of calcification. Mesenchymal chondrosarcoma is a highly malignant variant of chondrosarcoma that requires a radical surgical excision and often metastasizes to lung or bone.

Approximately 5% of osteosarcomas occur in the jaws. They appear most frequently in men between 30 and 40 years of age. Like osteochondromas, they commonly present as preauricular swelling with painful, rapidly enlarging lesions. Paresthesia may occur secondary to a compression neuropathy involving the inferior alveolar nerve. Variants of osteosarcoma that may affect the temporomandibular joint are the osteoblastic, fibroblastic, and chondroblastic osteosarcomas. They tend to initially appear as lytic lesions. Overall, the 5-year survival rate for osteosarcomas of the jaw is 25% to 40%, which is somewhat better than the approximately 20% 5-year survival rate for chondrosarcomas of the jaws. The recurrence rate for osteosarcoma is approximately 40% to 70%, with a metastatic rate of 25% to 50%. Common sites for metastasis are the lung and brain. Osteosarcomas are best treated by radical wide excision, and radiotherapy and chemotherapy are reserved for recurrences. (Chondrosarcomas are relatively radioresistant.)

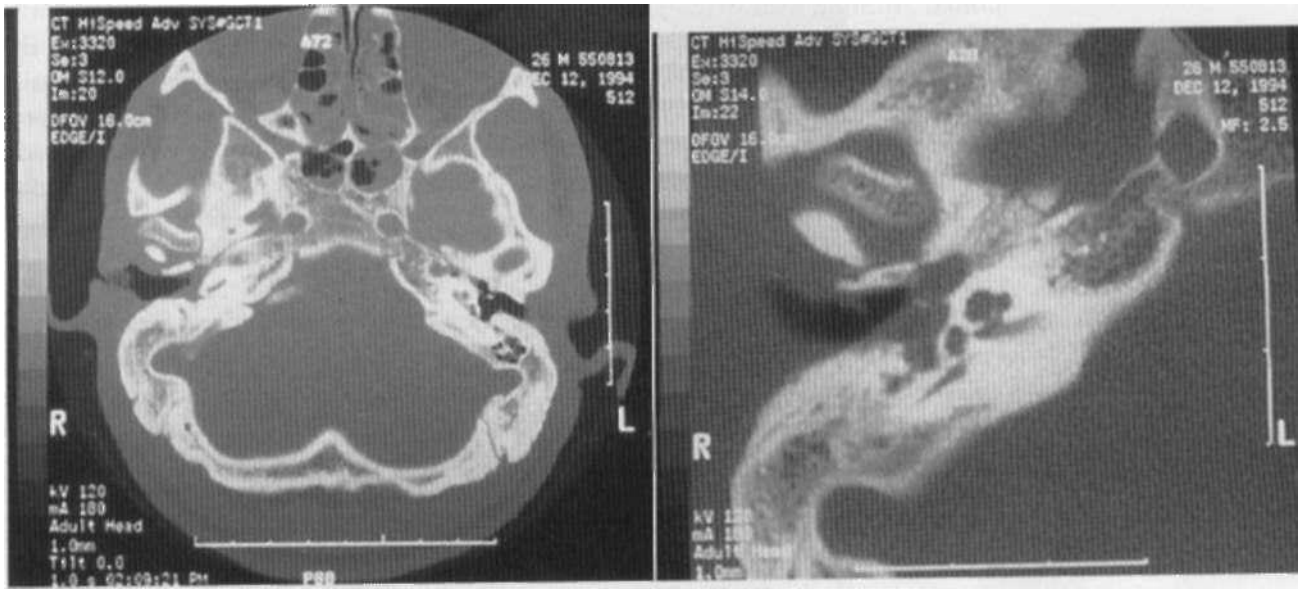
FIG. 8.10



A, Axial scan showing infiltrating soft tissue lesion of left temporomandibular joint with erosion into the base of skull. B, Lateral view of 61-year-old man with lesion in A. C, D, Preoperative and postoperative panorex x-ray films showing presurgical displacement of left condyle by space-occupying lesion in left glenoid fossa. After the lesion is debulked by open arthroplasty, the condyle seats in a more physiologic position within the glenoid fossa. The lesion was diagnosed as aggressive fibromatosis.

FIG. 8.11

A

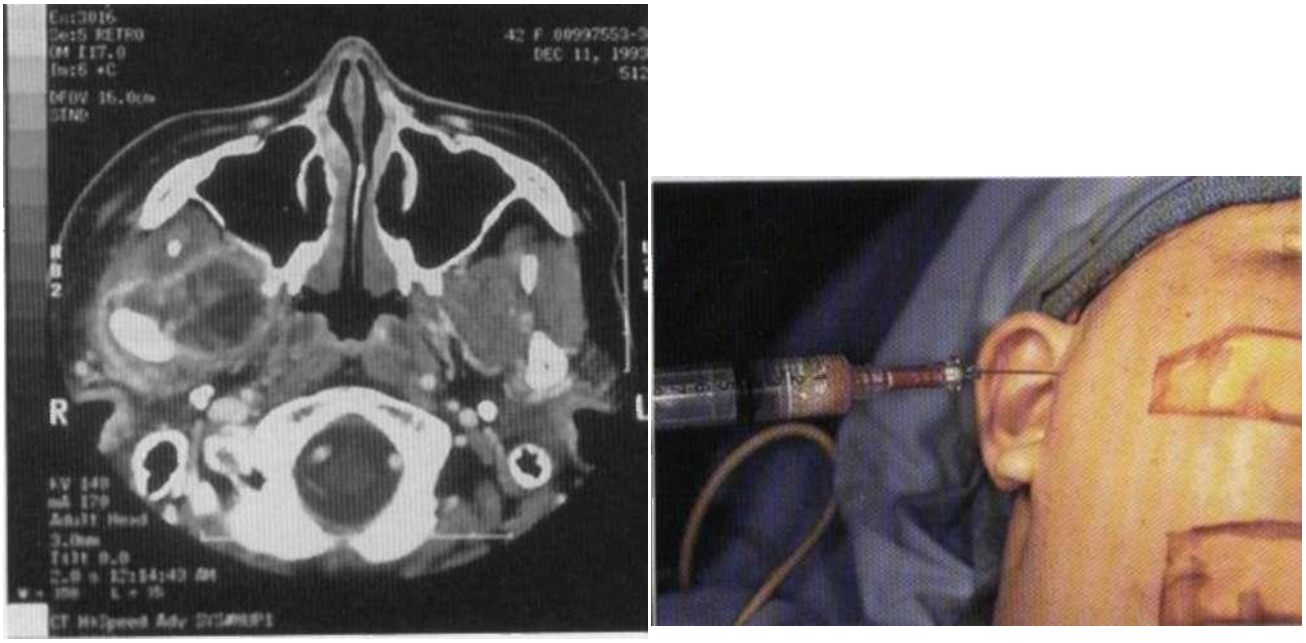


B

Axial CT scans showing cholesteatoma. The condition appears as radiopacity distal to the condylar head. Patient had the presenting symptoms of marked restriction of motion and pain.

FIG. 8.12

A



B

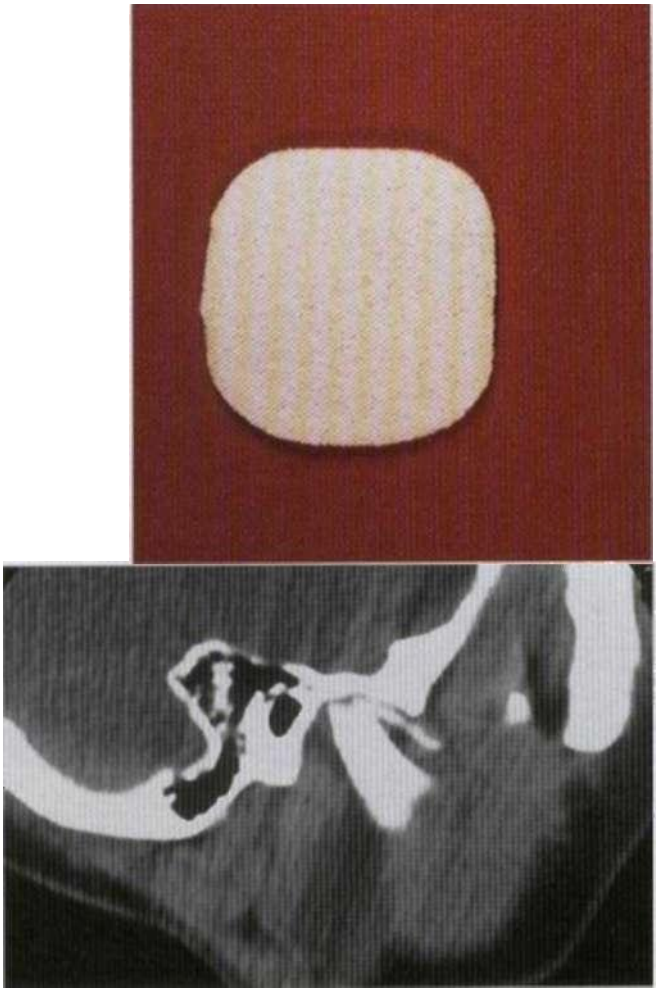
A, B, A 56-year-old man with decreased range of motion and episodic preauricular pain. B, Needle aspiration of a fluid collection depicted on the axial CT scan. Culture results proved this to be gonococcal arthritis, which was treated with antibiotics.

The most common malignancy affecting skeletal bones is metastatic carcinoma. Although only 1% of malignant neoplasms metastasize to the jaws, the most common sites for metastasis are secondary to primary carcinomas in the breast, kidney, lung, colon, prostate, and thyroid gland. Unexplained paresthesia, loosening of teeth, spontaneous bone pain, and pathologic fracture can be presenting symptoms of metastatic carcinoma. Ill-defined radiolucent lesions that do not respond to extraction or endodontic therapy demand immediate biopsy. Initial diagnosis of a metastatic lesion requires a complete workup to identify the primary site of malignancy.

Although foreign body reaction to alloplastic implants is not usually considered an inherent pathology of the temporomandibular joint, it is worth mentioning. In the early 1980s, initial success was reported with a Teflon-Proplast sheeting used as a disk replacement. Before that, block Silastic was the alloplastic material most often used after gap arthroplasty. In the mid 1980s, clinicians began to report biomechanical failure of Teflon-Proplast interpositional implants, causing condylar resorption, pain, and malocclusion. Since that time the oral and maxillofacial surgery community has become aware of the pathology of polymeric debris in the temporomandibular joint. Proplast (polytetraflouroethylene) had been used as an onlay implant for chin and zygomatic arch augmentation. Used in that context, it formed a fibrous encapsulation and was not widely known to cause any pathologic response. Unfortunately, when placed in a loaded joint, the material can fragment. This point is extremely important because it is clearly the size of the polymeric particle that determines the aggressiveness of the foreign body reaction. Particles small enough to undergo phagocytosis stimulate a multinucleated giant cell reaction that can cause marked destruction of the temporomandibular joint. When used for permanent joint implantation, silicone rubber has also been known to cause a foreign-body giant cell reaction with articular erosion. The reaction does not appear to be as aggressive as those associated with the interpositional Proplast implants. When silicone sheeting is used as a temporary replacement (as introduced by Wilkes in 1982), it stimulates a connective tissue encapsulation. This has been very successful in preventing the formation of fibrous adhesions after meniscoplasty or meniscectomy. In light of these findings, most surgeons recommend the removal of Teflon-Proplast implants. If asymptomatic patients decide against this approach, they should receive regular clinical and radiographic examinations to ensure that no adverse reactions are taking place.

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FIG. 8.13

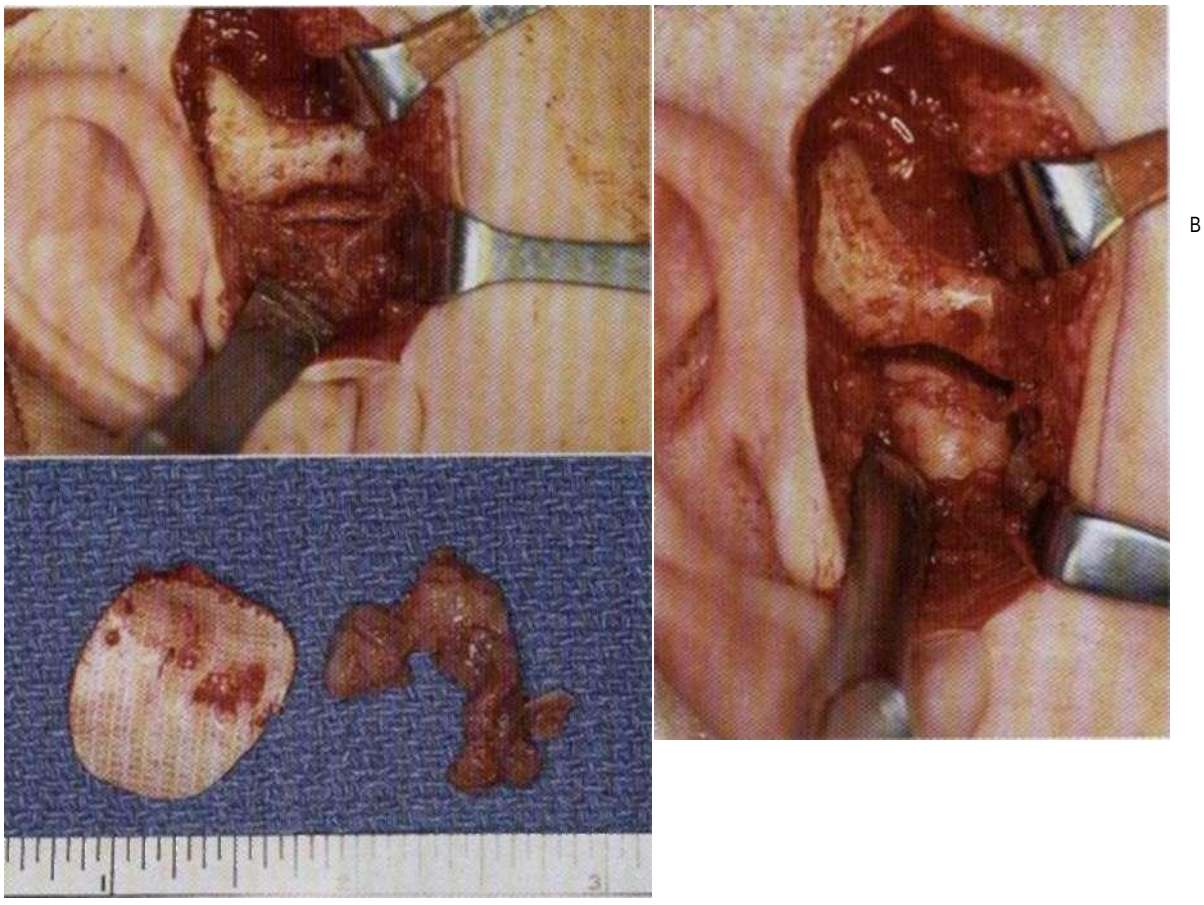


A

B

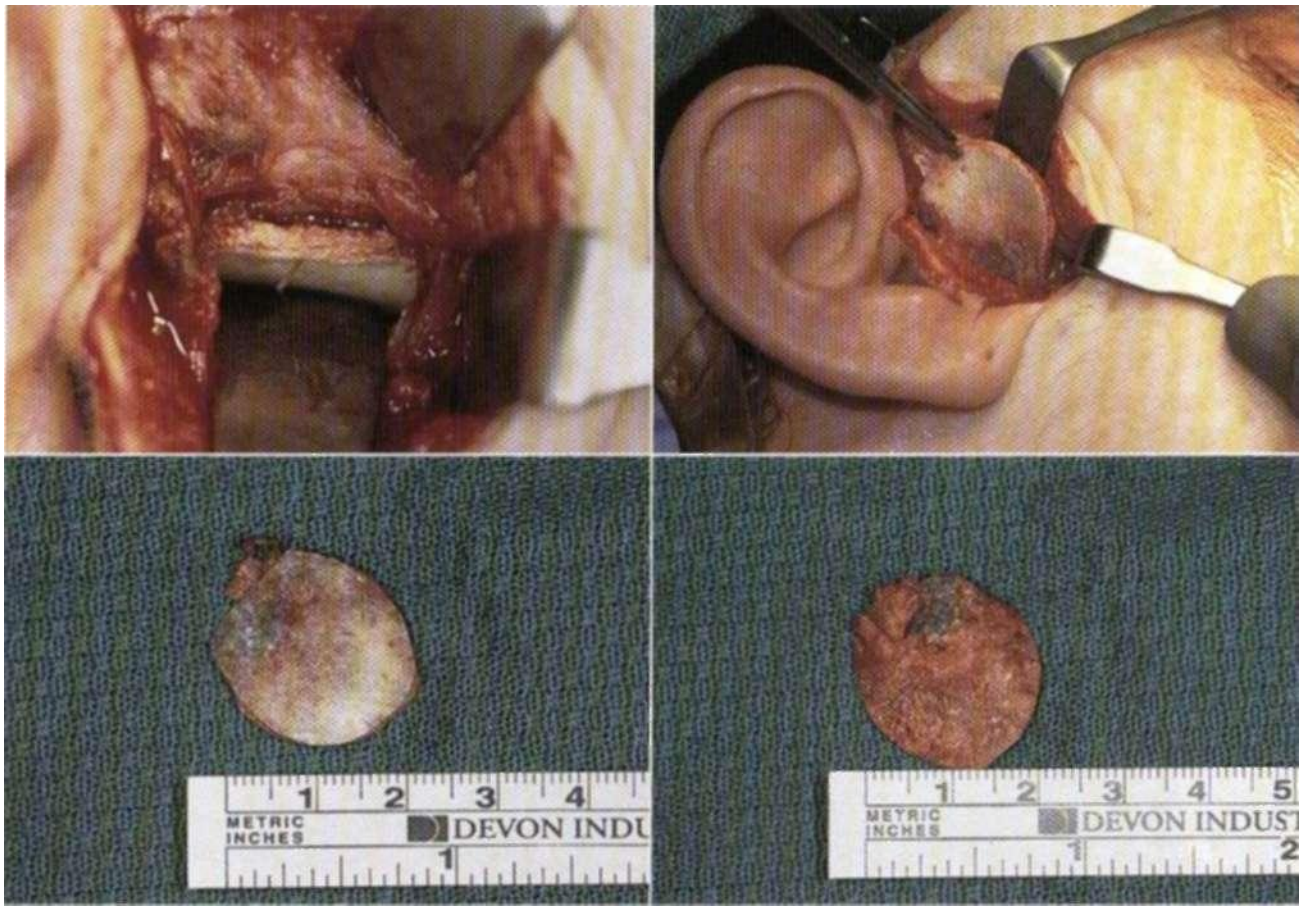
A, Proplast inlerpositional implant viewed from superior surface. B, Sagittal CT scan showing displaced Proplast interpositional implant with irregularities of condylar head.

FIG. 8.14



A, B, Proplast interpositional implant before and after removal, with significant foreign body giant cell reaction. C, Specimen showing perforation of Teflon surface of Proplast implant. Granulomatous tissue is consistent with giant cell foreign body reaction.

FIG. 8.15



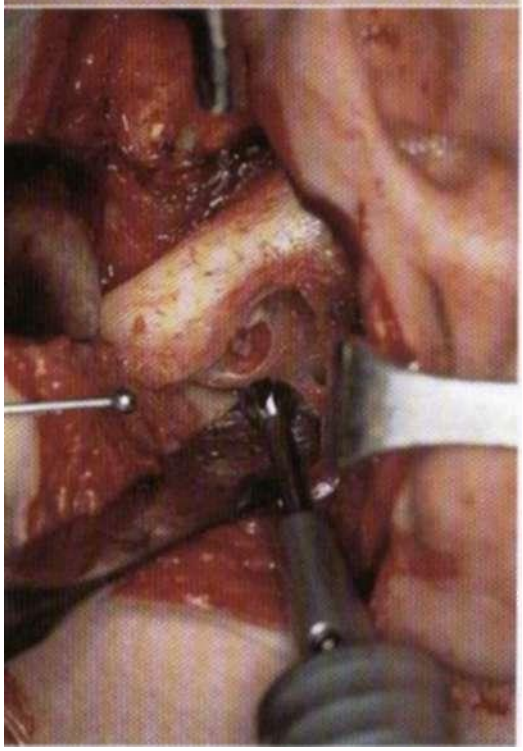
A, Intetposilional implant showing Proplasl facing glenoid fossa surface, with Teflon on inferior surface. **B,** Implant being removed, with obvious fragmentation of the Proplasl visible on the implant. **C, D,** Superior and inferior surfaces of fragmented Proplast-Teflon interpositional implant.

FIG. 8.16

A

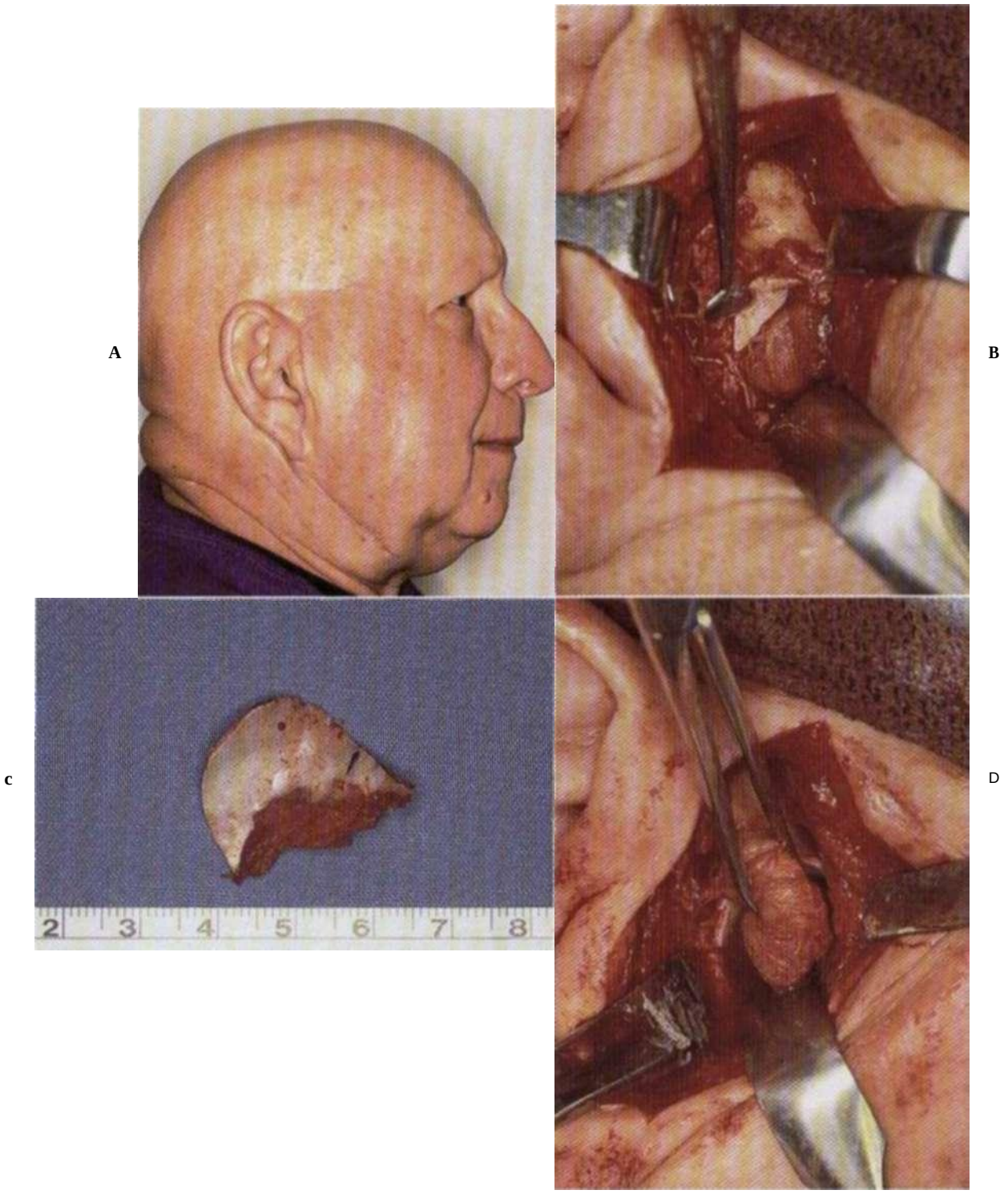


B



A After removal of proplast implant. Note erosive soft tissue mass on the posterior slope of the glenoid fosso. **B,** A large, round bur is being used to perform a peripheral ostectomy after removal of the giant cell granuloma that had caused erosion through the glenoid fossa into the middle cranial fossa. The dura was intact, and no cerebospinal fluid leak was encountered-

FIG. 8.17



A, A 58-year-old man with alopecia universalis. He had a Proplast IPI implant in place for approximately 5 years. Over the past year, he developed recurrent preauricular swelling and pain. B, Proplast implant in place with obvious medial perforation. C, Perforated implant upon removal. D, Soft tissue mass (3 cm X 2 cm) that had caused extensive erosion of both the fossa and the medial pole of the condyle. The mass was situated in the medial recess of the joint space and was classified as a giant cell tumor because of the cellularity of the lesion.

FIG. 8.18

A

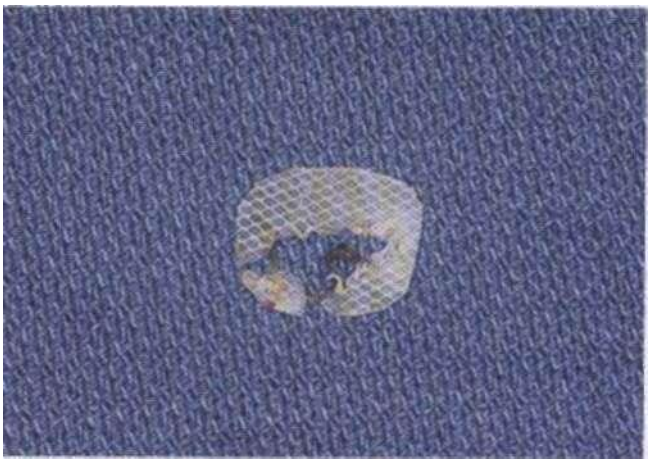




B

A, Temporary medical-grade silicone sheeting used as an interpositional implant for approximately 10 to 12 weeks after meniscectomy. The implant induced a fibrous encapsulation without evidence of foreign body reaction. B, Silicone sheeting with temporal extension used as temporary interpositional implant following meniscectomy.

FIG. 8.19



Perforated and fragmented Dacron-reinforced silastic implant.

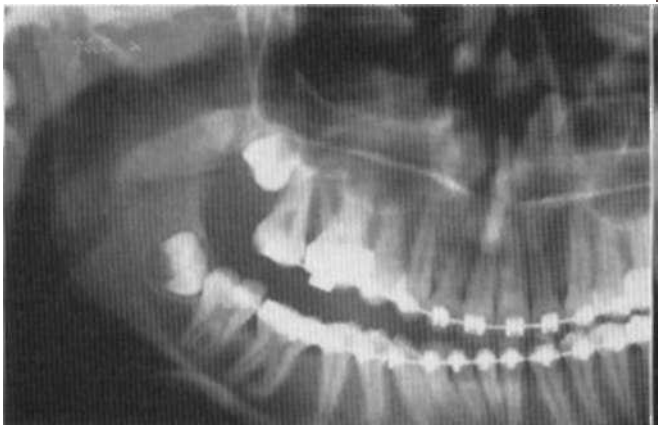
FIG. 8.20



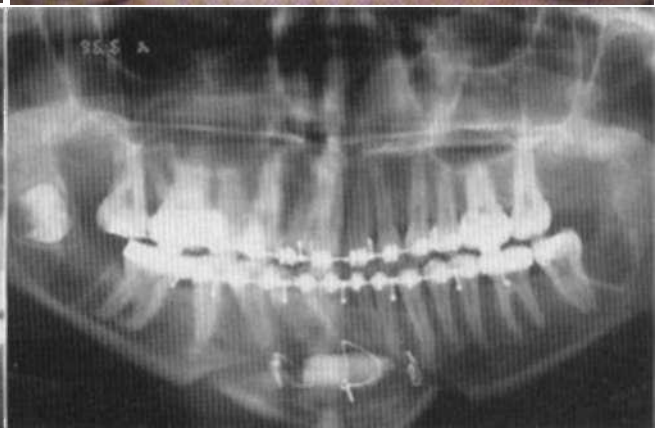
A



B



C

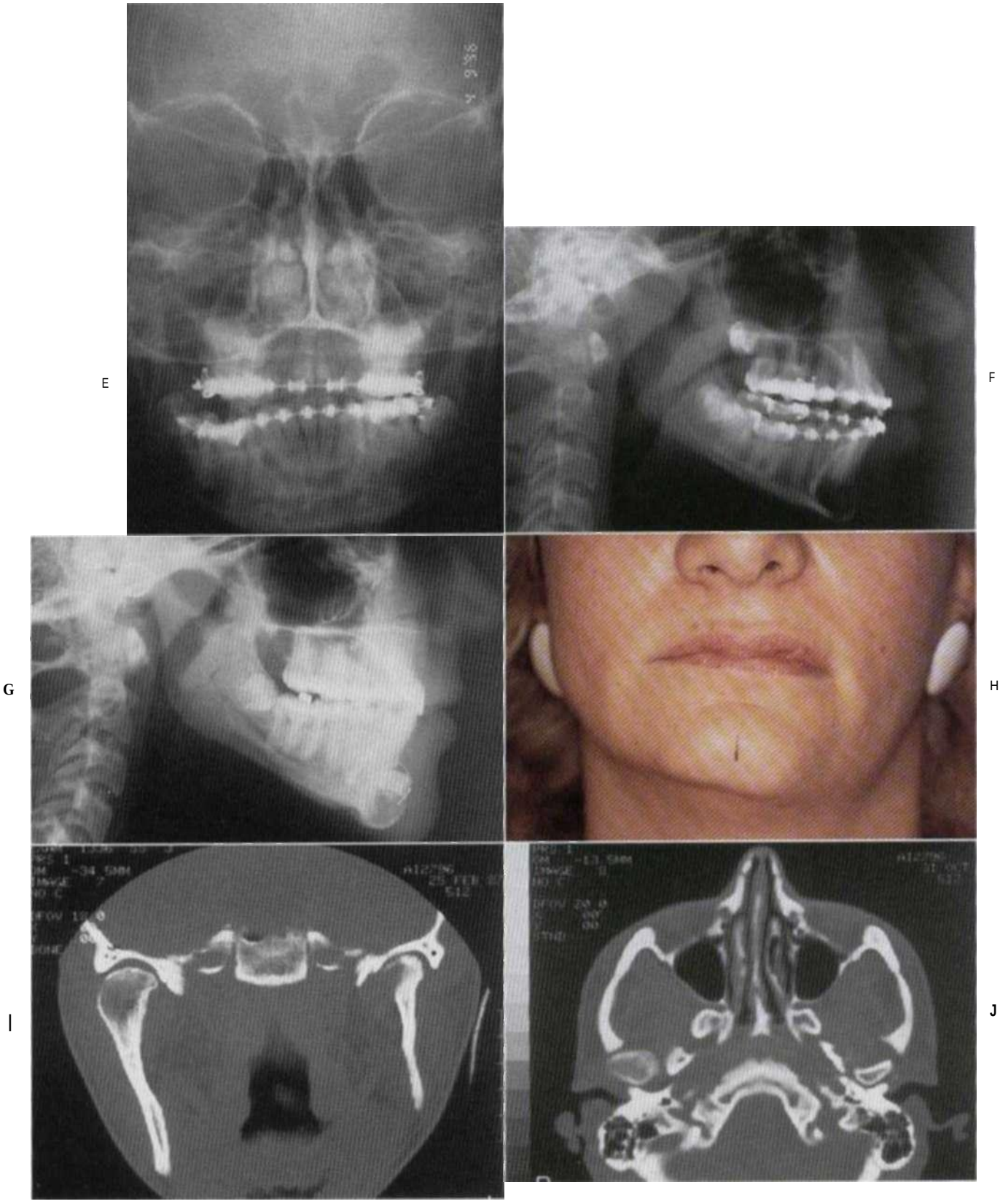


D

A, A 12-year-old girl with rapid (i.e., over a period of approximately 4 to 6 months) onset of a unilateral open bile. **B,** Intraoral occlusal photograph showing marked posterior open bite. Note that the midlines are still symmetric, which is consistent with ihe nonrelational form of condylar hyperplasia. **C,** Panorex x-ray film showing posterior open bite on the right side, with elongation of the condylar neck. The postoperative panorex **(D)** shows correction of the open bite with an intraoral vertical subsigmoid osteotomy and simultaneous correction of the symphyseal deviation via genioplosty and interpositional hydroxylapatite block.

Continued

FIG. 8.20, CONT'D



C, Preoperative posterior-anterior skull film depicting the canting of the mandibular plane. **F, G,** Lateral skull films showing right posterior open bile before and after surgical correction. **H, I,** Mandibular asymmetry secondary to condylar hyperplasia in a 36-year-old woman. Note the size differential on the axial and coronal CT scans. The condyle appears to have normal relative dimensions but is clearly enlarged in relation to the contralateral condyle. **J,** Axial CT scan showing enlargement of condylar heod.

K



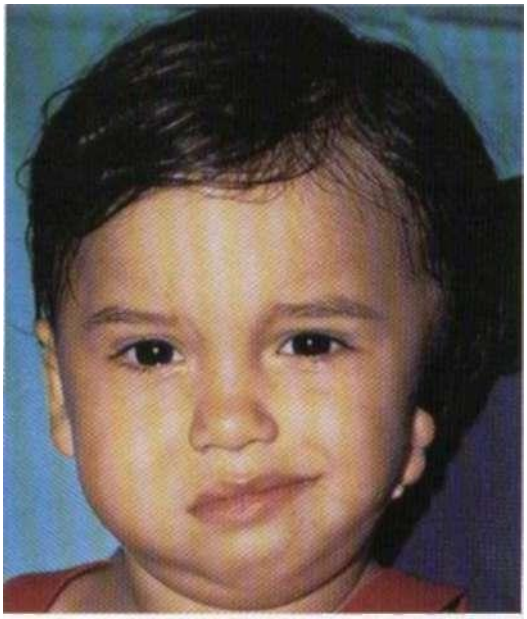
L

K, L, Occlusal films depicting condylar hyperplasia before and after cor-ection by mandibular osteotomies.

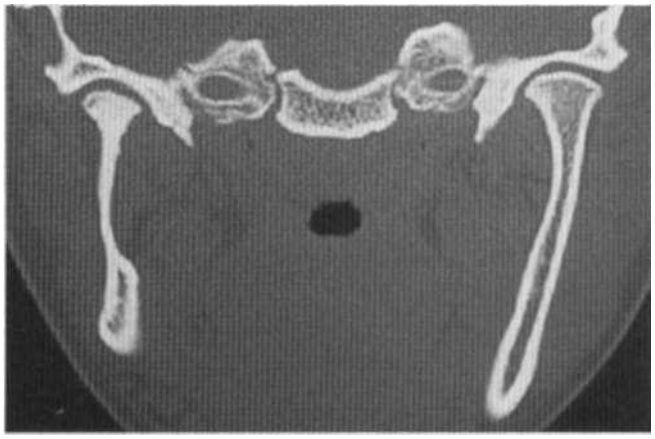
FIG. 8.20, CONT,D

Although space-occupying benign or malignant lesions can displace the condyle from the fossa and cause asymmetry with malocclusion, condylar hyperplasia can have similar presenting symptoms. Although the actual cause of this disorder is not fully understood, histologic events involve the abnormal presence of hyaline cartilage, which undergoes ossification and results in abnormal growth. In the normal condyle the articular surface is composed of fibrocartilage that undergoes appositional growth instead of endochondral ossification. Two types of condylar hyperplasia exist. In the Type I deformity, or hcmimandibular elongation, the mandible is asymmetric, with deviation of the chin to the contralateral side. In the Type II deformity, or hcmimandibular hypertrophy, deviation of the chin is not a prominent feature but a marked vertical open bite is present on the side of the hyperplasia. Condylar hyperplasia is not a true neoplasia but actually a self-limiting disorder. Radionuclide bone scans with technetium 99m can be helpful in differentiating between active and inactive disorders. Some researchers favor the use of a high condylar shave to remove the zone of abnormal tissue if the disorder is diagnosed early in its active stages. Removal of only 5 or 6 mm of the most superior condylar surface is usually adequate, and condylectomy is unnecessarily aggressive. Surgeons sometimes must perform a recontouring of the inferior border and angle of the mandible in conjunction with this procedure to address the inferior component of the mandibular asymmetry. When the bone scan shows that the process is inactive, orthognathic procedures such as an intraoral vertical subsigmoid osteotomy can be useful in closing the open bite while maintaining a functional joint articulation.

FIGS. 8.21, 8.22

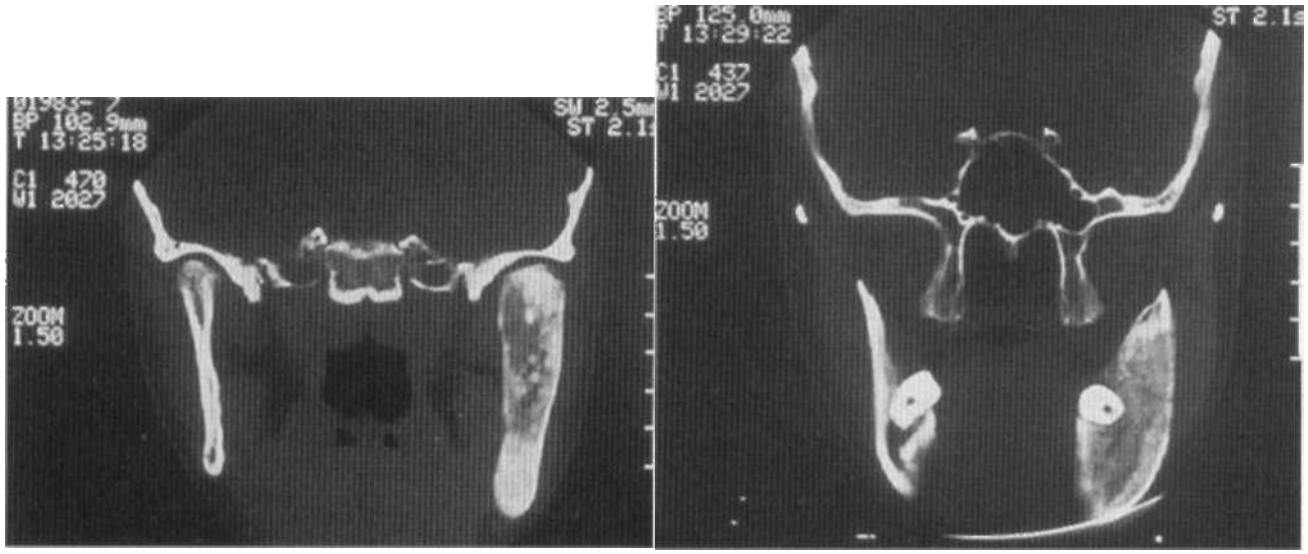


A 4-year-old boy with hemifacial microsomia. Condylar hyperplasia is not difficult to differentiate from hemifacial microsomia when there is full expression of the syndrome, but it may be difficult to differentiate condylar hyperplasia from the more mild variants of hemifacial microsomia, in which the only clinical manifestation is a diminution in the size of the condyle and ramus on the affected side.



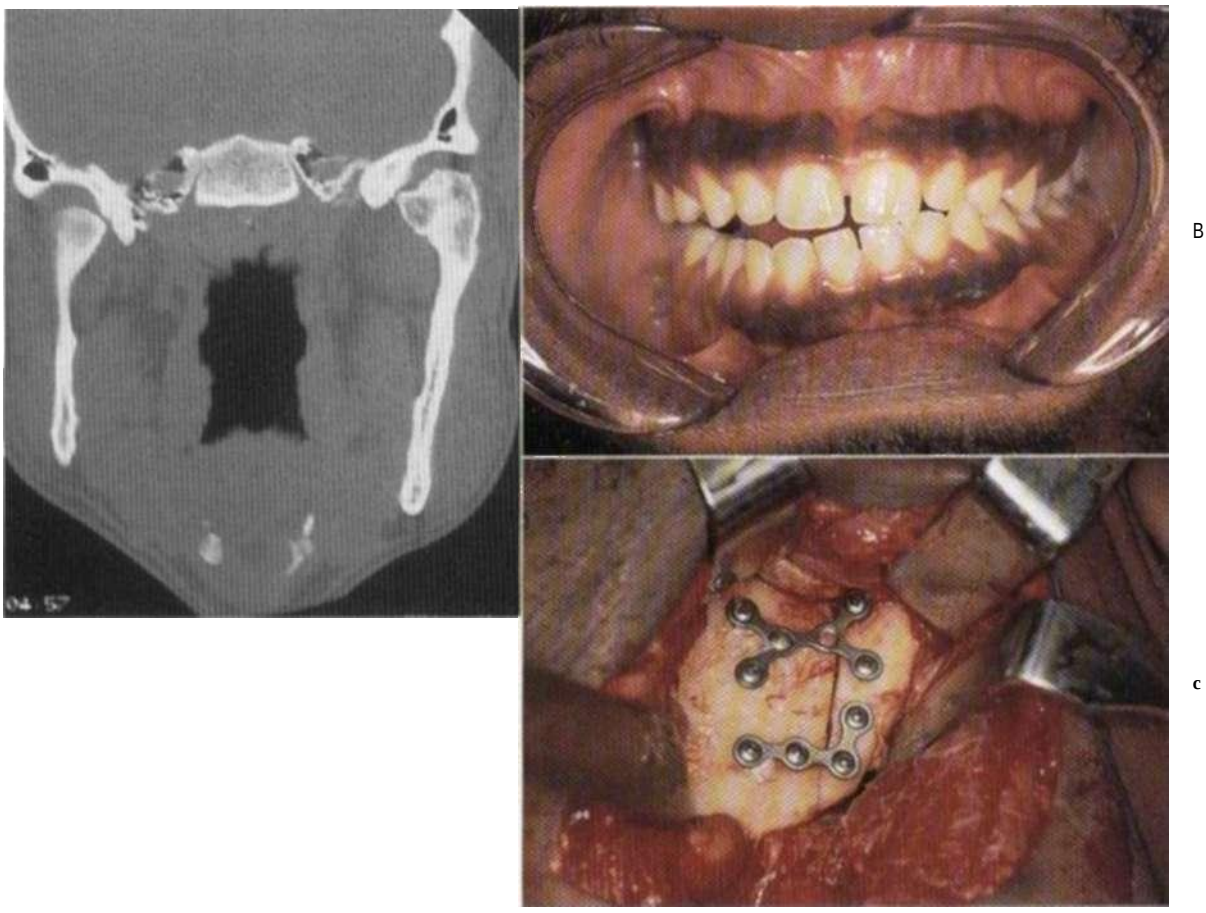
Gross deformity of right condyle, with hypoplasia and deformity of ramus and condyle secondary to a compression deformity from neurofibromatosis.

FIG. 8.23



A B

A, B, Coronal CT scans depicting gross deformity of condyle and angle region in a 14-year-old patient with facial asymmetry. A biopsy proved this lesion to be fibrous dysplasia, a type of deformity that must be differentiated from condylar hyperplasia.

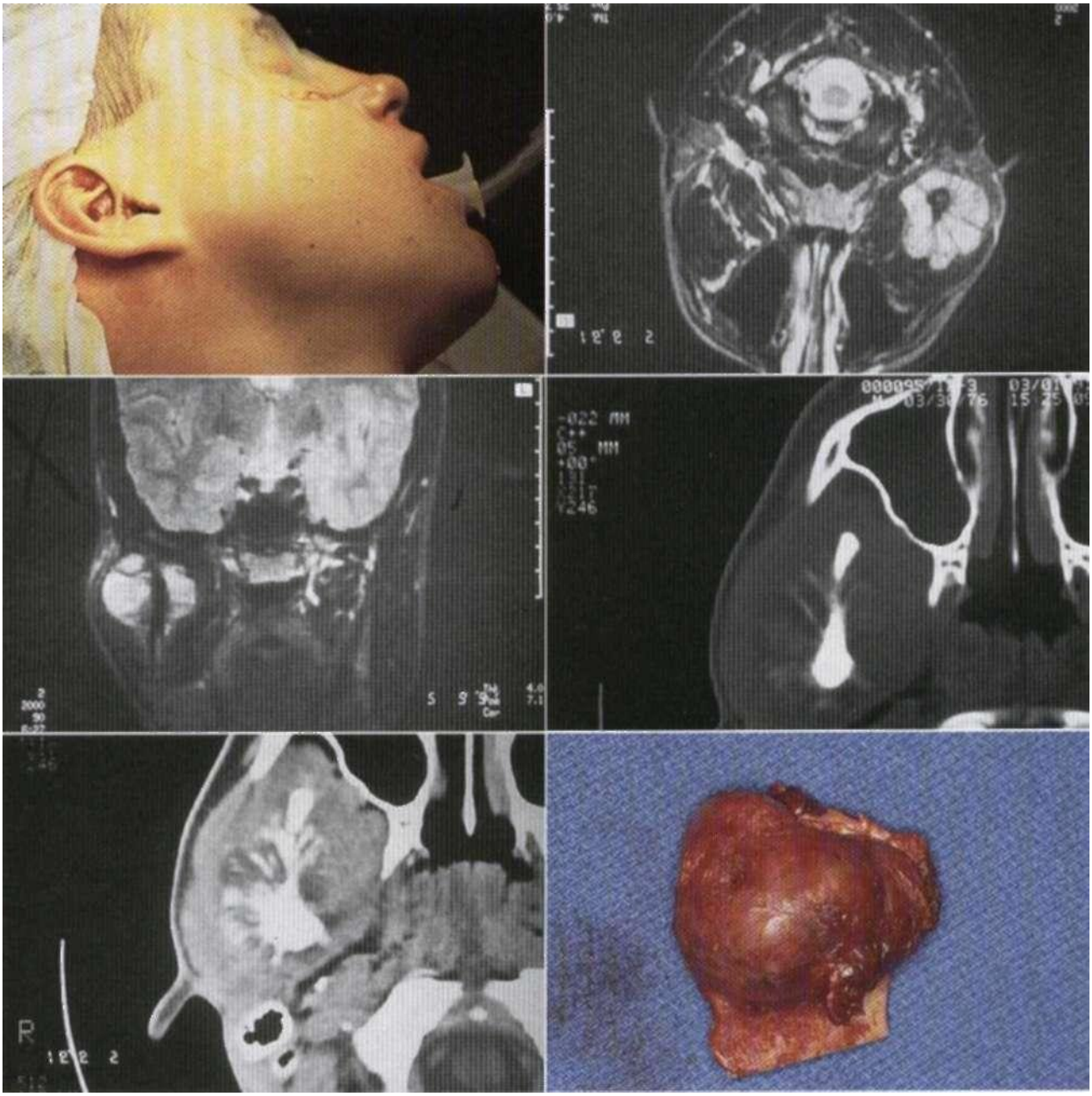


A, Condylar hyperplasia with some deformity of the condylar head, as depicted in the coronal CT scan. **B,** Rotational variant of condylar hyperplasia, with midline deviation of the mandible away from the affected side. **C,** Rigid fixation used to reposition the distal proximal segments after an exlraoral subsigmoid osteotomy was performed to correct condylar hyperplasia.

FIG. 8.24

Clinicians must be careful to ensure that they arc dealing with actual condylar hyperplasia before making this diagnosis in patients with facial asymmetry. Congenital disorders such as hemifacial microsomia and traumatic deformities on the contralateral side can be confused with condylar hyperplasia. Computer tomographic imaging in both the axial and the coronal planes should help clinicians distinguish between these disorders. Moreover, other pathologic conditions can also cause enlargement of the condyle with mandibular asymmetry and acquired malocclusions. For example, fibrous dysplasia, which can occupy the entire ramal-condyle complex, sometimes resembles condylar hyperplasia but is easily differentiated by radiologic examination.

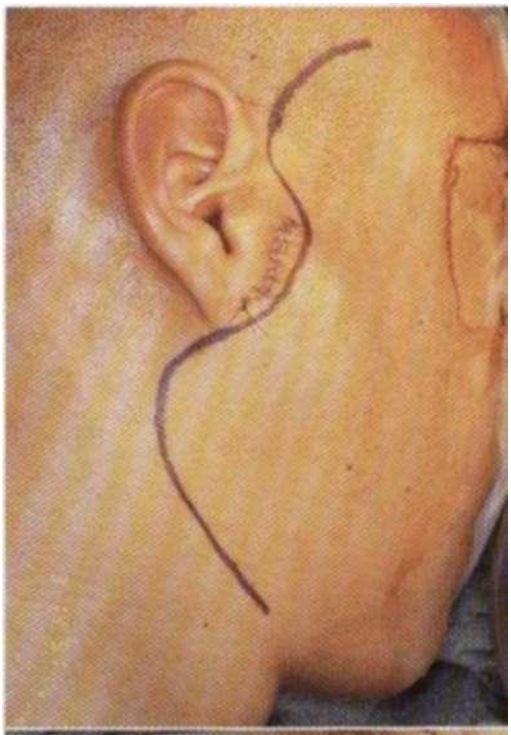
FIG. 8.25



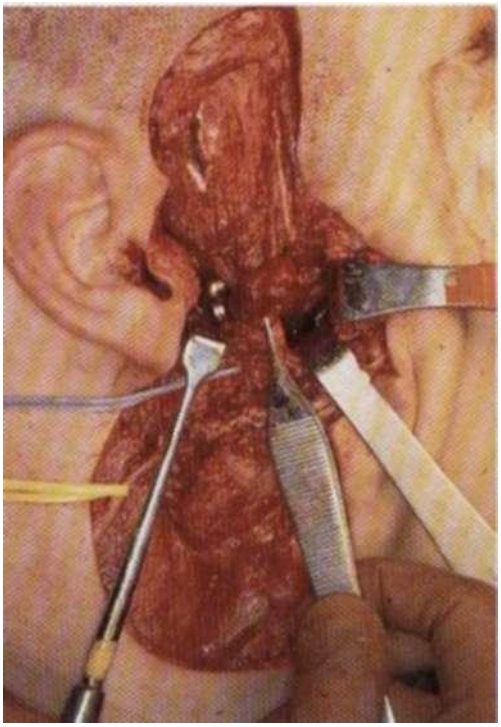
A, A 17-year-old patient with large, palpable preauricular mass. **B, C,** Axial and coronal MRI scan depicting a large moss of the condylar head displacing medial pterygoid and masseter muscles. **D, E,** Soft tissue and bone CT scans depicting irregular spicules of bone radiating outward on the periphery of the lesion. This produces the so-called sun-ray appearance of osteogenic sarcoma. **F,** Osteogenic sarcoma surgical specimen with 2-cm bony margins.

FIG. 8.25, CONT'D

G



H

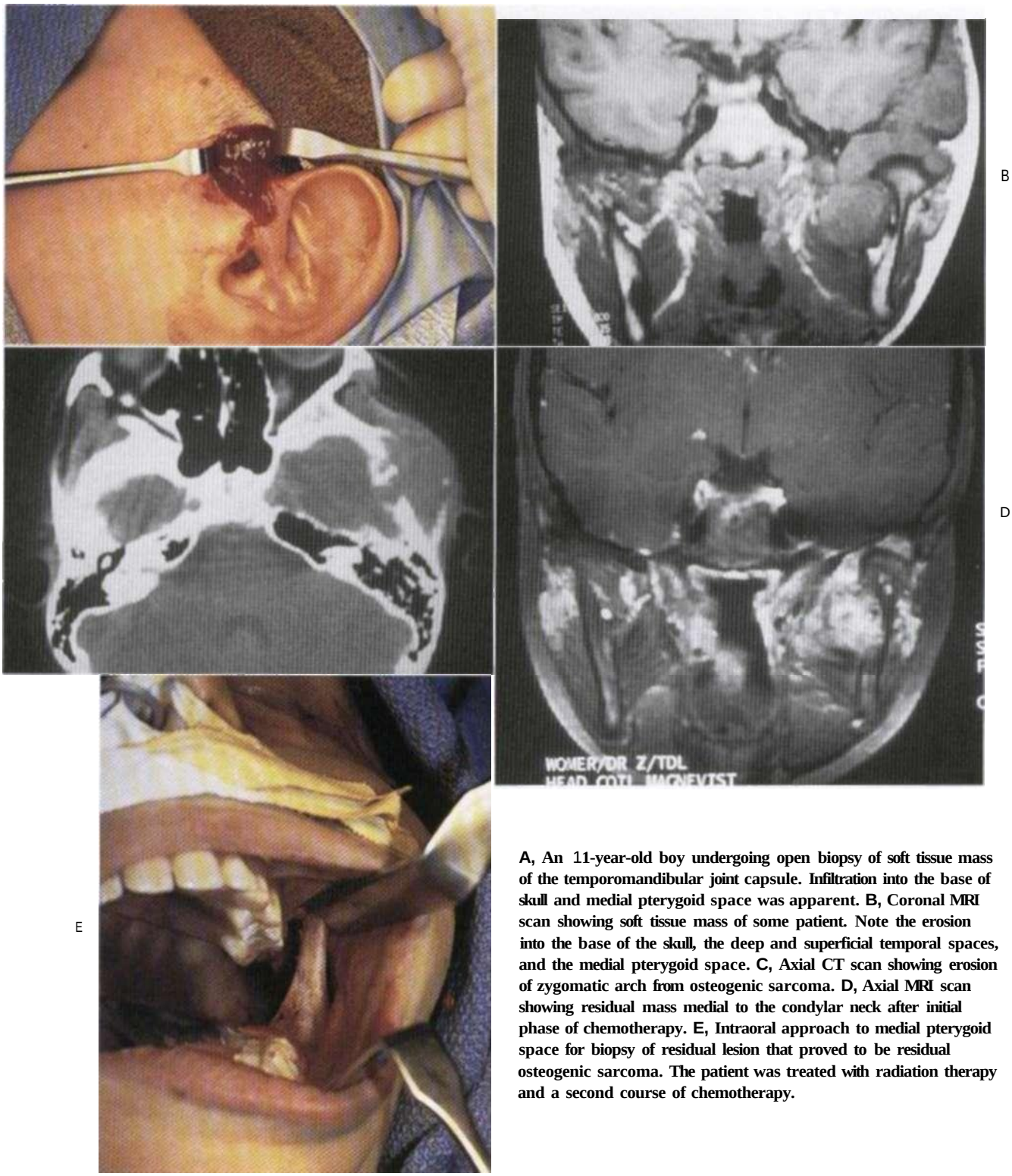


I



G, Porotidectomy type of incision with temporal extension. Biopsy site was excised with mass by extending temporal incision into an endaural incision to elliptically incise biopsy site. **H,** After resection of lesion and placement of temporary reconstruction plate with condylar head. Note the vessel loops identifying the facial nerve, which was dissected to protect it during the surgical procedure. Because the bulk of the masseter muscle was excised, the sternocleidomastoid flap was rotated anteriorly and superiorly for soft tissue cover of the reconstruction plate. **I,** Wound closure with surgical drain in place.

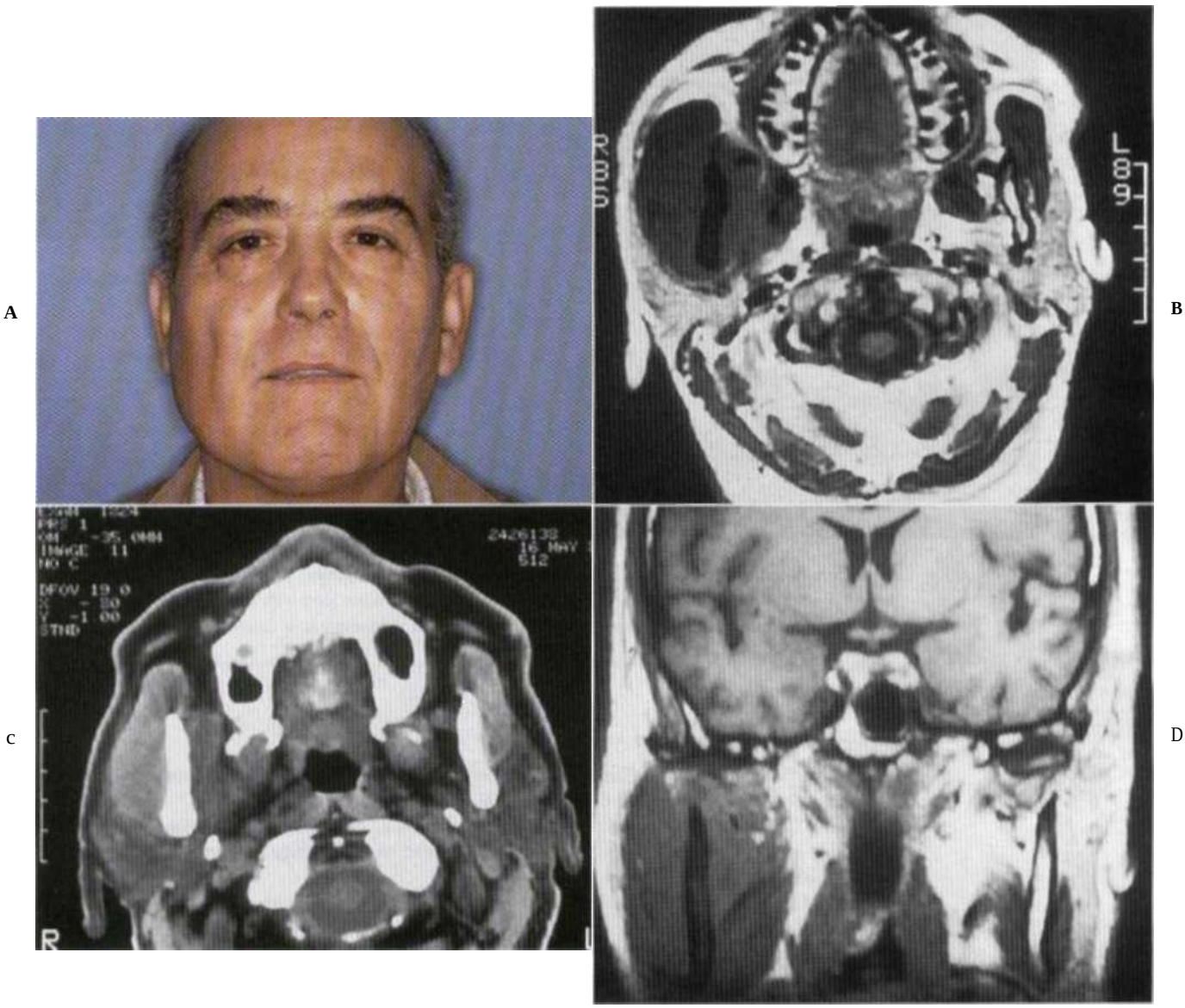
FIG. 8.26



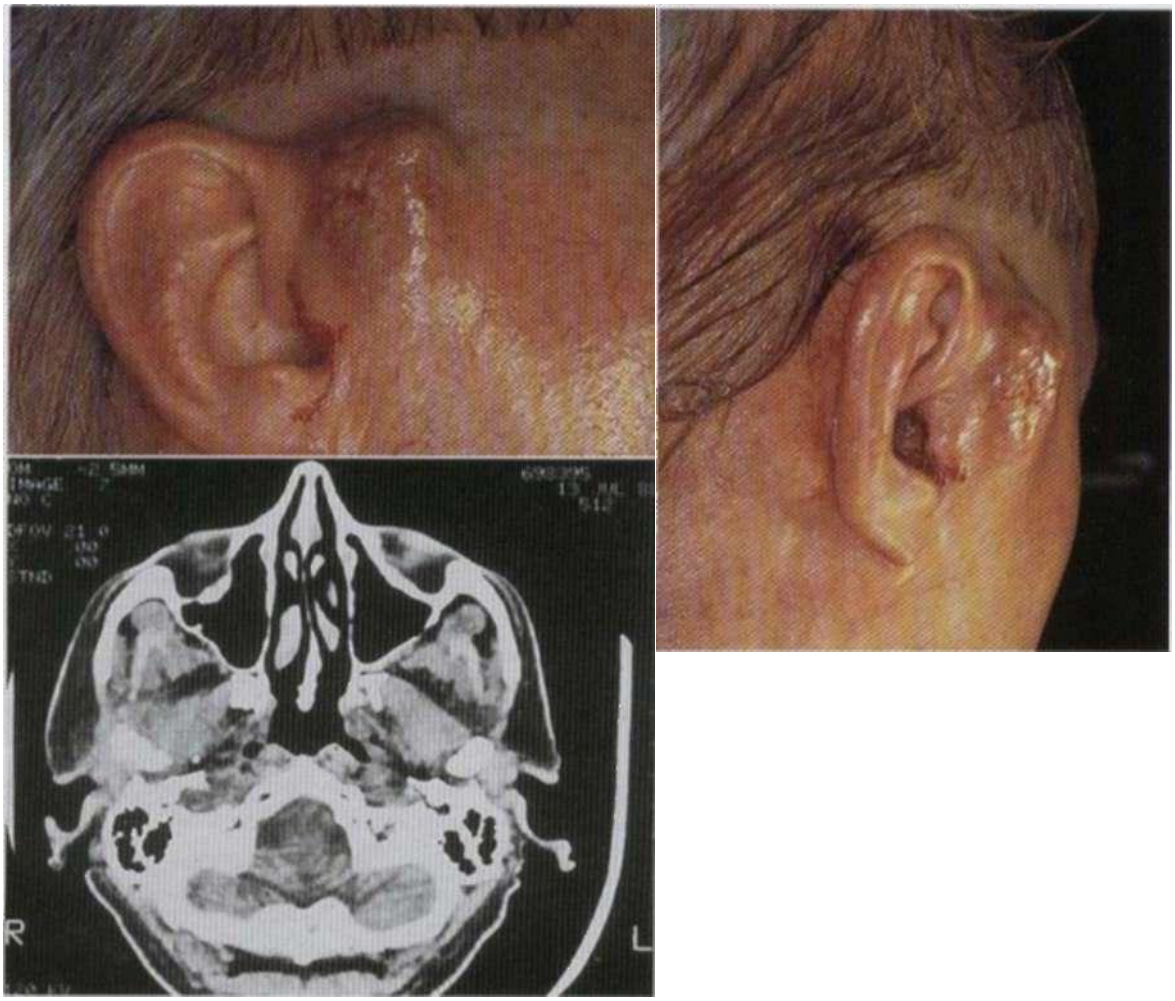
A, An 11-year-old boy undergoing open biopsy of soft tissue mass of the temporomandibular joint capsule. Infiltration into the base of skull and medial pterygoid space was apparent. B, Coronal MRI scan showing soft tissue mass of some patient. Note the erosion into the base of the skull, the deep and superficial temporal spaces, and the medial pterygoid space. C, Axial CT scan showing erosion of zygomatic arch from osteogenic sarcoma. D, Axial MRI scan showing residual mass medial to the condylar neck after initial phase of chemotherapy. E, Intraoral approach to medial pterygoid space for biopsy of residual lesion that proved to be residual osteogenic sarcoma. The patient was treated with radiation therapy and a second course of chemotherapy.

In addition to tumor infiltration of the temporomandibular joint apparatus, trismus, pain, and swelling can be caused by infectious or myeloproliferative disorders. Septic arthritis of the temporomandibular joint is easily diagnosed by computer tomographic and magnetic resonance imaging, which show a high signal collection within the joint space. Infiltrates from leukemia or lymphomas can cause diffuse enlargement of the tissues of the masticator space; fine-needle aspiration or open biopsy is of great help in diagnosing these disorders.

FIG. 8.27



A, A 61-year-old man with painless masseteric space enlargement. **B,** MRI scan showing diffuse infiltrate of entire pterygoid masseteric spread. **C, D,** MRI and **CT** scans depicting diffuse enlargement of masseler and medial pterygoid muscles, with loss of fat planes in the entire masticator space. Incisional biopsy proved this to be a non-Hodgkin's lymphoma, which was treated with chemotherapy.



A, B, Lateral and posterior views of a 55-year-old man with an exophytic preauricular mass. C, Axial soft tissue CT scan showing infiltrative lesion of right temporomandibular joint with extracapsular spread. This was subsequently diagnosed as metastatic adenocarcinoma secondary to a colon tumor.

FIG. 8.28

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