Textbook of Oral and Maxillofacial Surgery

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Chapter 20

The temporomandibular joint

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The temporomandibular joint has been the subject of considerable interest and scientific investigation for many years. It is indeed one of the most complex of the facial structures, producingt, in its various pathological states, many problems, the correct diagnosis and treatment of which are frequently neither obvious nor easily executed. However, it is not realized that many forms of therapy advocated in the past were basically incorrect, and this is evidence that much has been learned about the joint in recent years. As understanding of the function and pathology of the joint has progressed, so has the management of its many problems. Today the vast majority of temporomandibular joint problems can be corrected with adequate treatment.

Anatomy

Since a description of the temporomandibular joint is available in standard texts of anatomy, it will not be included in detail here. However, a review of the pertinent points is indicated.

The temporomandibular joint ia s ginglymoarthroidal joint differing from most articulations in that the articulating surfaces are covered with avascular fibrous tissue rather than hyaline cartilage. The articular surface consists of a concave articular fossa and a convex articular tubercle. The fossa terminates posteriorly at the posterior articular lip. This ridge prevents the direct impingement of the condyle on the tympanic bone in posterosuperior displacement of the condyloid process. Bony lips also exist at the lateral and medial borders of the articular fossa, the latter being the more prominent. The fossa continues anteriorly to the articular tubercle (eminentia articularis). The tubercle is markedly convex in its anteroposterior direction and slightly concave mediolaterally. The atnerior boundary of the tubercle is indistinct.

Condyloid process. The condyle is oval with its long axis extending in a mediolateral direction. It is more convex anteroposteriorly than mediolaterally. The articular surface of the condyle faces upward and forward so that, in a lateral view, the neck of the condyle appears to be bent anteriorly.

Articular disk. The articular disk (meniscus) is positioned between the articular surface of the temporal bone (glenoid fossa) above and the mandibular condyle below, dividing the joint into superior and inferior compartments. The disk is oval and fibrous. It is much thinner in its central portion than along the periphery. The posterior border of the disk exhibits the greatest thickness. The upper surface of the disk is concavoconvex, and the

undersurface is concave in its anteroposterior direction. The circumference of the disk is attached to the tendon of the external pterygoid muscle anteriorly; posteriorly the disk continues into a pad of loose neurovascular connective tissue that extends to and fuses with the posterior wall of the articular capsule. The remaining circumference of the disk is attached directly to the capsule.

Capsule. The capsule is a thin, ligamentous sutructure that extends from the temporal portion of the glenoid fossa above, fuses with the meniscus, and extends below to the condylar neck. The superior portion of the capsule is loose, permitting the anterior gliding movements of normal function, whereas the inferior portion is much tighter where the hinge movements occur.

Synovial membrane. The synovial membrane is a connective tissue membrane that lines the joint cavity and secretes synovial fluid for lubrication of the joint.

Ligaments. The temporomandibular ligament extends from the zygomatic arch inferiorly and posteriorly to the lateral posterior border of the condylar neck. It is the only ligament that gives direct support to the capsule. The sphenomandibular and stylomandibular ligaments are considered accessory ligaments. The former is inserted at the lingula of the mandible and the latter at the angle of the mandible.

Neural and vascular components. Posterior to the articular disk is a loose pad of connective tissue containing many nerves and the blood vessels. The sensory nerves are derived from the auriculotemporal and masseteric branches of the mandibular nerve and are proprioceptive for pain perception. The vascular network consists of arteries arising from the superficial temporal branch of the external carotid artery.

The Painful Temporomandibular Joint

Considerable attention has been devoted to the diagnosis and treatment of the painful temporomandibular joint since Goodfriend published the original work in 1933, followed shortly afterward by the widely read work of Costen in 1934. As a result of these two contributions and continuing study by oral surgeons, prosthodontists, periodontists, orthodontists, and other interested investigators, much knowledge has been accumulated in this challenging field. Many patients with previously undiagnosed facial or head pain have had the benefit of a concise diagnosis and increasingly effective treatment since that time.

Etiology

Temporomandibular arthralgia is usually attributed to one or a combination of the following factors:

1. Occlusal disharmony.
2. Posterosuperior displacement of the condylar head resulting from a decreased vertical maxillary mandibular relation.
3. Psychogenic factors producing resultant habits of bruxism and muscle spasm.
4. A sincle act trauma.
5. Acute synovitis resulting from acute rheumatic fever.
6. Rheumatoid arthritis.
7. Osteoarthritis.

Many of these factors will be discussed later, so it is not necessary to discuss them in detail here. It is important to note, however, that the role of the decreased maxillary-mandibular relation in the production of joint pain has been greatly minimized in recent years. When it is seen clinically, it is usually either in patients wearing full dentures or in individuals who have been tobacco chewers for many years, so that considerable tooth structure has been lost by occlusal attrition. In either circumstance it is not a frequent cause of difficulty per se, and in patients with full dentures, the deficiency is usually corrected by simple reestablishment of a proper maxillomandibular space. It must be clearly understood that muscles cannot be extended beyond their normal physiological limit. Any contest that is set up between the muscles of mastication on one side and bone, teeth, and gingiva on the other will always be won by the muscles. Instead of setting up such a contest, a precise attempt should be made to adjust the maxillomandibular opening to its normal position. Occlusal disharmony and psychogenic factors are the most common etiological agents and are frequently seen together.

Symptoms

The symptoms arising from dysfunction of the temporomandibular joint are varied. All the various symptoms may occur in one patient, whereas in another only a single symptom may be present. It is therefoore of importance that the patient be allowed to describe his symptomatology in detail, and if necessary, the attending clinician may then follow this up with pertinent questions relative to the complaint. The symptoms that are classically present in this syndrome, in the order of their rate of occurrence, are as follows:

1. Pain anterior to the ear, usually unilateral and extending anteriorly into the face; especially marked during use of the jaw.

2. Snappling, cracking, or grating sensation in the joint area during mastication.

3. Inability to open the mouth normally without pain.

4. Pain in the postauricular area.

5. Pain in the temporal or cervical areas usually associated with facial pain.

6. Inability to close the posterior teeth completely into occlusion on the affected side.

7. Rarely pain in the lateral surface of the tongue; usually associated with other more specific joint symptoms.

Of these symptoms, the first three are classic and are seen in the vast majority of patients with pain of temporomandibular joint origin. The remainder of these symptoms are usually seen in addition to these three.

Clinical findings

Clinical evaluation is of great importance and must be done with meticulous care. To ensure proper evaluation a routine examination should be developed that is sufficiently inclusive to rule out errors of omission. The clinical signs that are found on examination, in the order of their rate of occurrence, are as follows:

1. Tenderness over the affected temporomandibular joint during normal opening and closing motions. This is best elicited by placing the examining fingers at the posterosuperior aspect of both condyles and expressing pressure anteriorly during their excursion. This finding is consistent and must be present to justify a positive diagnosis of temporomandibular arthralgia. Some discomfort is usually experienced in the normal joint by this diagostic test, but on the pathological side, the tenderness is greatly accentuated in comparison to the unaffected joint.

2. Deviation of the jaw to the affected side during the normal opening motion. This is a common finding, since muscle spasm frequently accompanies joint dysfunction and, as such, contributes to the pain that ensures. This restricts the motion of the condyle, impairing or completely eliminating the forward gliding motion so that all that remains is a simple hinge action, with the condyle remaining in the fossa. It may also indicate that the joint has degenerated to the point of fibrous ankylosis. It is a significan clinical observation.

3. Crepitation during jaw excursion. Crepitation may be audible, palpable, or both. It is easily discernible with the stethoscope but is usually noted on simple palpation directly over the condylar head during the opening movement.

4. Discrepancy in occlusion. Occlusal discrepancies may be immediately obvious by casual observation or may require careful inspection and study, including the use of articulated models. The common occlusal discrepancies include the following:

a. Acquired malocclusion. The loss of any tooth or teeth without replacement at an early date is frequently followed by at least a local disruption in occlusal balance by drifting and tipping of the teeth surrounding the edentulous area. This acquired malocclusion disrupts normal occlusal function by producing cust interference and prematurities of contact that contribute greatly to alteration in joint function and the subsequent development of pain. This alteration, when combined with nervous tension, is the most frequently noted clinical state. Its correction requires treatment that may vary from simple extraction of an extruded maxillary third mollar to extensive occlusal adjustment and so-called equilibration. Such adjustments should be done by someone especially trained and qualified in the correction of occlusal discrepancies.

b. Inherent malocclusion. Many deviations are found from the ideal concept of balanced occlusion. Despite the fact that the teeth may be acceptable cosmetically, either naturally or as a result of orthodontic therapy, cusp interference may be considerable in a dentition in which no teeth have been lost. Here again a nervous tension state is frequently the factor that produces muscle spasm and bruxing habits.

However, purely mechanical factors may also produce joint pain. An example of this is the maxillary third molar that erupts in a posterolateral direction to that it eventually is inthe excursion pathway of the anterior border of the ramus of the mandible. This causes deviation of the mandible to miss the third molar during normal chewing movements, which may in turn cause a sufficient alteration in physiology to produce an acutely painful joint. Treatment, of course, consists primarily of extraction of the offending tooth to allow the reestablishment of normal jaw excursion.

c. Improper dental restorations. When dental structures are repaired or replaced, procedures are frequently done without proper consideration for occlusal function. In the vast majority of the population, this is not particularly important. However, in others the end result

is either periodontal alveolar bone loss or development of a painful temporomandibular joint. Again, an important contributing factor is nervous tension, with subsequent clenching, clamping, or grinding of the teeth. It is important therefore to check the history of insertion of dental restorations or replacements in relation to the onset of joint pain.

5. Nervous tension. This background factor may not be immediately apparent, but it must be recognized as an active factor in the production of joint pain. Its early recognition as an important factor in a given case may well make the difference between success and failure in treatment. Its importance as an etiological agent can be readily appreciated when it is realized that although great numbers of patients have occlusal disharmonies with cusp interference or even loss of vertical dimension, only a few actually develop joint symptoms. Conversely, those who do suffer with joint pain usually have occlusal disharmonies that are no greater than those of the average population who have no temporomandibular joint problem in any form. The clenching, clamping, and grinding of the teeth are direct results of tension and produce a state of muscle fatigue that in itself may be preoductive of pain even though the joint may not be involved.

Roentgenographic findings

Proper roentgenographic study should include dental roentgenograms as well as films of the temporomandibular joints. Joint films should be obtained in all cases to classify the type of joint derangement and also to provide a basic record for future reference if the patient develops additional difficulties in the ensuing years. These films should include the normal as well as the painful side to provide proper comparison and should also include both open and closed positions to give an indication of jaw function and possible muscle spasm.

Adequate diagnostic roentgenograms are sometimes difficult to secure. Several techniques are available, and one should be selected that gives the most consistently good results in a given operator's hands. When deviations from normal are seen or are questionable, the routine transcranial films should be supplemented by laminograms of the condylar head. Laminograms are not a routine part of study of the typical patient with temporomandibular joint pain. Interpretation of films is also difficult for the inexperienced observer and requires much patience, persistent study, and correlation of clinical and roentgenographic findings. In viewing them it is important to first become oriented to the position of the condyle and glenoid fossa. Often there will be superimposition of other structures over the joint area, further masking the true findings.

The following variations from normal are most frequently noted:

1. Restriction of motion of one or both condyles. This finding is usually unilateral and may indicate either beginning ankylosis or simply muscle spasm. In either event it will immediately verify a clinical impression of joint dysfunction on that side. It is one of the most significant and most frequently seen positive findings.

2. Haziness of the joint space in both the open and closed positions. This is usually indicative of acute inflammation within the joint.

3. Posterosuperior displacement of the condylar head resulting from a decreased vertical dimension. This is difficult to interpret because of variations that may occur in angulation of the films.

4. Erosion or demineralization of the condylar head. This may be a reflection of a generalized metabolic dysfunction, localized osteoarthritis, or may be the result of a localized tumor process. Its presence calls for careful evaluation.

5. Proliferative changes or osteophyte formation, which are portrayed by a diffuse enlargement of the condylar head or by relatively opaque projections from the articular surface into the joint space.

6. Subluxation or luxation of one or both condyles. Relaxation of the supporting ligaments will occasionally allow the condyle to extend anteriorly beyond its normal open position. This may be manifested by true luxation (dislocation) that requires assistance for reduction, or it may be merely an overextended excursion anteriorly that is self-reducing (subluxation).

It should be noted that although many patients have demonstrable roentgenographic changes, others may have persistent pain without demonstrable roentgenographic evidence of abnormality. When this circumstance exists, it is usually the result of an early disease process, or the patient may simply have pain of muscle or myofascial origin without true intra-articular involvement.

Treatment

The treatment of temporomandibular joint arthralgia has varies considerably in the past, but in more recent years a relative unanimity of opinion has existed. At present the treatment program should be considered to be in three progressive stages: conservative supportive and corrective therapy; injection therapy; and mandibular condylotomy.

Conservative supportive and corrective therapy. Every patient who has temporomandibular joint pain should be placed on a specific program that is designed to reduce local inflammatory changes as promptly as possible. Some parts ofthe program should be continued indefinitely, although others can be discontinued as the patient gradually becomes more comfortable. However, all patients should understand that even though relief is obtained by conservative treatment the joint may again become painful if it is subjected to undue stress. Because of this, they should use the jaw with sensible caution in future years.

Placing the joint at rest. This is accomplished in a relative fashion by placing the patient on a regimen consisting of a soft diet and limitation of motion. It is generally unwise to completely eliminate motion by interdental ligation, since this may cause an exacerbation of pain by compression of the condyle against the meniscus and periarticular structures, which are already involved in some degree of inflammation, and will not in itself eliminate bruxism that may be present. Voluntary limitation of motion and subsistence on a soft diet allow the joint structures to rest insofar as possible so that the inflammation and edema that are present may gradually recede. Opening of the jaw should be restricted to whatever opening is possible without production of pain. This reduces the stimulus of pain and therefore tends to reduce the accompanying muscle spasm.

Application of heat. Muscle relaxation is also aided by the application of heat to the affected area. An electric heating pad is the most practical form to use, although moist packs may also be of considerable benefit. An electric pad can be used with care at night and early morning when muscle spasms are frequently the most bothersome.

Analgesics. Buffered acetylsalicylic acid, 0.6 g taken four times daily, will do much to eliminate discomfort by its analgesic action, thereby reducing muscle spasm and trismus. It should always be given by prescription with definite directions to maintain the dosage schedule faithfully during the active treatment period. This usually involves approximately 4 to 6 weeks and bears no contraindication unless the patient is allergic to acetylsalicylic acid, symptoms of gastric intolerance occur, or the patient is taking anticoagulants. It is most effective if taken 15 to 20 minutes prior to meals with a full glass of water, with the final daily dose at bedtime.

Sedatives and tranquilizers. Most patients with a painful temporomandibular arthralgia have considerable nervous tension, which is usually a contributing factor to their problem but on occasion may be secondary to the continuing pain. Mild sedation is therefore in order. Amobarbital (Amytal), 60 mg taken four times daily, is effective and is not depressing. Diazepam (Valium) is an effective tranquilizing agent and induces muscle relaxation as a side benefit. Dosage varies from 2 mg three times daily to 5 mg four times daily in severe cases. It should never be used in association with alcohol, since it has a significant potentiating effect.

Regular exercise. Muscle spasm and tension are both relieved considerably by a program of regular daily physical exercise. Out-of-door exercise that is associated with sports is preferred but not entirely necessary. Daily out-of-door walks or bicycling is excellent and is especially effective for the otherwise sedentary individual. The greater portion of patients of this type are women, and as a group they are prone to naturally refrain from physical exercise. However, they should be urged to adopt a well-balanced physical exercise program and to continue it indefinitely. If the patient is especially tense, an evening walk followed by a warm tub bath and the last of the daily dosage of acetylsalicylic acid and amobarbital sodium or diazepam will do much to promote a restful night, free of muscle spasm.

Construction of a bite plane. A palatal bite plane should be constructed for those patients who exhibit evidences of bruxism. It should be so designed that only the lower anterior teeth can contact the smooth, shiny surface of the plane so that they cannot be locked into occlusion and thereby permit bruxism. The bite plane should not be considered to be primarily a bite-opening splint, but instead, one that will assist the patient in breaking a subconscious habit of clenching and grinding during the sleeping or even the waking hours. It may be necessary for the patient to wear such an appliance continuously for 2 or 3 weeks, but this should be reduced to the night hours as promptly as possible to eliminate the possibility of elongation of the posterior teeth. The bite plane is constructed of clear acrylic, covering approximately the anterior third of the hard palate. The acrylic should be smooth and highly polished. The appliance is held in position by a continuous nonprecious metal wire extending along the labial cervical margins of the maxillary anterior teeth. The appliance should be considered as a temporary splint, since it is used primarily to assist the patient in breaking the bruxism habit. When this has been accomplished, the use of the splint should be gradually discontinued.

Occlusal rehabilitation. After a conscientious effort by the patient to follow the regimens as outlined above, it is usually possible after 1 or 2 weeks to subject the patient to the indicated occlusal adjustments. The details of this procedure will not be included here. However, the basic objective of occlusal rehabilitation should be the restoration of relatively normal occlusion without premature contacts or cust interference. This may require extensive occlusal grinding, or it may require a few indicated extractions and restoration of the edentulous areas. The use of carefully articulated models and study of the functioning

occlusion are imperative if the objective is to be attained. Ill-fitting restorations that may have been inserted immediately preceding the onset of pain deserve special attention and early correction. Extruded third molar teeth are also of importance, since they may cause a subconscious and spontaneous shift in the occlusion that may be sufficient to set up muscle imbalance and subsequent spasm and joint pain. Occlusal equilibration is a subject unto itself, and the interested student should avail himself of proper postgraduate sutdy to develop a proper concept of its execution.

Injection therapy. Injection therapy consists of two types: hydrocortisone compounds and sclerosing solutions.

Hydrocortisone compounds. The intraarticular injection of the hydrocortisone compounds has proved to be beneficial in reduction of joint pain throughout the body by reducing the inflammatory process that exists within the joint. As a result of recent developments, more potent compounds are available. These are prednisolone acetate (Meticortelone acetate) and prednisolone tertiary butylacetate (Hydeltra-TBA). rapid and long-acting corticosteroids are combined in betamethasone acetate and betamethasone disodium phosphate (Celestone Soluspan), or the two types may simply be combined by mixing rapid and repository drugs prior to intraarticular injection. With either drug, beneficial effects can usually be obtained by intraarticular injection into the temporomandibular joint. The following indications for injection should be strictly observed:

1. Joint is so painful that occlusal rehabilitation cannot be started.

2. Pain persists despite adequate conservative and supportive therapy.

Hydrocortisone injections should be used only as an occasional adjunct to an overall treatment program. In those cases in which the onset is sudden and no occlusal complication exists, a permanent cure may result. However, in those patients who have a prolonged history, occlusal disharmonies, and an overlying tension state, relief from injection alone, without additional supportive and corrective treatment, is usually followed by the prompt recurrence of symptoms in 2 to 4 weeks, when the antiinflammatory action of the drug has disappeared.

Patients in whom roentgenographic evidence indicates extensive proliferative changes within the joint or erosion of the condylar head should, when symptoms persist despite generall supportive therapy, be treated surgically. Since both joints are rarely involved simultaneously, the injection is almost invariably given on a single side, although there is no strict contraindication to injecting the drug bilaterally.

The technique of hydrocortisone injeciton of the joint is as follows:

1. The injection site must be prepared so that it is surgically clean.

2. The patient's mouth should be opened one third of the normal full distance.

3. When a local anesthetic is used, it is deposited through the sigmoid notch and also into the tissues overlying the joint.

4. With the mouth opened one third of the normal full distance, the hydrocortisone injection is done with a 25-gauge needle. The needle is inserted over the lateral surface of the joint and directed at the glenoid fossa.

5. On contacting the roof of the glenoid fossa, the needle is withdrawn 1 mm, aspiration is done, and the drug is then deposited.

6. The needle is withdrawn, and a small sterile dressing is applied.

Patients who have had such an injection may complain of an increase in symptoms for 24 to 36 hours, but this is almost universally followed by a significant and frequently total reduction in pain and dysfunction. As noted previously, the beneficial results will usually persist for a period of 2 to 4 weeks, which is usually ample to carry out most occlusal adjustments that are required.

Sclerosing solutions. The injection of sclerosing solutions should be restricted to those joints that show demonstrable clinical and roentgenographic evidence of hypermobility (subluxation or luxation). In such a circumstance, relaxation of the capsule and temporomandibular ligament permits the condyle to overextend its anterior excursion. Injection of the sclerosing solution should be restricted to the capsule overlying the upper condylar neck to aid in fibrosis and tightening of that structure. The material used should not be injected into the joint space, such as is done with the hydrocortisone compounds. Usually more than one injection is required, but since a considerable local reaction to the injection may occur, it is wise to space them at intervals of 2 to 3 weeks. The patient should understand that a series of as many as four or five injections may be required.

Mandibular condylectomy. Surgical intervention to eliminate temporomandibular joint pain is indicated only when all other more conservative forms of therapy have failed and roentgenographic evidence indicates extensive proliferative changes or erosion of the condylar head. Psychoneurotic patients should not be submitted to surgery unless the procedure has been approved by a psychiatrist after adequate evaluation. When surgery is indicated, the procedure of choice is a high condylectomy (condylotomy). This approach to the problem has evolved after the failure of earlier methods, which were associated with a high rate of recurrent pain after surgery for meniscectomy. Selection of patients for surgery must be done with care to be certain that the pain is arising from the joint and not the musculature, since if the latter is true, recurrence of pain postoperatively is the rule. The rationale of the procedure is based on the surgical reduction of the height of the condylar head, thereby relieving the persistent irritation and pressure on the nerve supply to the joint. This tissue has been described by Sicher to be located posterior to the condylar head and to contain "loose connective tissue rich in blood vessels, nerves and nerve endings". It binds the articular disk posteriorly to the capsule. Although one might normally expect unusual shifting of the mandible in the postoperative state to the side operated on, this does not happen. When deviation does occur, it is usually of a relatively slight degree easily correctable by occlusal adjustment. Preservation of the meniscus is of importance, since it prevents adhesions that would otherwise form between the stump of the resected mandible and the glenoid fossa, the development of which would cause deviation of the jaw to the affected side. No attempt to restrict motion is necessary in the postoperative state. Instead, the patient should be urged to gradually resume jaw function as promptly as possible.

The recommended condylectomy procedure is as follows:

1. The hair is shaved for 3 cm above, behind, and in front of the ear

2. A local anesthetic solution containing epinephrine is infiltrated into the area anterior to the ear and overlying the condyle.

3. An incision is made immediately anterior to the ear, extending from its inferior to its superior attachments and running along the medial surface of the tragus.

4. A skin flap is undermined for approximately 2 cm anterior to the incision. It is sutured forward to the skin to aid in its retraction.

5. Dissection is begun in intimate contact with the ear cartilage. The dissection actually consists of dissecting the attached soft tissues off from the cartilage of the ear and external auditory canal until the zygomatic arch is reached.

6. The condyle is palpated, and the dissection is carried slightly deeper and then forward until the joint capsule is exposed.

7. The capsule is opened through a semilunar incision extending along its posterior and superior borders but avoiding the meniscus, thus exposing the condyle.

8. The condyle is resected 6 to 8 mm below its superior border. This is accomplished rapidly and easily by means of a small, round, tungsten carbide drill.

9. The specimen is removed by limited stripping of attaching fibers of the lateral pterygoid muscle. Most fibers of the lateral pterygoid remain attached above and below the resection site, thus providing good postoperative function.

10. The stump of the condyle remaining is smoothed with bone files, and Gelfoam is placed into the defect to control capillary oozing or brisk venous bleeding that may be present.

11. The capsule is sutured with fine plain catgut. The balance of the wound is closed in the usual fashion.

12. A generous pressure dressing is applied and is left in place for 48 hours.

13. The patient is urged to use the jaw as soon as possible.

14. Because of the spilling of blood in to the external auditory canal, it is imperative to irrigate and cleanse the canal postoperatively since clotted blood lying against the drum is highly irritating.

This technique has several advantages. It allows adequate visualization; also, if the soft tissues are dissected off directly from the ear cartialge as described, it is virtually impossible to damage either the facial nerve or the vessels that richly supply the area.

There has been a tendency in recent years to substitute an alloplastic implant, primarily Silastic or metal, for the resected condylar segment. Although this may be desirable in some surgeons' hands when total condylectomy, including the condylar neck, is done, it has been my experience that insertion of any type of foreign material is not required in the procedure described previously. In the vast majority of cases, the arthritic process is not sufficiently extensive to require resection of more than 6 to 8 mm of the most superior portion of the condylar head. In any event, only the amount required to eliminate the pathologic condition should be excised. If the meniscus is preserved, as it always should be, even though it may require repair by suturing of tears or other perforations, it is by far the best biologically

acceptable material available. Its presence prevents cicatricial adhesions between the condylar stump and the glenoid fossa. It is these adhesions that produce deviation of the mandible to the operated side postoperatively. Thus preservation of the meniscus and early, continued exercise are the key to the return to normal, comfortable function. Since the resection point is relatively high, the inferior belly of the lateral pterygoid muscle remains intact and is a significant asset in the return to normal mandibular function. Preservation of the funciton of the lateral pterygoid muscle is, of course, impossible to regain when an alloplastic implant is used.

When the entire condyle must be removed or if both condyles must be removed, it has been my experience that jaw dysfunction is almost inevitable without reconstruction of at least one joint. Autogenous and biologically acceptable materials are always preferable. This opinion is shared by others. My personal experience is based on the use of costochondral rib grafts in 14 cases. Some of these grafts also replaced a portion or all of the ascending ramus but others were used to reconstruct the condyle alone or the condyle and neck. When the condylar head only is to be replaced, it can be done through the preauricular incision described above. The graft is morticed into the stump remaining and is held firmly in place with stainless steel wires that perforate the graft and stump and also circumscribe both. If the morticing is well done, the graft is held very firmly in position and will remain there without complication. Costochondral grafts are remarkably adaptable for use in the ramus and temporomandibular joint area. They are especially useful in children with agenesis of the condyle since they can be used early in life when a growth spurt can be anticipated. An increase in the size of the graft in harmony with mandibular growth then occurs, thus eliminating the facial and jaw deformity at a relatively early age and eliminating the need to wait for jaw reconstruction until skeletal maturity is complete.

Dislocation

Dislocation (luxation) of the temporomandibular joint occurs with relative frequency when the capsule and the temporomandibular ligament are sufficiently relaxed to allow the condyle to move to a point anterior to the eminentia articularis during the opening motion. Muscle contraction and spasm then lock the condyle into this position so that it is impossible for the patient to close the jaws to their normal occluding position. Dislocation may be unilateral or bilateral and may occur spontaneously after stretching of the mouth to its extreme open position, such as during a yawn or during a routine dental operation. It may also occur when the jaws are forcibly dilated open during general anesthesia.

Treatment

Dislocations can usually be reduced by inducing downward pressure on the posterior teeth and upward pressure on the chin, accompanied by posterior displacement of the entire mandible. It is preferred that the operator stand in front of the patient. Ordinarily reduction is not a difficult procedure. However, muscle spasm may occasionally be sufficiently great to disallow simple manipulation of the condyle back to its normal closed position. In such circumstances it is necessary to induce sufficient muscle relaxation to allow proper reduction of the luxated condyle. This can be accomplished by the administration of a general anesthetic supplemented, if necessary, by a muscle-relaxing drug. Johnson has reported the successful spontaneous reduction of dislocations of the temporomandibular joint by infiltration of a local anesthetic solution into the musculature surrounding the condyle. This method requires no manipulation, since the muscles become sufficiently flaccid to allow the condyle to drop back into its normal position in the glenoid fossa. It is of interest to mention that Johnson has noted

that when the dislocation is bilateral, it is necessary to anesthetize only one side to accomplish spontaneous bilateral reduction.

Occasionally dislocations of long standing may be present without recognition. Frequently, this follows extraction of teeth or tonsillectomy using general anesthesia, the jaw being necessarily forced open. Dislocation may then remain unrecognized if the patient is not examined postoperatively. Frequently, dislocations of long standing require open reduction, since they have usually had the opportunity of developing a new articulation anterior to the eminentia articularis. Open reduction consists of opening into the joint through a preauricular incision as described previously for mandibular condylectomy, exposing the dislocated condyle, and, under deep relaxation medication and direct vision, manipulating the condyle back into the glenoid fossa. I have seen two such cases, one of 13 weeks' duraction and the other of 8 weeks' duration. Both were bilateral and resisted all efforts to reduce the dislocation by conservative means. Both patients had normal postoperative courses and have had no additional tendency to dislocate since that time.

When chronic, persistent luxation (dislocation) occurs, surgical intervention may be necessary. In almost every instance of repetitious dislocation, there is abnormal laxity of the supporting ligaments. Several procedures have been advocated by various authors and all report successful results. The procedures vary from simple plication of the loose capsular ligament to removal of the eminentia articularis or ligation of the condylar head to the glenoid fossa. Since I have seen several cases of repetitious dislocation in patients who have lost all of the eminence and have cured them by creating a new eminence by rig grafting, it would appear that excision of the eminence in itself is not responsible for the successful result of the surgery. In fact it would appear that, with success reported from so many varied surgical procedures, the true reason for the success is the postoperative fibrosis produced in the capsular ligament. This in itself produces a functional result that is similar to surgical plication.

Repetitious dislocation may also be caused by hysteria or neuromuscular disease. When hysteria is the cause, it is most frequently seen in young females. The use of routine interdental ligation is usually fruitless since the patient will invariably find a way to break the ligatures loose, given sufficient time to do so. Obviously psychotherapy is imperative and should be carried out without delay. Surgical intervention is *not* indicated and indeed may be strongly contraindicated.

When advanced, incurable neuromuscular disease accompanies repeated dislocation, conservative therapy may be tried, but eventually a complete condylectomy including a generous portion of the condylar neck may be necessary to assist in the nursing and nutritional care of the patient.

Ankylosis

Ankylosis of the temporomandibular joint occurs with relative infrequency. Loss of jaw function may vary from partial to complete. Surgical correction of the ankylosis is required in all cases to permit proper rehabilitation of the patient. Whereas ankylosis occurred most commonly as a complication of childhood illnesses some years ago, this has rarely been the case since antibiotic medications have been available to control secondary infections. The commonest cause of ankylosis today is trauma. Fracture of the condyle with involvement of the articular surface, hemorrhage, and subsequent elevation of the periosteum followed by clot organization occasionally produces bony union between the ramus of the mandible and the

zygomatic arch. Advanced arthritis may also produce proliferative alterations in the condyle, eventuating in ankylosis.

Surgical correction (arthroplasty) involves exposure of the joint area through the previously described preauricular incision. If the condyle area alone is involved in the ankylosis, it is unnecessary to expose the coronoid process. The osteotomy is usually first extended across the base of the condylar neck. The condyle is then chiseled loose and is removed. In other circumstances, if the condyle has been fractured and displaced medially, it is necessary to perform a 1 cm ostectomy at the superior portion of the ramus. This allows visualization of the medial aspect of the ramus and exposure of the malpositioned condyle, which can then be chiseled from the medial surface of the ramus and removed through the wound.

Two principles are involved in developing a successful arthroplasty:

1. Perform an adequate arthroplasty by removing the displaced condyle if one is present and creating a 1 to 1.5 cm space between the superior margin of the ramus and the zygomatic process.

2. Provide early, vigorous, and sustained postoperative jaw dilation.

An otherwise adequate arthroplasty may fail if the second principle is not carried out with determination. To ensure success it is wise to return the patient to the operating room on the third postoperative day and, under general anesthesia with deep relaxation, forcibly dilate the jaws with a side-action mouth prop. Thereafter, the patient should have forcible daily dilation with the mouth prop for 3 months after surgery. When this program is followed, postoperative results are universally good, and it is unnecessary to interpose any foreign material at the arthroplasty site. Since the dentition of most patients of this type is usually in poor repair, it is important that the patient be encouraged to complete rehabilitation by undergoind whatever dental procedures may be indicated as soon as practicable.

Metallic condylar prostheses have been used with good results reported by several operators. Their use appears to be a good procedure when the condyle alone is ankylosed to the glenoid fossa. In our experience with a large number of cases of ankylosis it has been evident that when the ankylosis extends medially to include the coronoid process and the base of the skull, a patient may continue to lay down bone in the area regardless of a metallic implant. In some instances this new bone may completely encompass any alloplastic material that is interposed to create a false joint. We have enjoyed the greatest success by total excision of all new bone from the base of the skull and reconstruction of the ramus and condyle with a costochondral graft. Early mobility followed by vigorous exercise is, as usual, important to complete recovery.

Micrognathia may be a complication of ankylosis because of the lack of the condylar growth center. Surgical correction of this deformity may also be required to develop an acceptable cosmetic and functional result. Although this is not within the scope of this chapter, it should be stated that a combination of surgery and orthodontics yields good results and usually completes excellent rehabilitation of the patient. Bone onlays over the chin area are only rarely indicated and should not be depended on to mask the jaw deformity, since many of them resorb over a period of time.