Paparella: Volume I: Basic Sciences and Related Principles

Section 9: Otolaryngologic Manifestations of Systemic Diseases and Pain

Chapter 43: Temporomandibular Disorders and Facial Pain Syndromes

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It has been estimated that approximately 15 per cent of the population suffers from TMJ disorders and facial pain. TMJ disorders afflict females much more frequently than males, with the female predominance ranging as high as 4:1. The age range of this population is between the second and fourth decades and, in those with unilateral pain, the left and right joints are equal in their frequency of involvement. The proximity of this structure to the ear, combined with the similar innervation patterns, frequently serves to direct patients with TMJ complaints to the otolaryngologists.

Historical Considerations

Hippocrates may have been the first to identify TMJ disorders, describing "a group of patients whose teeth are disposed irregularly, crowding one on the other and they are molested by headaches". A series of reports in the early part of this century addressed the various aspects of TMJ disorders, but Costen is generally credited with describing a syndrome of deafness, pain, vertigo, tinnitus, and the relationship of this to malocclusion and its effects on the TMJ. In 1948 Sicher recommended that the term "Costen's syndrome" be replaced by "temporomandibular deforming arthritis", and also noted a relationship between aural pain and masticatory muscle spasm. Specific subdivision of the various different types of TMJ disorders was still lacking: In referring to the generic approach to TMJ disorders as a "diagnostic wastebasket", Laskin, of the University of Illinois, wrote that "it is this lack of diagnostic discrimination that probably accounts for many of the failures in the management of patients with TMJ disorders". Further work by many investigators has generally subdivided the "TMJ syndrome" into the categories of myofascial pain-dysfunction syndrome, internal derangement, and degenerative joint disease. Other TMJ disorders discussed in this chapter include ankylosis, hypermobility, and rheumatoid arthritis.

Despite this increased understanding of the temporomandibular apparatus and its disorders, evaluation of these patients is challenging and treatment remains controversial.

Anatomy

The TMJ os termed a ginglymoarthrodial joint in that it undergoes both hinge and gliding motions. The TMJ is unusual in that its articulating surfaces are covered with fibrous connective tissue rather than hyaline cartilage. The innervation of the joint is provided by branches of the third division of the trigeminal nerve. A branch of the auriculotemporal nerve passes posterior

to the condylar neck and innervates most of the joint capsule. The anteromedial aspect of the capsule receives sensory innervation from the masseteric nerve and the anterolateral aspect of the capsule is supplied by the posterior deep temporal nerve.

The blood supply to the TMJ is primarily derived from the maxillary artery, which courses medial to the medial pole of the condyle; it is at potential risk in extensive operations around the joint. The temporal, middle meningeal, and anterior tympanic branches, as well as contributions from the ascending pharyngeal artery, supply the joint.

The temporomandibular ligament is a thickened zone within the lateral aspect of the joint capsule. Its fibers extend from the zygomatic tubercle of the temporal bone, located on the inferolateral aspect of the zygomatic arch, to the lateral surface of the condylar neck. This posterior and inferiorly oriented ligament resists forces that might displace the condyle in a posterior or lateral direction.

The meniscus is an ovoid disc of fibrous connective tissue interposed between the head of the mandibular condyle and the glenoid fossa of the temporal bone. It divides the joint into separate upper and lower joint spaces. The meniscus, or disc, is attached to the TMJ capsule about its periphery. The thin central region of the disc is almost avascular and is without innervation, although the periphery of the disc and capsule are richly innervated. As viewed in the midsagittal plane, the thin central region of the disc extends anteriorly into a thickened area, the anterior band. A similar posterior band is noted posterior to the central aspect of the disc. A three-dimensional representation of these bands would demonstrate that they constitute an oval ring, wider transversely than anteroposteriorly, which encircles the central zone of the disc and is attached to the condylar head at its medial and lateral poles.

In normal function, the meniscus moves synchronously with the condyle, aligning the central zone directly between the closest articulating points on the condyle and glenoid fossa. This synchronous movement is maintained by the action of the lateral pterygoid muscle. The lateral pterygoid arises from the lateral surface of the lateral pterygoid plate and adjacent roof of the infratemporal fossa, and extends almost horizontally in a posterolateral direction. The muscles divides into two insertions, the lower of which attaches to the pterygoid fovea in the neck of the mandibular condyle. This component of the lateral pterygoid produces anterior movement of the condyle on jaw opening and is responsible for the characteristic anterior and medial dislocation of a fractured condyle. The upper insertion attaches directly to the meniscus and, by coordinated action of the two parts of the muscle, maintains the meniscus in its proper position over the condyle in all position of condylar movement.

The posterior attachment of the disc, the "bilaminar zone", contains elastin rather than collagen. This provides the elastic properties necessary for retracting the disc in the absence of the lateral pterygoid contraction. In addition to the bilaminar zone the highly vascular retrodiscal pad serves as a venous plexus, rapidly engorging with venous blood to fill the volume vacated by anterior movement of the condyle and then discharging that blood as the condyle returns posteriorly.

Patient Evaluation

History

The evaluation of a TMJ disorder begins with a detailed history. The history can be obtained by use of a printed questionnaire that is later reviewed with the patient or by direct interview. A number of specific points should be discussed.

Pain. The patient should be questioned as to the initial onset of pain and the number of months or years of its duration. Its character and location should also be discussed. Is the pain unilateral or bilateral? If the patient experiences headaches, are they usually noted in the morning or evening? Morning headaches can suggest nocturnal bruxism, whereas evening headaches might be related to stressful activities during the day.

Joint Noise. How long have clicks or pops been present or were they ever noted in the past? What happens in terms of jaw position when the click or pop occurs? Clicks or pops can represent uncoordinated movement of the meniscus over the condylar head. The history of a click that spontaneously ceased with simultaneous onset of limited jaw opening is highly suggestive of an internal derangement, with anterior dislocation of the meniscus. Reciprocal clicks (click on opening followed by a click on closing) might also be reported. Clicks occurring early in the opening cycle might portend a more benign course, whereas late clicks could indicate a more advanced internal derangement. Are these clicks associated with a relief of pain? The patient should be questioned as to the presence of grating or grinding sounds, because these are cardinal signs of degenerative joint disease.

Lock. A history of joint locking should be explored by using terminology such as "catching" or "sticking". Although uncomfortable, a closed lock is not acutely painful and can be frequently overcome by the patient using jaw manipulation. This condition is highly suggestive of an internal derangement. An open lock, or subluxation of the mandibular condyle, is frequently painful, but can be present in an otherwise normal but hypermobile joint.

Trauma. The patient should be questioned as to prior facial injury or jaw fracture. Oral habits should be discussed, because the chronic trauma of parafunctional oral habits such as fingernail or cheek biting can result in painful muscle spasm.

Prior Treatment. The specifics of prior treatment should be discussed, including prior courses of medications and their effectiveness and previous nonsurgical treatments, such as intra-articular corticosteroid injections, dental splints, and orthodontic therapy. The records of previous surgery on the joint or orthognathic surgery should be obtained.

Relevant Social History. Because stress is an important factor in a myofascial pain-dysfunction syndrome, a social history exploring past and current stress in the patient's life, such as marital problems and job or financial trouble, frequently provides valuable information. Goss and colleagues found a significant psychiatric history in 30 per cent of facial pain patients. They

also noted that this history was rarely volunteered by the patient.

Physical Examination

A patient presenting with a TMJ complaint should receive complete head and neck examination. Specific points to be addressed in the physical examination include interincisal measurement, a dental evaluation, and checking for muscle tenderness and joint sounds.

Interincisal Measurement. A measurement of the maximal interincisal opening, from the incisal edge of opposing central incisors or between the edentulous ridges, should be performed. In the dentulous patient, an opening of 40 mm should be considered as the lower limit of normal. Patients with an internal derangement of the joint with anterior subluxation of the disc rarely can open beyond 30 to 35 mm. Their maximal opening is generally painless and seems to be limited by a mechanical impediment to joint movement. Patients with myofascial pain-dysfunction (MPD) syndrome exhibit a similar limitation of opening, but are limited by pain.

Dental Evaluation. The general condition of the teeth and periodontium should be assessed and evidence of bruxism, such as excessively worn occlusal surfaces of the teeth, should be sought. The presence of third molars (wisdom teeth) should be evaluated, because painful inflammation around these teeth can produce trismus and thereby mimic MPD.

Muscle Tenderness. Palpation of the muscles of mastication, TMJ capsule, and adjacent musculature should be performed to identify areas of specific tenderness (Table 1). Palpation of the lateral aspects of the temporalis and masseter muscles is straightforward. The anterior aspect of the temporalis insertion can be palpated transorally by sliding the palpating finger up the anterior border of the ramus to the coronoid tip. The medial pterygoid can be palpated along its anterior border by placing the index finger medial to the mandibular retromolar region and sliding the finger superiorly. Palpation of the lateral pterygoid muscle along its inferior aspect can best be performed with the mouth in the half-open position. The index finger is then placed on the buccal aspect of the maxillary tuberosity and is slid posteriorly and superiorly. The lateral aspect of the joint capsule can be palpated directly, just anterior to the tragus. The posterior aspect of the capsule can be palpated by placing a finger in the external auditory canal and pressing anteriorly.

Table 1. Masticatory Muscle Tenderness in TMJ Dysfunction Patients

Muscle	Patients Affected (per cent)
Lateral pterygoid	84
Masseter	70
Temporalis	49
Medial pterygoid	35
Others (cervical, scalp, facial)	43.

Joint Sounds. Clicks emanating from the TMJ are very apparent to the patient and can usually be palpated or auscultated by the examiner. Clicks are associated with an internal derangement, but many asymptomatic individuals experience occasional clicks or pops. The timing of the click relative to the opening and closing excursion is important. An opening click of the TMJ probably represents the meniscus repositioning itself from an anteriorly displaced position in its proper orientation over the head of the condyle. An early click implies that most of the condylar excursion occurs in synchrony with the meniscus. Reciprocal clicks are frequently noted, suggesting disc repositioning over the condylar head with the opening click and repeat anterior displacement of the disc with the closing click. Patients who complain of grating, grinding, or crunching sounds should have these sounds evaluated by careful auscultation using the bell of the stethoscope. Such noises are suggestive of advanced degenerative joint disease (osteoarthritis).

Radiographic Evaluation

Although radiographic evaluation of the TMJ is an important part of the evaluation, these films alone do not make the diagnosis, but do provide information that can support the diagnosis as determined by history and physical examination.

Transpharyngeal View

The transpharyngeal view of the temporomandibular joint entails a technique that can be performed with ordinary dental office radiographic equipment and frequently gives an excellent view of the condyle in its open position. Degenerative joint disease changes can be seen on this view but, like other plain film techniques, no diagnostic information can be obtained regarding internal derangement or MPD syndrome.

Transorbital View

The transorbital view images the entire mediolateral aspect of the condylar head. Like the transpharyngeal view, it shares the advantage that it can be obtained with office radiographic equipment.

Panorex

Rotational panoramic radiography is a tomographic technique that images the right and left sides of the mandible and maxilla as a single two-dimensional projection. The panorex obtained can provide an excellent view of the condyle and glenoid fossa and serves as a radiographic screen for dental pathology, such as impacted third molars, and for other osseous lesions. Although minor distortion is inherent in this technique, advanced degenerative joint disease and ankylosis can readily be identified, as can many other benign conditions of the condyle.

Tomography

Typical open and closed TMJ tomograms can provide a series of sagittal cuts from the medial to the lateral pole of each condyle. The small osteophytes, early cortical thickening, or Ely's subendochondral cysts that occur in early degenerative joint disease (DJD), which might escape detection on a panorex, can frequently be seen on a good-quality tomogram, as can the manifestations of true ankylosis of the joint. Some importance has been placed on the tomographic findings of decreased joint space as an indicator of meniscal pathology. The joint space should measure at least 2.5 mm superiorly and posteriorly, with a measurement of 2.0 mm or less suggestive of disc damage. New methods of disc imaging, such as arthrotomography, computed tomography, and magnetic resonance imaging, make the measurement of the joint space of questionable value.

Arthrotomography

Within the last 10 years, the significance of pathologic conditions of the meniscus has become better appreciated, and improved means of imaging this radiolucent structure have been required. Arthrograms of the TMJ, projected onto plain film, provide confusing information; but arthrography combined with multidirectional tomography allows precise viewing of the midsagittal plane of the TMJ and provides valuable information regarding the position of the meniscus. Using this technique, the most significant abnormalities noted by Katzberg and associates were anterior meniscus displacement without reduction, anterior meniscus displacement with reduction, and perforation of the posterior attachment of the meniscus. It was noted that, within this group of patients with arthrotomogram-proven anterior dislocation of the meniscus, "a mechanism of pain in all these patients could then be explained by the articulation of the condyle and eminence with the posterior attachment which is richly innervated".

Although this technique provides an effective means of imaging the disc, arthrography of the joint is technically difficult to perform and provides valuable information only in those patients where a derangement of the internal soft tissues of the joint is suspected.

Computed Tomography

Computed tomography (CT) scanning of the TMJ can be used to provide information regarding osseous pathology in and around the joint, such as true ankylosis or tumor. The role of the CT scan in the elucidation of meniscal pathology is also promising. Thompson and co-workers found that CT findings correlated with arthrotomography and surgical findings in 13 of 15 joints. A combined CT arthrogram in one case provided additional useful information. Manzione and colleagues used the appearance of a fat pad between the bellies of the lateral pterygoid muscle to detect internal derangement, and found CT to be 94 per cent accurate in detecting meniscal derangements and 96 per cent accurate in diagnosing DJD.

Magnetic Resonance Imaging

Magnetic resonance imaging offers three important advantages over other imaging techniques: it exposes the patient to no radiation; the potential exists for visualization of the internal soft tissues; and inflammation can be detected by a T2 weighted image. In a report of MRI imaging of the TMJ using a surface coil, MRI diagnosis was confirmed by surgical findings in all of the 15 cases requiring surgery.

Arthroscopy

Improvements in the optics of arthroscopic equipment have enabled this technique to be applied to smaller joints, including the TMJ. TMJ arthroscopy was first described in 1975 and has gained somewhat wider acceptance in recent years. Goss and Bosanquet reported that diagnostic information was obtained in 88 per cent of 50 TMJ arthroscopies. The indications for TMJ arthroscopy and its role in the management of the various TMJ disorders await clarification.

Differential Diagnosis of TMJ Disorders

Myofascial Pain-Dysfunction Syndrome (MPD)

MPD syndrome represents the most common painful disorder of the TMJ.

Findings

The cardinal sign of MPD is muscle spasm, as manifested by muscle tenderness in approximately 80 per cent of these patients. Schwartz has described the "pain-dysfunction syndrome" as a functional disorder of the masticatory musculature, and differentiated it from Costen's symptom complex. Laskin modified the term to "myofascial pain-dysfunction syndrome", stating that the most common cause is thought to be muscle fatigue produced by "chronic oral habits that are often an involuntary tension-relieving mechanism". He described six cardinal symptoms, four of which are positive findings and two of which are negative (Table 2).

Table 2. Myofascial Pain-Dysfunction Syndrome

Positive findings:
1. Pain of unilateral origin
2. Muscle tenderness
3. Clicking or popping noise in the TMJ
4. Limitation of jaw function.

Negative findings:
5. *Absence* if clinical, radiographic, or biochemical evidence of organic TMJ changes is found
6. *Lack* if tenderness is produced on palpation of the TMJ via the external auditory meatus.

Treatment

The literature reflects the diversity of viewpoints regarding the treatment of MPD, and support can be obtained for almost any approach. The goal in MPD treatment is to decrease the muscle spasm and thereby relieve the pain. Treatment measures can generally be subdivided into reversible treatment and irreversible structural alterations.

Reversible Treatment

Pharmacotherapy. Nonsteroidal anti-inflammatory drugs (NSAIDs) in adequate doses are the initial drugs of choice for this disorder. Ibuprofen 400 to 600 mg qid for 7 days, followed by 400 mg q4-6h on a prn basis, constitutes a generally well-tolerated regimen. Other NSAIDs can be substituted as needed. The acutely painful patient might also require muscle relaxants such as diazepam and narcotic analgesics as initial therapy.

Topical Therapy. The application of moist heat to the preauricular area helps to decrease muscle spasm and its attendant pain. Massage of the masseter and temporalis muscles can also help alleviate spasm.

Diet. A soft diet rests the masticatory musculature. Many patients frequently have already limited their diet prior to their initial physician visit because of pain and limited opening. The presence of severe muscle spasm and pain might necessitate a liquid diet.

Splint Therapy. A mainstay of dental therapy has been the fabrication of acrylic splints that serve to disarticulate the teeth, open the bite, and probably remove some of the stimulus to nocturnal bruxism. Although splint therapy is generally regarded as highly effective, the lack of controlled clinical studies makes it difficult to separate the effects of the splint from other treatment factors. In a study of MPD patients prospectively treated by various types of splints, 87 per cent showed some improvement. Of particular significance in this study was the fact that 40 per cent of those treated with a placebo type of splint also improved, demonstrating the significant response to placebo therapy of various types in many MPD patients.

Irreversible Structural Alterations

Occlusal Equilibration. Occlusal equilibration is a dental procedure in which occlusal disharmonies are removed by grinding away tooth structure. The jaw musculature is richly endowed with proprioceptive sensors that can detect the smallest occlusal prematurity, such as a "high" filling in a tooth. The stomatognathic system tends to grind away such prematurities naturally, by bruxism, in a physiologic attempt to provide such an equilibration. This can begin the cycle of masticatory muscle spasm and pain that characterizes MPD. The elimination of such occlusal interferences by selective grinding might therefore be therapeutic.

Orthodontic Therapy. Orthodontic therapy addressed at treating MPD seeks to realign the occlusion so that occlusal interferences are removed. The dentition can be shifted over the

basal bone of the mandible and maxilla so that the position of the condyle is moved slightly anteriorly within the glenoid fossa.

Subcondylar Osteotomy. The creation of a subcondylar osteotomy that would allow the condyle to shift to a more neutral or unloaded position within the glenoid fossa has been advocated. Banks and MacKenzie reported a 91 per cent success rate with this procedure among 211 patients, and noted that most patients maintained an increased joint space postoperatively. Although they and other authors have advocated a blind technique using a percutaneously introduced Gigli saw, the procedure can be performed under direct vision through an extraoral or transoral approach.

Internal Derangement

Internal derangement of the TMJ is defined as an abnormal relationship of the articular disc to the mandibular condyle, fossa, and articular eminence. The most common internal derangement involves and anteromedial displacement of the disc with the richly innervated retrodiscal tissues, specifically in the bilaminar zone, stretched over the head of the condyle. The diagnostic triad of significant internal derangement includes pain, clicking of the joint (currently or formerly), and limitation of opening or a history of such limitation. Pain might be noted around the TMJ capsule or in the masticatory musculature. The type of clicking most frequently encountered is the reciprocal click, in which the opening click signifies repositioning of the displaced disc over the condylar head, allowing normal jaw opening, followed by a closing click, which signifies repeat anterior dislocation of the disc prior to occlusion of the teeth. This clicking might spontaneously cease and be followed by a period of limited jaw opening or "closed lock", at which time the meniscus is permanently dislocated anteriorly and mechanically blocks condylar opening movement. Pain is not a consistent finding with closed lock and, if present, is secondary to spasm of the masticatory musculature, most frequently the lateral pterygoid. In contradistinction to the muscle spasm of MPD, the muscle spasm seen occasionally in internal derangement is produced by the organic problem within the joint; in MPD the spasm itself *is* the problem and no organic intra-articular pathology is present.

Perforation of the meniscus is another internal derangement of the TMJ that can occur in conjunction with disc displacement. Arthrographic techniques are highly accurate indicators of perforation because the dye, which is normally injected into the lower joint space only, is seen to communicate with the upper space. Graham and associates found that clinically palpable crepitus in patients who could not open beyond 26 mm was highly indicative of perforation of the disc. When the diagnosis is in doubt or surgical correction is contemplated, arthrography can be used to demonstrate disc position.

Treatment

Nonsurgical Therapy

Pharmacotherapy. NSAIDs and muscle relaxants are less effective for internal derangement therapy than for MPD treatment, but should not be excluded from consideration. If anterior disc displacement is caused by spasm of the superior division of the lateral pterygoid muscle, pharmacologic treatment with NSAIDs can be highly effective.

Splint Therapy. The fabrication of a splint for treatment of an internal derangement with anterior dislocation of the disc should create an anterior and inferior displacement of the mandibular dentition relative to the maxilla. This would allow the mandibular condyle to move under and "recapture" the disc. Although splint therapy seems to be an effective way of treating an internal derangement, no prospective randomized studies support this.

Surgical Therapy

Meniscoplasty. The anatomic and physiologic correction of an anteriorly displaced meniscus involves the resection and/or plication of the retrodiscal tissues to allow the disc to be repositioned posteriorly. If a perforation of the retrodiscal tissue is found at surgery, this area is resected and primarily closed. Surgical repositioning of the disc is frequently accompanied by a reduction in the vertical height of the condylar head, ostensibly to decrease the chances of repeat anterior dislocation. Careful and intensive postoperative physical therapy is necessary to restore normal range of motion.

Meniscotomy. Removal of the disc is very rarely indicated, and is reserved only for those patients in whom the disc is shredded beyond repair. Placement of an alloplastic implant partially restores some meniscal function, but meniscectomy remains a last resort.

Subcondylar Osteotomy. Performance of a horizontal osteotomy through the subcondylar neck is an indirect method of treating internal derangements. Following subcondylar osteotomy, the condyle drifts anteromedially under the influence of the lower head of the lateral pterygoid muscle. The condylar head may then come to lie in a more normal position under the disc. Nonunion is almost unheard of in this area of the mandible, and the condyle ultimately heals in a more favorable relationship to the glenoid fossa.

Degenerative Joint Disease

Degenerative joint disease (DJD), or osteoarthritis, is an organic degeneration of the articular surfaces of the joint that produces a degenerative remodeling of the entire joint. Kreutziger and Mahan have presented detailed reviews of this process as it affects the TMJ. The etiology of DJD is probably related to trauma, either a specific traumatic injury or infection (macrotrauma) or to repeated overloading of the joint surfaces (microtrauma). The possibility exists that DJD might represent the end-point of long-term abuse from bruxism (as in MPD), or

from the meniscal malrelationships seen in internal derangement. Histologic evidence of DJD has been found in 40 per cent of TMJs in patients over the age of 40, and the incidence of DJD has been shown to increase with age.

Findings

The symptoms of DJD are moderate pain and stiffness, worsened by immobilization. The problem is generally unilateral and the cardinal sign of DJD is crepitus. Characteristically, the patient complains that mouth opening is limited in the morning, but improves with repeated function. Occasional episodes of more severe pain can result from muscle spasm and splinting, possibly confusing the clinical diagnosis with that of MPD.

Radiographic evaluation of patients with early DJD may show subtle, if any, findings. More advanced DJD demonstrates the articular remodeling that characterizes this disease. Although considerable variation occurs in the radiographic appearance, decreased joint space, marginal lipping, osteophytes, and subchondral sclerosis with discrete radiolucent areas, called Ely's cysts, can be seen as well as flattening of the condylar head and articular eminence. The signs and symptoms of DJD patients are not directly related to the degree of radiographic degeneration, and it is not uncommon to see severe degeneration in relatively asymptomatic individuals.

Treatment

Noninvasive Therapy

Physical Therapy. Range-of-motion exercises preceded by a warm-up session help to preserve function in those with advanced DJD. As part of the warm-up phase, the application of moist heat for 15 to 20 minutes is helpful.

NSAID Therapy. The regular use of NSAIDs in a dosage titrated by the patient to relieve symptoms often allows a relatively normal degree of function. As in other forms of arthritis, regular aspirin use can also be beneficial, and at a lower cost.

Invasive Therapy

Intra-Articular Corticosteroid Injections. Intra-articular corticosteroid injections are not recommended for routine management of DJD, but should be reserved only for patients with evidence of acute inflammation. The usual dosage is 0.5 mg betamethasone, or an equivalent corticosteroid; this can be mixed with a local anesthetic. Multiple injections are to be avoided, if possible, because degenerative changes in the articular histology of monkey TMJs has been demonstrated after six injections of hydrocortisone.

Surgery. Joint reconstruction should be undertaken only in those patients whose DJD causes them significant pain and debilitation. It is remarkable how many patients have

radiographic evidence of severe degeneration but have relatively few symptoms. Various reconstructive procedures are available; the procedure should be tailored to the patient's needs. In those with deterioration of the condylar head, a high condylectomy is performed and a Silastic cap is wired to the condylar stump to preserve condylar height. If the entire condyle is destroyed, a condylar prosthesis can be fixed to the ascending ramus. When the glenoid fossa and articular eminence have also undergone arthritic deterioration, implants can be used to reconstruct this area.

Rheumatoid Arthritis

Rheumatoid arthritis affects the TMJ in two-thirds of patients. In contrast to osteoarthritis, rheumatoid arthritis first involves the synovial membrane rather than the articular cartilage. Erosion of the rheumatoid condyle begins at the periphery and extends toward the center, whereas destruction of the osteoarthritic condyle (as in DJD) begins at the center. The marginal proliferation of bone (marginal lipping) seen in DJD is not seen in rheumatoid arthritis. Rheumatoid arthritic changes are usually bilateral, whereas those of DJD are generally unilateral.

The clinical presentation of adult rheumatoid arthritis is similar to that of DJD in that crepitus is a characteristic finding. Like DJD, severe destruction of the joint can occur with minimal symptoms. The condylar destruction can result in a decreased height of the ascending ramus and produce an anterior open bite, which might require orthognathic surgical correction.

A pediatric form of rheumatoid arthritis, juvenile rheumatoid arthritis (Still's disease), can cause early destruction of the condyle. A tethering effect on mandibular growth accompanies this destruction, producing a characteristic *vogelgesicht,* or bird-face, deformity. Juvenile rheumatoid arthritis may occasionally lead either to fibrous or bony ankylosis of the joint.

The TMJ and other affected joints respond to appropriate rheumatologic therapy, and it is uncommon for the rheumatologist to require assistance in nonsurgical management. Those patients exhibiting mechanical problems resulting from TMJ destruction may undergo reconstructive procedures similar to those available for DJD. Dentofacial deformities resulting from arthritic joint destruction might require orthognathic surgical correction.

Ankylosis

Ankylosis of the TMJ was classified by Kazanjian in 1938 as true and false ankylosis. True ankylosis refers to a true bony or fibrous fusion of the condyle to the temporal bone at the site of the TMJ. False ankylosis refers to other conditions outside the joint that result in lack of mandibular movement. A minimal amount of mandibular movement is preserved, even in cases of complete bony fusion, because of the flexing of the mandibular ramus and angle. An opening of 5 mm or less is indicative of complete bony fusion.

True ankylosis is more frequently seen than false ankylosis and, although myriad etiologies are possible, the most common are trauma and inflammation or infection. In a review

of 229 cases, Topazian found that 31 per cent were related to trauma and 49 per cent to joint inflammation or infection; causes for 19 per cent were unknown. Those in the pediatric age group are predisposed to the development of ankylosis following juvenile rheumatoid arthritis or otitis media affecting the TMJ. El-Mofty reported that more than 50 per cent of ankylosis cases occur in children under the age of 10.

Findings

Facial appearance can be drastically altered by ankylosis that occurs during facial development. Unilateral ankylosis produces an asymmetric deviation of the chin to the affected side because of its tethering effect on mandibular growth. Compensatory maxillary development also creates a cant in the occlusal plane. Bilateral cases show a markedly receding chin and mandibular micrognathia. The degree of the deformity varies inversely with the age of onset of the ankylosis.

Radiographic evaluation of true ankylosis demonstrates solid bone in place of the TMJ, often with additional extra-articular bone masses. False ankylosis might be seen as advanced arthritic joint changes or as an unexpected site of limitation, such as coronoid-to-zygoma fusion or elongation of the coronoid (Jacobsen's syndrome).

Treatment

The treatment for true ankylosis is surgical. Various arthroplasty techniques have been described. Most have attempted to create a gap in the ascending ramus of the mandible, into which is interposed adjacent soft tissue or an inert substance such as Silastic to prevent refusion. Vigorous postoperative physiotherapy is *essential* for success. False ankylosis cases require that the area of attachment be surgically lysed or removed, as in the case of an elongated coronoid. Again, postoperative physiotherapy is essential. The duration of the ankylosis has an effect on success because of the presence of muscle atrophy. Those patients with 20 or more years of ankylosis have a very poor prognosis for return of function.

Hypermobility

The problem of hypermobility as manifested by open lock us usually seen among individuals who generally do not have chronically painful TMJs. In open lock the mouth is opened so widely by yawning (or other such actions) that the condyle subluxes out of the glenoid fossa into a position anterior to the articular eminence. Spasm of the masticatory musculature then locks the condyle in this position so that the weaker retruding muscles cannot overcome the lock. The problem can occur unilaterally or bilaterally and can be associated with moderate pain. Open lock might be only mildly uncomfortable in habitual subluxers.

Evaluation

History and physical examination are generally sufficient to make the diagnosis of acute subluxation, and radiographs are generally not needed. Screening radiographs should be obtained, however, on patients with chronic subluxation problems. In unilateral subluxation the chin point is deviated to the opposite side and an obvious malocclusion is present. Bilateral subluxation produces an anterior open bite, with the chin in the midline.

Treatment

Manual reduction of the subluxation followed by approximately 1 week of soft diet is generally all that is required. Because continued muscle spasm might tend to resublux the jaw, treatment of the muscle spasm with appropriate muscle relaxants can be a helpful adjunct. A 2-week period of intermaxillary fixation might occasionally be required. Repeat subluxation is not infrequently seen in the setting of a dystonic reaction to phenothiazine drugs. Adjunctive treatment of this problem should include the administration of diphenhydramine, initially as an intravenous loading dose of 50 mg IV, followed by 5 to 7 days of oral administration of 50 mg t.i.d. in the adult patients.

Chronic subluxation of the joint is not only uncomfortable but is socially embarrassing, and victims of this condition frequently request definitive treatment. Although many procedures have been used in an attempt to limit TMJ hypermobility, the procedure that seems to have withstood the test of time is the eminectomy. The operation entails the complete mediolateral removal of the articular eminence; this removes the separate impedance to the condylar return into the glenoid fossa.

Facial Pain Syndromes

Various facial pain syndromes can occasionally produce pain that mimics the pain of a TMJ disorder. The physician must be familiar with these entities so they can be given appropriate consideration in the differential diagnosis.

Trigeminal Neuralgia

Trigeminal neuralgia (tic douloureux; trifacial neuralgia) is a recurrent, unilateral, pain syndrome characterized by paroxysms of sharp, stabbing pain in the face that last about 20 to 30 minutes and are precipitated by some external stimulus. These stimuli include touching, rubbing, or even cold air blowing across a specific trigger point. Following the intense pain, which can last several minutes, a brief, painless interlude ensues, followed within minutes to hours by another brief paroxysm of pain. The series of painful episodes may spontaneously subside for weeks or even years, but be followed by another series. The series of painful episodes may spontaneously subside for weeks or even years, but be followed by another series. The maxillary is the most common division of the trigeminal nerve to be affected, followed by the mandibular and the ophthalmic divisions. Initial presentation of the pain is frequently confused with the pain

of dental etiology. The most frequent location of the trigger point is the lateral border of the nose. Those most frequently affected range in age from 50 to 70 years, although exceptions exist, and a 3 per cent incidence of bilaterality has been quoted. The pain rarely awakens a patient from sleep in the absence of some inadvertent stimulus to the trigger area. The incidence of multiple sclerosis among patients with trigeminal neuralgia is approximately 3 per cent, although trigeminal neuralgia is almost never the first manifestation of this disease.

The mainstays of medical management of trigeminal neuralgia include carbamazepine and diphenylhydantoin. Surgical destruction of the involved branch of the trigeminal nerve by various means has generally been found to be effective.

Janetta has reported that trigeminal neuralgia can be caused by direct compression of the nerve by an offending artery. Pain in the second and third divisions is caused by compression of the rostral and anterior parts of the nerve by the superior cerebellar artery. Pain in the mandibular division is produced by compression of the caudal and anterior aspects of the nerve by the anterior inferior cerebellar artery. Appropriate decompression of the involved areas has proven successful.

Glossopharyngeal Neuralgia

Glossopharyngeal neuralgia is analogous to trigeminal neuralgia in that the pain is initiated by non-noxious stimulus of a trigger point. In glossopharyngeal neuralgia the trigger point is in the oropharynx, and the pharyngeal stimulus can be swallowing or coughing. The pain is described as severe and stabbing and affects the tonsillar area, with radiation to the ipsilateral ear. During a series of attacks, the patient can eat or drink only during the brief respite between paroxysms. Treatment involves carbamazepine or intracranial nerve section.

Superior Laryngeal Neuralgia

Superior laryngeal neuralgia, like glossopharyngeal neuralgia, is analogous to trigeminal neuralgia. It is confined, however, to severe lancinating pain in the small region near the thyrohyoid membrane innervated by the superior laryngeal nerve.

Cluster Headache

Cluster headache (periodic migrainous neuralgia; Horton's histaminic cephalalgia; histamine headache) is one of a recurring series of unilateral, burning, facial pain episodes punctuated by long periods of remission. The pain most frequently involves the maxillary division of the trigeminal nerve but lacks a trigger point, and the pain tends to begin spontaneously in the absence of external stimuli. Various ipsilateral facial autonomic manifestations accompany the pain, including vasodilatation and flushing of the hemiface, conjunctival irritation, tearing, salivation, and rhinorrhea. The attacks last longer than those of trigeminal neuralgia, sometimes lasting up to 1 hour. The pain might not be confined to one division and can spread to other areas, such as from the upper to lower teeth, or to the neck. The pain awakens the patient from

sleep violently, with two-thirds of patients having this complaint.

Horton believed that this disorder is caused by histamine sensitivity, and statistically significant elevations of serum histamine levels have been identified during attacks. Treatment of cluster headache includes vasoconstrictor agents, such as methylsergide or ergotamine tartarate, and corticosteroids.

Temporal Arteritis

Temporal arteritis (Horton-Magath syndrome) is an inflammation of the superficial temporal artery that heralds a more widespread involvement of the arteries of the head and neck. The pain of this disease is described as moderate to severe persistent throbbing. The pain is generally located in the region of the superficial temporal artery. The patient frequently presents with a constellation of signs and symptoms, including fever, sweating, weakness, and anorexia with weight loss. Patients may complain of jaw pain and stiffness on chewing, referred to as "jaw claudication". The headache worsens when supine and patients frequently have great difficulty sleeping.

Palpation of the superficial temporal artery demonstrates a tender, nodular, pulseless vessel. Biopsy of the artery shows intimal thickening and medial necrosis with foreign body giant cells. Blindness occurs in 50 per cent of patients, with bilateral blindness developing in 25 per cent. High-dose systemic corticosteroid therapy should be promptly instituted prior to biopsy confirmation of the diagnosis.

Migraine Headache

The constellation of a prodrome heralded by such features as visual, motor, or sensory aberrations, and followed by severe unilateral headaches associated with nausea, vomiting, photophobia, and mood disorders, is typical of migraine headache. Most migraineurs, however, experience the more common vascular headache, which is not preceded by a definite aura. The migraine headache can last from hours to several days and is frequently associated with nausea, giving rise to the term "sick headache". A subgroup of migraine sufferers experiences transient neurologic sequelae to the event, such as ophthalmoplegia (with involvement of cranial nerves III, VI, or occasionally IV), hemiplegia, or hemianopsia. Although the migraineur usually experiences headache pain, variations in the location of the pain exist. The malar region, teeth of either jaw, and the medical orbit-nasal region can be the sites of the migraine pain, possibly confusing the diagnosis.

Herpetic Facial Pain

Herpes zoster affects the facial dermatomes as it does the rest of the body. The herpes zoster virus inhabits the dorsal root ganglia or sensory ganglia of the cranial nerves. During an attack, pain in the region involved is soon followed by a papulovesicular skin eruption. Prior to development of the characteristic skin lesions, the source of pain is difficult to evaluate. The

trigeminal nerve is involved in 18 per cent of patients with herpes zoster, but other cranial nerves and facial dermatomes might also be involved. Papulovesicular lesions around the auricle in conjunction with ipsilateral facial nerve paralysis are the hallmarks of the Ramsay Hunt syndrome, or herpes zoster oticus. The skin lesions of herpes zoster of the auriculotemporal nerve can be obscured by scalp hair and the pain can mimic that of a TMJ disorder.

Postherpetic neuralgia can affect the facial structures as it does the rest of the body, and treatment of this disorder in the face is equally frustrating.

Eagle's Syndrome

Eagle's syndrome (stylohyoid syndrome) results from elongation of the styloid process or from calcification of the stylohyoid ligament. Estimates of the incidence of styloid elongation in the general population range from 4 to 28 per cent, although not all these patients are symptomatic. The pain associated with Eagle's syndrome is a moderate pain deep in the tonsillar fossa and upper neck that can radiate to the ear and that can be aggravated by swallowing. Irritation of the internal and external carotid arteries can be produced, and occlusion of either of these vessels can result from extreme head turning. The diagnosis is made by transoral palpation of the styloid process through the tonsillar fossa. If this maneuver reproduces the pain, excision of the styloid process proves curative.

Carotidynia

Carotidynia is characterized by tenderness and swelling of the carotid artery and is apparently not related to temporal arteritis. The pain is either unilateral or bilateral and is accentuated by palpation of the carotid. The problem is self-limiting in 90 per cent of patients and lasts an average of 11 days. A course of corticosteroids produces relief, although aspiring or NSAIDs can also be effective.

Both Raeder's syndrome and the pericarotid syndrome include occulosympathetic paralysis with ipsilateral facial pain, and might represent variants of carotidynia.

Tolosa-Hunt Syndrome

Tolosa-Hunt syndrome (painful ophthalmoplegia) is characterized by a deep retro-orbital pain associated with ophthalmoplegia. Because of involvement of cranial nerve III, IV and VI the condition has been associated with an inflammatory lesion of the cavernous sinus. Treatment consists of corticosteroids, and recurrences can occur months to years later.

Gradenigo's Syndrome

Inflammation of the petrous part of the temporal bone can produce headache or facial pain. When this process involves the anterior aspect of the petrous pyramid, the pain is referred to the orbital region. A persistent aural discharge also accompanies the petrositis. When

concurrent edema compresses the abducent nerve as it passes under the petrosphenoid ligament in Dorello's canal, the triad of retro-orbital pain, persistent aural discharge, and diplopia is referred to as Gradenigo's syndrome, after the Italian physician who first reported this relationship in 1904.

Trotter's Syndrome

Trotter's syndrome refers to the facial pain produced by nasopharyngeal tumors. The pain is accompanied by ipsilateral conductive hearing loss, most likely as a result of serous otitis media from eustachian tube obstruction. In one series, 12 per cent of patients with nasopharyngeal tumors presented with this type of facial pain.

Atypical Facial Pain

Atypical facial pain is the term used to distinguish this condition from the "typical" patterns of facial pain previously described in this section. Atypical facial pain is seen in those in a younger age group than cluster headache or trigeminal neuralgia, and the symptoms are not confined to the trigeminal nerve. A long history of discomfort can frequently be elicited and the pain tends to be less severe than that of trigeminal neuralgia. The pain can be unilateral or bilateral. Psychological problems are common in this group of patients, and treatment of the psychological disturbance can help to relieve the pain. Atypical facial pain patients respond less frequently to carbamazepine and diphenylhydantoin, and neurosurgical decompression of offending vascular loops is also less successful for these patients than for those with trigeminal neuralgia.

Ratner Bone Cavities

Ratner and associates evaluated 38 patients with trigeminal neuralgia and 23 patients with atypical facial neuralgia, and found that all had small cavities within the alveolar bone at the site of prior tooth extractions. In some patients, these cavities were more than 1 cm in diameter, but were rarely detectable by dental radiographs. Ratner and colleagues located these lesions by injecting small amounts of local anesthetic into the area and observing for prompt relief of symptoms. Treatment consisted of vigorous curettage of the lesions, packing the defects, and antibiotic administration. Histologic evaluation of the surgical specimens demonstrated a "highly vascular abnormal healing response of bone" and cultures yielded mixed aerobic and anaerobic flora. In all patients a marked relief of pain was reported.