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Temperomandibular Joint: A Review

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ABSTRACT: Little or no data support the idea that orthodontic treatment is needed at any age to prevent the development of temperomandibular dysfunction. First it is not a single joint but a pair of joints working in tandem and in a well-coordinated manner to meet functional demands. Second, unlike other joints of the body where movements of the joint are determined by functional demands and anatomy of the joint, the path of movements and position of the Temperomandibular joint at rest are determined by the teeth of either jaw which the joint helps to keep in an occluded position. The frequency of TMJ complaints has multiplied in the last few years. This may have been brought about by the increased stresses of our fast paced world, or at least we now recognize that there is a stress strain tension release syndrome that often manifests itself with nocturnal Para functional activity. Temperomandibular disorder may be considered a cluster of joint and muscle disorders in the orofacial region which is characterized by pain, joint sounds such clicking and irregular or deviating jaw function.This article reviews the various aspects of temperomandibular joint involving on orthpodontic diagnosis and various treatment approach.

KEYWORDS: Temperomandibular joint, orthodontics, anomalies.

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1 INTRODUCTION

Despite many years of basic and clinical research in the field, there is still great controversy regarding the management of temperomandibular disorders in the field of dentistry. This article reviews the influence of the temperomandibular disorders on orthodontic diagnosis and various treatment approaches. The major challenge to the clinician dealing with patients having temperomandibular disorders (TMD) is to distinguish the problem between those suffering from masticatory myofascial pain and those who have pathology in the temperomandibular joint which can evaluated by various diagnostic approaches.

Along with accurate diagnostic approach, having an understanding of the etiology of a condition is helpful in determining therapy. Whereas successful treatment can still be achieved in some instances even though the cause of the problem is unknown, the chances of success are greatly improved when there is both an exact diagnosis and a known etiology is known to the clinician.

Of the various conditions encountered in the orthodontic patient, the two most common are masticatory myofascial pain and dysfunction and the internal derangements of the temperomandibular joint. These conditions are of particular concern, not only because their presence may require modification in orthodontic treatment, but also because there have been claims that they can be caused by such therapy.

Congenital Anomalies

The various congenital anomalies that affect the region of the TMJ are a diagnostic as well as a therapeutic challenge to the orthodontist. Although they may share some clinical features, there are distinct differences that make each uniquely different from the others [1].

Hemifacial microsomia (first and second arch syndrome, lateral facial dysplasia): This congenital anomaly is characterized by hypoplasia or agenesis of the tissues in the region of the first and second branchial arch. Although it is usually unilateral, bilateral cases have been reported [2]. The faces of the patients, however, are asymmetrical, a feature that generally distinguishes them from patients with Treacher Collins syndrome.The mandibular deformity generally involves the TMJ and mandibular ramus, rarely extending beyond the antegonial notch. There are also associated abnormalities of the external, middle, and inner ear; the temporal bone; the parotid gland; the muscles of mastication and the facial nerve. Because of the absent or hypoplastic condyle, the mandible deviates to the affected side and the unaffected side is flattened and elongated. Associated with the skeletal deformity is a malocclusion which, along with the facial deformity, becomes worse as growth continues.

Goldenhar's syndrome (oculoauriculovertebral dysostosis)

The facial asymmetry and malocclusion observed in patients with this syndrome are similar to that which occurs with hemifacial microsomia. However, in addition there are facial skin tags, epibulbar dermoids and vertebral anomalies. In approximately half the cases there are also anomalies of the cardiovascular and genitourinary systems and in a small percentage of patients there is a cleft palate.

Treacher Collins syndrome (mandibulofacial dysostosis)

In comparison with the first and second arch syndrome and Goldenhar's syndrome, which are usually unilateral, Treacher Collins syndrome usually presents as a symmetrical bilateral facial deformity characterized by a hypoplastic mandible, deficient malar bones, low-set deformed ears, and an antimongoloid slant to the palpebral fissures. Although joint function is generally normal, the condyles are usually small, the mandibular body and ramus are short, and there is antegonial notching and a downward bowing of the lower border of the mandible. Although the deformity is classically symmetrical, asymmetrical cases have been reported [3], and in such patients it may be difficult to distinguish between Treacher Collins syndrome and bilateral facial microsomia.

Hallerman-Streiff syndrome (oculomandibulodyscephaly)

The facial deformity in this syndrome resembles Treacher Collins syndrome but, in addition, one finds scaphocephaly, congenital cataracts, and proportionate dwarfism. The face is small in comparison to the skull, the mandible is narrow, and the nose is beaked, leading to a bird-like facial appearance. The TMJ, which is located more anteriorly than normal, is hypoplastic and the condyles are small or absent.

2 DEVELOPMENTAL ANOMALIES

Injury to the TMJ in the growing child by such conditions as trauma, infection, or irradiation can also cause condylar hypoplasia, with growth arrest or retardation and facial asymmetry similar to that observed with the congenital hypoplasias. However, because of the later onset, the morphological changes are usually less severe, and the other syndromic phenomena are not present. Condylar hyperplasia and mandibular overgrowth can also occur in some individuals. However, unlike condylar hypoplasia, which is usually recognized at an early age, condylar hyperplasia is usually not recognized until the late teens or early 20s when condylar growth continues beyond the normal time.

Condylar hypoplasia

Condylar hypoplasia produces a facial deformity on the affected side characterized by a short and wide mandibular ramus, a short mandibular body, fullness of the face, and deviation of the chin. On the unaffected side the body of the mandible is elongated and the face is flat. Malocclusion develops from the mandibular deviation. When there is a bilateral growth arrest, there is usually a symmetrical underdevelopment of the mandible and a micrognathic appearance.

Diagnosis is based on the history of a progressive facial asymmetry beginning during the growth period, generally associated with an injury; radiographic evidence of condylar underdevelopment and increased antegonial notching [2]. The last is important in helping to distinguish condylar hypoplasia and growth retardation from condylar hyperplasia and mandibular overgrowth.

Unilateral condylar hyperplasia

This disorder of unknown origin is characterized by persistent or accelerated unilateral condylar growth at the time when growth should be diminishing or ended. The slowly progressive unilateral enlargement of the mandible causes a cross-bite malocclusion, facial asymmetry, and shifting of the midpoint of the chin to the unaffected side. Concomitant with the increased downward and forward growth of the mandible, which carries the teeth with it, there is compensatory eruption of the maxillary teeth and downward growth of the maxillary alveolar process, as well as upward growth of the mandibular alveolar process in an attempt to maintain the occlusion. The latter often leads to a convex appearance of the inferior mandibular border on the affected side. This is in contrast to the antegonial notching observed with condylar hypoplasia.

The Arthritis

All of the various forms of arthritis that can affect the other joints of the body can also involve the TMJ. The commonest forms seen are degenerative and rheumatoid arthritis. However, in some instances, infectious and traumatic arthritis, as well as the rarer types such as psoriatic arthritis, ankylosing spondylitis, gout and pseudogout can be encountered [4].

Rheumatoid Arthritis: As many as 50% of patients with rheumatoid arthritis will show some involvement of the TMJ [5], [6]. The degree of involvement may vary from transient episodes of pain, swelling, and limited movement to severe damage of the periarticular and articular structures resulting in fibrous or bony ankylosis. The disease has a female to male predilection of approximately 3:1 [6]. The distribution of rheumatoid arthritis, in comparison with that of degenerative arthritis, generally tends to be symmetrical. Moreover, whereas degenerative arthritis can be limited to only the TMJ, rheumatoid arthritis usually begins in the peripheral joints (wrists, elbows, ankles) and the clinical findings are more generalized.

3 RADIOGRAPHIC DIAGNOSIS OF TEMPOROMANDIBULAR DISORDERS

The status of the temperomandibular joint (TMJ) and associated musculature is not only a concern when a patient is complaining of pain or dysfunction, but also at any time treatment may affect loading and usage patterns.

This is especially true at the initiation of orthodontic treatment where it is difficult to imagine that such manipulation of occlusal relationships would not alter demands on the system. This article will review the evidence that specific findings on imaging lead to diagnoses that allow prediction of future disease onset or the course of the current disease. Without providing such information, the clinical value of imaging is greatly reduced.

Joint Anatomy Relative to Imaging

The diverse anatomy of the TMJ makes the task of consistent, high-quality imaging demanding. Yale [7] identified four markedly different naturally occurring condyle morphologies, some of which might appear abnormal on imaging to the inexperienced eye. The mediolateral length of the condyle, averaging 20 mm, prevents reproduction of the medial portions of the joint on conventional, flat plane radiographs. Adjacent dense osseous structures in and around the cranial base are easily superimposed on the joint image, absorbing radiation and degrading image clarity. Perhaps the most technically

demanding anatomic obstacle to overcome is the great variability in angulation of the long axis of the condyle both in the horizontal and vertical planes. Optimal imaging results require the central X-ray beam to be aligned with the condylar long axis.

Transcranial Radiographs

Transcranial radiography (TR) has been used extensively as a diagnostic aid for TMDs, partly caused by the technique's simplicity and the wide availability of the required equipment. Historically, transcranial radiographs have been used to evaluate the status of joint hard tissue and the spatial relationship of the condyle to the fossa [8],[9].

TR images can be produced with standard dental X-ray units and relatively inexpensive head and film positioning devices. Some head positioning devices produce only the standard projection while others allow individualizing the central X-ray beam to each patient's anatomy. The TR image represents a profile view of the lateral third of the joint because the central and medial portions of the joint are projected inferiorly onto the condylar neck by the vertical angulation of the X-ray beam. This may be an advantage when looking for osseous lesions because they most often occur in the lateral third of the joint. However, it must be kept in mind that lesions occurring in the central and medial portions will not be discernible on TR. It is possible to image the more medial portions of the joint with the transmaxillary

Transmaxillary Radiography

This technique provides a frontal view of the TMJ, sometimes referred to as the transorbital, or infraorbital projection. The entire mediolateral profile of the condyle is imaged, making this view a very useful supplement to a sagittal view, such as the transcranial projection.

Used together, the views provide a three-dimensional perspective not possible with either of the views alone. A disadvantage of the transmaxillary view is its failure to portray most of the fossa, which is hidden by the shadow of the eminence. The technique, as described by Bean, [10] involves positioning the film cassette perpendicular to a standard dental X-ray beam. The condyle should be translated to the height of the eminence either by opening the mouth or protruding the mandible maximally. Failure to translate the condyle properly will result in a degrading superimposition of the eminence on the superior condylar margin. A mouth prop may aid in maintaining desired condyle positioning. The required beam angulations result in some distortion and magnification of the condylar image, although it seems to be of minor clinical importance in detecting

The panoramic image: The quality and clarity of the image depends in part on how well the patient is positioned relative to the focal trough and how closely the patient's jaw curvature fits the image layer configuration. In general, image sharpness is typically less than with technically correct plane film radiography. Larheim [11] found panoramic radiography to compare favorably to transcranial and transpharyngeal radiography in detecting rheumatoid arthritic lesions.

Considering its comparability to other imaging techniques for detecting osseous abnormalities, cost effectiveness, availability, and relatively low radiation dose, the panoramic radiograph is a good choice for a screening view. Combined with a carefully conducted clinical examination and history, the probability of overlooking a malignancy or life-threatening disease is low. However, with this technique many early lesions will not be detected, and no information on joint soft tissue status will be provided.

Arthrography

Arthrography is a technique used to highlight or outline joint structures by using a radiopaque contrast medium to enhance their images on plane or tomographic films. In the case of the TMJ, the contrast medium is injected into the upper or lowers joint space or both. The disc then appears as a radiolucent mass against the background of contrast medium on conventional radiographs, tomography, or fluoroscopy.

Anterior and posterior recesses are identified. The last method allows for monitoring of the needle during the injection procedure, viewing of dynamic disc movements, and visualizing contrast material moving through existing perforations. In many cases of disc displacement with reduction on mouth opening the dynamic movement of the disc during displacement and reduction is dramatically evident and can be recorded on videotape for later study. If the diagnosis cannot be made using fluoroscopy, sagittal and possibly coronal view tomography, referred to as arthrotomography when used with contrast medium in the joint, may be required to provide high definition views of the medial and lateral portions of the joint. Both the closed mouth and an open mouth view, with the mandible past the opening click, are required to diagnose disc displacement with reduction. The contrast medium may also show joint space distention in the anterior, posterior, and/or lateral and medial recesses, a possible indication of a displaced disc or stretched attachments. An enlarged anterior recess is indicative of an anteriorly directed disc displacement, whereas an enlarged anteromedial recess on the medial cut arthrotomogram may indicate a medially directed displacement

Computed Tomography

Computed tomography (CT) is a technologically advanced form of tomography using computerized storage of data from a series of thin X-ray tomographic sections taken from multiple directions. The exposures are recorded by an array of sensors positioned on the opposite side of the rotating gantry from the radiation source. The data are collected as a three-dimensional matrix of small volumes or voxels, each assigned a value corresponding to the density of the tissue within. These data can be reformatted to produce tomographic- like sections in different planes, although reconstruction of planes other than that of the original scan results in images that are somewhat degraded. Because CT uses X radiation just as in all previously discussed radiographic techniques, it is not well suited for differentiation between soft tissue types. Density differences between muscle, capsule connective tissue, and the disc are relatively subtle under the normal CT operating mode, and not well differentiated.

Discs in normal position are often lost in the background of the immediately adjacent high contrast condyle and fossa. Anteriorly displaced discs usually appear as amorphous masses anterior to the condyle when special computer enhancement techniques are used. The sensitivity/specificity values from several studies assessing accuracy of CT in detecting disc displacement have varied considerably [12],[13]. Westesson found poor specificity (0.50) caused by difficulty in differentiating between the insertion of the lateral pterygoid muscle and a displaced disc. Other difficulties encountered with CT include inability to detail perforations and disc morphology, as well as its relatively higher cost and radiation dose. These factors have led to declining use of CT for soft tissue diagnosis.

Computed tomography: CT has good validity for diagnosing osseous abnormalities. However, tomography should be considered for this purpose because it costs much less and its validity is comparable with that of CT. Probably the best use of CT is for diagnosing intraosseous lesions. Moreover, CT has a large area of coverage that is not only useful for diagnosing tumors in the TMJ, which are very rare [14] but also in adjacent anatomic regions.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) has several distinct advantages over previously discussed

imaging techniques. Chief among these advantages is the substitution of relatively harmless superconducting magnets and radio wave energy for the well-known hazards of ionizing radiation used with all previous forms of imaging. Several studies have assessed the validity of MRI in diagnosing disc displacements [15], [16].

4 TMD AND ORTHODONTIC TREATMENT

Initial identification of a putative causal relationship between occlusal factors and pain in the region of the TMJ is generally attributed to Costen in 1934 [17]. Since that time, various types of corrective therapy involving orthodontic/ orthopedic approaches and occlusal adjustment have been proposed to correct the malocclusion and thereby to alleviate the signs and symptoms of TMD [18], [19]. It was assumed generally that structural or functional malocclusions cause TMD, and that normalization of the occlusion by means of occlusal adjustment and orthodontics should correct the disorder [20], [21].

Another interesting dichotomy concerning the relationship between TMD and orthodontic treatment has developed recently. Although it is more common to regard malocclusion as a predisposing factor for TMD, recent publications by Schellhas and colleagues [22] have reversed this causal relationship and proposed that TMD, and internal derangement of the disc specifically, is a causal factor leading to malocclusion, which then requires orthodontic treatment because of abnormal facial growth and form. Several specific orthodontically related procedures have been proposed to cause TMD.

Two critical review articles dealing with the evidence concerning the association between TMD and orthodontic treatment were published very recently by Sadowsky [23] and by Mc- Namara and colleagues. Sadowsky reviewed studies totaling 1,300 patients who had previously undergone orthodontic treatment. Mc-Namara and coworkers provided an excellent historical overview and reviewed data from more than 150 clinical studies covering several thousand subjects. Although different in scope, both reviews arrived at very similar overall conclusions based on their extensive consideration of the literature. According to Sadowsky, "the overwhelming evidence supports the conclusion that orthodontic treatment performed on children and adolescents is generally not a risk for the development of TMD years later."

5 CONCLUSION

The TMJ is a very complex joint to deal with as a whole. As people who move teeth and change occlusion, the orthodontist may be the one who alters joint function the most. The importance of treating from a centric relation position

to a centric relation position cannot be stressed any more. A thorough knowledge of TMJ function and disorders and functional occlusion is essential to establish long term goals for the occlusion and the joint.

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