TMJ biocompatible orthodontic treatment

Michael Alpern, DDS, MS

Treating orthodontic patients who have symptoms of temporomandiublar joint dysfunction is a complicated problem requiring a multidisciplinary team approach. One such team, consisting of an orthodontist, a PhD clinical psychologist, a board certified neurologist, a prosthodontic general dentist and a board certified orthopaedic arthroscopic surgeon, has been conducting independent and joint research projects over a 6-year period in Port Charlotte, Florida. This report, which summarizes the presentation of four separate papers made February 1991 to the Midwest Component of the Edward H. Angle Society in Sanibel Island, Florids, represents the culmination of the team's research findings.

Psychological stress

The first paper, "Five year followup of the effectiveness of multidisciplinary approach" by Charlotte Wharton, PhD, is the sequel to a paper published in the Angle Orthodontist in 1988 (Alpern MC, Nuelle DG, Wharton C. TMJ diagnosis and treatment in a multidisciplinary environment. Angle Orthod 1988;58:101-126). In the followup report, Dr. Wharton presents the findings of the psychological evaluation, including a Minnesota Multiphasic Personality Inventory and a State-Trait Anger Expression Inventory, of 200 TMD patients presenting for TMD and/or orthodontic treatment. Each patient was rated on the Wharton Stress Scale, a 5-point system where 1 represents no stress involvement and 5 indicates severe stress requiring prolonged psychological treatment. Dr. Wharton found 51% of the 200 patients rated a 3; these patients would require at least six stress counseling sessions as part of their TMD treatment. Another 20.5% rated 4 or 5, which indicated stress was such a severe component that splint therapy or surgery were contraindicated due to a strong tendency to fail.

The implications seem clear. Over 70% of the TMD patients presenting for treatment had a psychological component to their stress. Without appropriate counseling to address the psychological component, treatment would be incomplete.

Dr. Wharton introduced a two-pronged approach to treatment: 1) psychological treatment of stress points discovered in the initial interview and 2) resetting the thermostat through stress management exercises. Success, Dr. Wharton emphasized, is often measured as two steps forward and one step back.

Dr. Wharton also presented a profile of an average TMD patient: a 31-year-old white female with at least 11 years of education and a critical, dominant father. She strives for perfection and experiences resentment and frustration in the process. She has difficulty expressing her anger or relaxing. Dr. Wharton concluded that TMD patients are psychologically very susceptible to suggestion by authority figures, including anyone suggesting surgery. Therefore, the stress aspect of their treatment needs careful evaluation prior to the consideration of surgery.

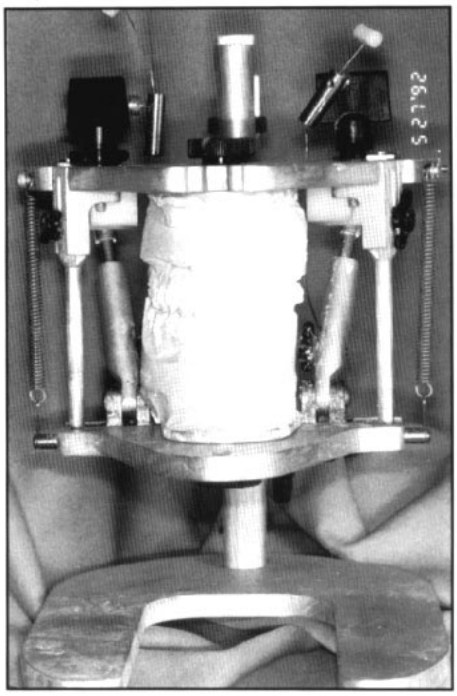
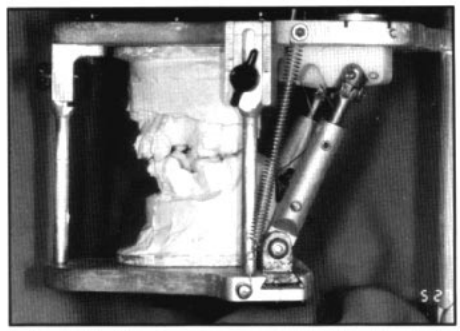


Figure 1



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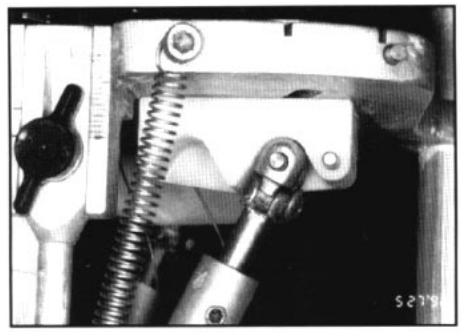

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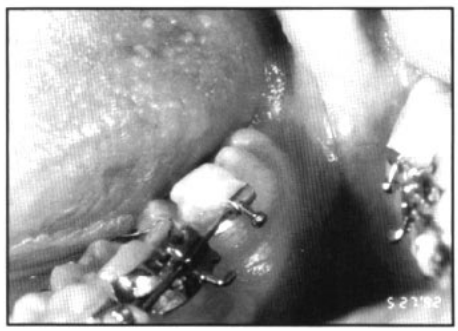


Figure 4

Figure 5

Figure 1
Front view of Polycentric Hinge Joint Articulator.

Figure 2
Side view of Polycentric Hinge Joint Articulator, demonstrating polycentric hinge joint and ligament guided motion.

Figure 3
Lateral view closeup of polycentric hinge joint. Note anterior fossa is not an additional fossa but a "catcher".

Figures 4-5
Mini brackets for second molars with Herculite universal enamel composite buildup to act as flat plane bite-splint therapy.

Medical, neurological considerations

In his report, Dr. Edward Steinmetz, a board certified neurologist, discussed the need for a thorough medical and neurological examination for any patient experiencing head pain. These patients may have an undiagnosed prolapse of the mitral valve or undiagnosed tumors, malignancies or temporal arteritis. If temporal arteritis is not diagnosed promptly, the patient could become blind. Dr. Steinmetz also stressed using a team approach to treatment so that one person controls the patient's pharmacology.

Arthroscopic surgery

Dr. Douglas Nuelle, an orthopaedic surgeon, presented a TMJ arthroscopic surgical update in which he stated that TMJ arthroscopic surgery remains an experimental, elective procedure. He maintains that this surgery should only be attempted after all other conservative methods of treatment have been unsuccessful. Even then, it should be considered elective and experimental.

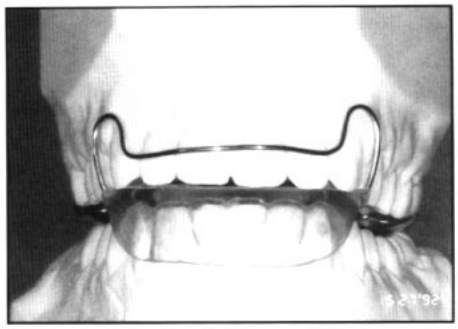
Dr. Nuelle stressed that when an orthodontist refers a patient for arthroscopic surgery, he or she shares in the liability should the surgery go awry. It is the orthodontist's responsibility to select a surgeon who has the education and skill to handle the problem.

There is a difference between an arthroscopic examination and/or joint lavage and arthroscopic surgery. In an exam, the joint may be observed or even washed out. In surgery, a second portal of entry is used and surgical manipulation, cutting, or removal is involved. Because arthroscopic surgery is new and involves video, patients may see it as a "magic pill". Indeed, its future could be filled with abuse because of its uniqueness.

Polycentric hinge joint

Dr. Neulle, prosthodontic general dentist Dr. Ralph Brandon, and the author presented a new concept for joint function as it pertains to a newly developed articulator. The human TMJ is a polycentric hinge joint. Dr. Nuelle suggested, based on direct arthroscopic observation, that the TMJ is not loaded in centric occlusion and is only partially loaded during function. According to Dr. Nuelle, Posselt in 1952 actually described a polycentric hinge joint with ligament-guided motion.[1]

Dr. Nuelle examined existing dental articulators and found them skeletally incorrect; they do not replicate the functional anatomy of the TMJ as observed arthroscopically. He presented a wooden prototype that exhibited a polycentric hinge joint with ligament-guided motion. Dr. Brandon and the author then introduced upscale models in wood and finally, metal prototypes of the polycentric hinge joint articulator, Figures 1-3. This articulator moves like a human TMJ. It has a polycentric hinge permitting multiple axes of rotation along the arc of movement. It is ligament-guided through a unique Beta titanium TMA wire suspension system that suspends the movement of the mandible on an arc rather than on a straight line. Most existing articulators use stainless steel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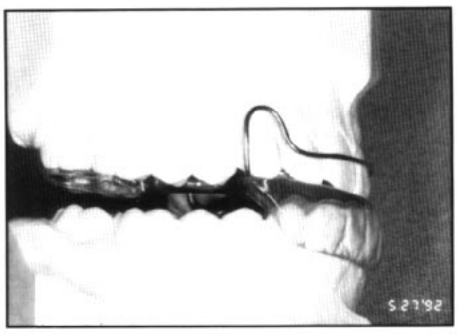
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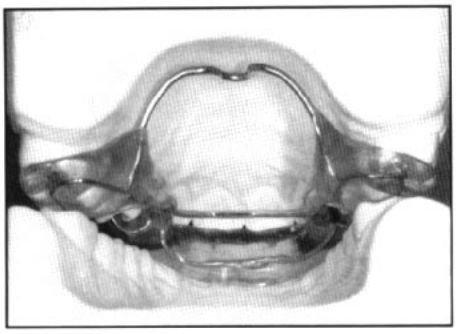
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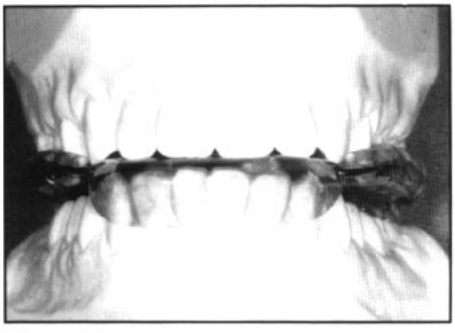
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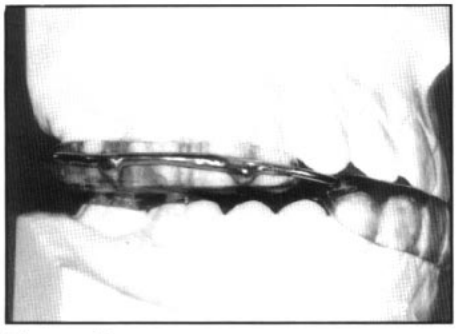
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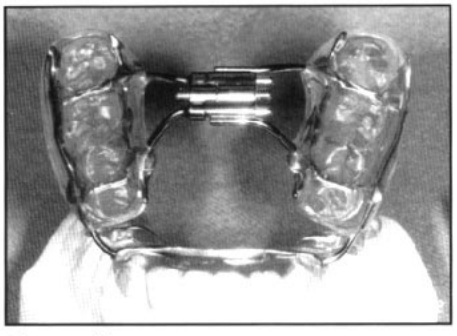
Figure 11

balls operating against metal plates. Nowhere in the human TMJ does function occur on flat straight plane lines. Instead, joint function occurs on linear curves.

TMJ considerations in orthodontic treatment

The final report in this series dealt with how the author's practice has changed based on this research, accepting the hypothesis that the maxilla and the maxillary teeth affect, and are affected by, the mandible and its dentition. Whatever happens to the teeth can affect the TMJ, and vice versa.

For all other joints in the body, general, medical and orthopaedic surgical principles call for joint unloading to permit healing and/or to prevent trauma during orthopaedic correction.

Orthodontists need to improve their ability to evaluate the TMJ complex as well as the malocclusion. In a number of cases, tomography or magnetic resonance imaging (MRI) must be used to aid in diagnosis. By using a triage method of history taking and an orthopaedic surgeon's clinical joint examination, at least 50% of the patients who presented for orthodontic treatment were found to be TMJ/orthodontic patients. These patients may present with dysplasias of the teeth and jaws but can just as readily have functional and pathological aberrations of the temporomandibular joints. The joints must be protected during tooth movement. Orthodontic therapy has been modified to include vertical unloading using the concept of a full arch, flat plane splint to permit unencumbered joint motion. This allows the patient's neuroskeletal muscular morphology to find the most comfortable joint position. Orthodontic cusp fossa correction to that position is accomplished with various appliances such as the bite plane headgear tube appliances and porcelainized light-cured composite overlays on the lingual of the maxillary incisors or the molars, Figure 4 and 5. This is similar to the recommendations of Lloyd Pearson.[2]

Early orthopaedic treatment could include TMJ biocompatible appliances, such as the rapid palatal expansion bite plane appliance to protract the maxilla and/or give unilateral expansion while keeping the joint vertically unloaded.[3] A MIROS appliance (Figures 6-8) can be used for skeletal correction of a Class II deep bite and a multifunctional appliance (Figures 9-11) for correction of Class II open bite and hyperdivergent skeletal patterns with maxillary width deficiencies.[4-5]

TMJ loading should not be attempted because it could lead to arthritic degeneration or other joint pathology. As an example, maxillary protraction was achieved by placing hooks on a football or hockey helmet. Elastics from the orthodontic appliances connect to the helmet hooks and thus avoid mandibular pressure and the resultant potential TMJ loading.

Vertical unloading appliances appear to have orthodontic advantages beyond TMJ concerns, including immediate opening of deep bites, open bite control, non-interfering AP correction and non-interfering transverse correction. In addition, they have the following benefits: they de-

Figure 6
Front view of MIROS appliance.

Figure 7
Side view of MIROS appliance.

Figure 8
Lingual view of MIROS appliance.

Figure 9
Front view of Multifunctional appliance.

Figure 10
Side view of Multifunctional appliance, demonstrating back-to-back biteplanes in the molar areas.

Figure 11
Occlusal view of Multifunctional appliance, demonstrating slow palatal expansion for the maxillary arch independent of mandibular orthopaedic traction.

Figure 12
Bracket system demonstrating mesiogingival bracket posts for maxillary lateral incisors, gingival posts for all cuspids, and mandibular lateral incisors.

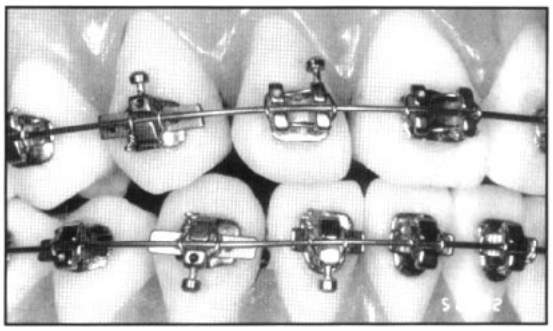

Figure 12

Figure 13
Mandibular first molar tube with a zero rotation and gingival hook. Also shown are mini pads with mini hooks for second molars for more efficient treatment. All tubes have hooks for elastic traction.

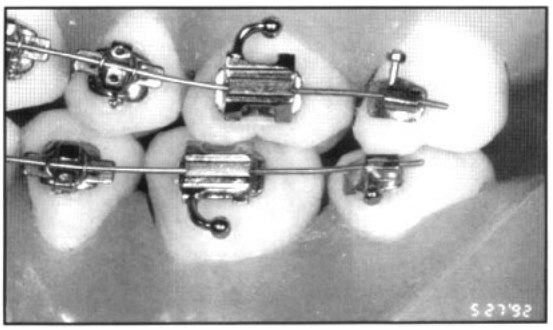

Figure 13

crease extraction requirements, decrease patient discomfort, decrease appliance breakage, and diminish treatment time.

Also introduced was a series of modifications to fixed orthodontic appliances, including a mesiogingival post to the maxillary lateral incisor bracket and gingival posts to the mandibular lateral incisor and all canine brackets (Figure 12). This permits a new system of elastics that enhance torque and bodily retraction of the maxillary incisors and prevent detorquing, as can occur with some existing elastic traction movement.

Treatment to a non settling position using zero rotation in the mandibular molars and a series of mini tubes to the second molars was also introduced (Figure 13). This permits universal banding and bonding of all teeth. Improved anchorage control using Class II elastics is achieved in the mandibular arch; a horizontal arm of force reaches from the second molar to the first and over the top of the canine bracket hook; another horizontal arm of force extends forward to the mesiogingival hook of the maxillary lateral incisor bracket.

Summary

The papers summarized here indicate that TMJ dysfunction remains a complicated problem, requiring a multidisciplinary team approach. Psychological stress is an important factor in diagnosis. New concepts of joint function must be considered. The functional anatomy of the TMJ from an arthroscopic perspective should be studied. New treatment methods, such as the polycentric hinge joint articulator, should be considered. And finally, orthodontic diagnosis and treatment conventions need to be modified, from obtaining a complete history, clinical examination, arriving at a diagnosis and obtaining informed consent for treatment that may include psychological counseling, splint therapy, simultaneous fixed orthodontics and splint therapy and possible TMJ arthroscopic surgery for nearly all orthodontic patients.

Author Address

Michael C. Alpern, DDS, MS
551 Port Charlotte Blvd.
Port Charlotte, FL 33952

M.C. Alpern is founder and lecturer of the Florida Institute for Temporomandibular Studies

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