

Temporomandibular disorders and orthodontics: What have we learned from 1992–2022?

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The January 2022 issue marks 30 years since the *American Journal of Orthodontics and Dentofacial Orthopedics* (AJODO) published a special temporomandibular joint (TMJ) issue in January 1992. It was dedicated to studies pertaining to the relationship between orthodontics, occlusion, condyle positions, and temporomandibular disorders (TMDs). In this commemorative article, we discuss what has been learned since the publication of that important milestone issue of AJODO in 1992.

EARLY CONTROVERSY

For nearly 100 years, TMDs have been a topic that stirred divergent opinions, which led to significant differences in clinical management by orthodontists as well as all other disciplines of dentistry. Two key events have contributed to initiating the dental specialty's interest in TMDs. The first was Costen's observations in 1934,^{1,2} which indirectly and incorrectly related pain and symptoms of the ear and TMJ to changes in the dental vertical dimension. Second, there were articles produced by members of the Gnathological Society,³⁻⁵ which centered their philosophy on harmonizing occlusal relationships with jaw function. Their concepts included establishing canine-protected occlusion and attaining the coincidence of maximum intercuspation

(MI) with centric relation (CR) of the mandible through complex and tedious methods and instrumentation. Since then, there have been countless opinions and philosophies about the diagnosis and management of TMD—a situation that persists today. Current concepts and procedures include variations in gnathological principles,⁶⁻¹³ electrically stimulating masticatory muscles to obtain ideal muscle-determined mandibular and joint positions,¹⁴⁻¹⁶ variations in the design and delivery of occlusal splint therapy, repositioning mandibles to recapture discs,^{17,18} changing occlusal and skeletal relationships with orthodontic treatment and orthognathic surgery as well as TMJ surgery to manage intracapsular TMD problems.

As early as 1939, prominent orthodontists such as Brodie,¹⁹ followed by Thompson,^{20,21} Moyers,²² Ricketts,²³ and Perry,^{24,25} discussed the importance of TMJs, occlusion, and jaw function considerations in orthodontic treatment planning. Ronald Roth played a pivotal role in merging the gnathological-prosthetic philosophies into orthodontics. He believed that orthodontics involved more than attaining traditional static occlusal goals.²⁶⁻²⁸ He expected orthodontists to establish “optimal” functional occlusal goals by establishing canine-protected occlusion and having a patient's MI coincide with their CR condyle position. These goals were to be achieved with his Roth Power bite registration and various instrumentation, including articulator mounting of study casts.²⁹⁻³³ Ultimately, he suggested that following these procedures would reduce the likelihood of developing TMDs. However, during this same period, a subgroup known as functional orthodontists were criticizing traditional orthodontic procedures like premolar teeth extractions and commonly used auxiliary appliances and retainers for causing TMDs.^{34,35}

Acknowledging the significant growing controversy and diverse opinions in the 1980s regarding TMDs, the American Dental Association in 1983 and 1989 and the National Institutes of Health in 1996 held conferences

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to try and establish guidelines on the examination, diagnosis, and management of TMDs.³⁶⁻³⁸ Unfortunately, many of the recommendations that arose from those conferences were not widely embraced by the dental community.

THE TURNING POINT

Although the relationship between orthodontics and TMDs had been vigorously debated for many decades before 1992, a significant increase in concerns about this area was stimulated by the infamous Brimm vs Malloy Michigan lawsuit in 1987. Briefly, a 16-year-old female patient, Susan Brimm, was treated by a board-certified Michigan specialist orthodontist to address her Class II Division I malocclusion with a 7 mm overjet. Treatment involved the extraction of 2 maxillary first premolar teeth and full fixed appliances and headgear. Susan did not exhibit any TMD signs or symptoms before or during treatment. After removing her appliances, she complained of joint pain and headaches, which worsened with retainer wear. She was later referred to an oral surgeon to remove her mandibular third molar teeth, after which she developed severe pain, clicking, and locking of her joints. A complaint was filed against the oral surgeon for failing to diagnose a TMD problem before the extractions and exacerbating her condition; that case was settled for \$2500. Another complaint was then filed against the orthodontist for providing substandard treatment resulting in TMD signs and symptoms. Expert witnesses for the plaintiff, who were not licensed dentists in the state of Michigan, stated that her orthodontic treatment should not have involved the extraction of maxillary premolar teeth, which led to the over retraction of her maxillary incisors, distally displacing her mandible and ultimately resulting in TMJ internal derangement causing her joint pain, clicking and locking. Irrespective of what the expert witnesses had to say on behalf of the defendant, all of whom were board-certified specialists in Michigan, the 6-member jury found in favor of the plaintiff, and she was awarded \$850,000 before costs.³⁹ This case resulted in a greater divide between “traditional” orthodontists and the self-proclaimed TMJ “friendly” or expert orthodontists and dentists.

As a result of this case, the American Association of Orthodontists saw the need to assist in much-needed research and the generation of further knowledge on orthodontic treatment in relation to TMD, regardless of the outcome. Early in 1988, a task force was formed by the American Association of Orthodontists (the Scientific Studies Committee), which was responsible for assessing incoming research proposals and

organizing funding for a series of studies, both cross-sectional and longitudinal, to address these topics.

When the supported studies were completed, an issue dedicated to orthodontics and the TMJ was published in the January issue of the AJODO in 1992. On the basis of the evidence at that time, the following conclusions were made:⁴⁰

1. Significant associations between dental relationships and skeletal structures and TMDs could not be demonstrated.
2. The development of TMDs cannot be predicted.
3. No method of TMD prevention has been demonstrated.
4. The prevalence of TMD symptoms increases with age, usually beginning in adolescence; thus, TMDs may originate during orthodontic treatment but not be related to the treatment.
5. Orthodontic treatments per se do not cause TMDs.
6. Evidence favors the beneficial nature of orthodontic treatment; as part of the regimen of care for TMD patients, orthodontics may assist in lessening symptoms.
7. Once TMD is present, TMD cures cannot be assumed or assured.

THREE DECADES OF KNOWLEDGE (1992-2022)

Since 1992, a large amount of evidence-based data has been accrued over the decades. These studies⁴¹⁻⁵⁵ have shown that orthodontic treatments performed with and without extractions, along with the appropriate use of headgears, chin cups, elastics, and deep overbite correction, do not cause TMDs and can be safely used for the retraction of maxillary incisor teeth. As related to the Brimm case, incisor retraction does not distally position condyles within the glenoid fossae leading to anteriorly displaced TMJ disks.⁴¹⁻⁵⁵

The orthodontic-gnathological principles^{29-33,56-58} of establishing canine-protected occlusion and analyzing and attaining coincidence of MI with a particular CR position with bite registrations, face bows, articulators, axiographs, and pantograph tracings as well as condylar position indicators have been challenged by several research papers. In summary, this approach to curing or preventing TMDs has been shown to be invalid, futile, and clinically irrelevant.⁵⁹⁻⁶⁴

A patient's original maxillomandibular relationship with their teeth in MI (ensuring no dual bite present) appears to be the best physiological guide to base treatment on. The patient's original condyle-fossa relationship should be maintained as much as possible throughout the orthodontic process. Any procedure

that positions the condyles away from this natural and physiological relationship should be avoided and may cause harm to the patient in the long term.⁶⁵

We can conclude that, in general, an individual's occlusion or condyle position after their orthodontic treatment neither increases nor decreases their risk of developing TMDs. Orthodontic treatment also does not prevent the likelihood of developing a TMD problem in the future.^{66,67} Given these above conclusions, it is not evidence-based to advise patients and parents of young children that orthodontic treatment is indicated to reduce or eliminate the risk of TMDs developing in the future.

TRANSITION INTO MEDICINE AND THE BIOPSYCHOSOCIAL FRAMEWORK

The definition of TMDs today is that they are a group of muscular and neuromuscular conditions that involve the muscles of mastication, the TMJ, and associated structures.⁶⁸ Currently, our knowledge of the etiology of TMDs and the complex assortment of initiating, predisposing, exacerbating, and perpetuating factors is limited but constantly growing.

Numerous studies ranging from placebo studies as early as the 1970s⁶⁹⁻⁷² to a 12-year series of large-scale clinical studies conducted at the beginning of the 21st century called the Orofacial Pain: Prospective Evaluation and Risk Assessment (OPPERA) trials⁷³⁻⁷⁷ have shifted our focus from a dental and mechanical-based model of TMD care to a biopsychosocial model of care. When placebo TMD treatments such as sham medications, nonoccluding oral appliances, and mock equilibrations elicited positive biological and behavioral responses, it became obvious that there must be another pathway to alleviating pain than the previously held mechanistic beliefs. Consequently, if conservative and reversible therapies could be equally or more effective in managing TMDs, it must be accepted that invasive, aggressive, and irreversible approaches to TMD care such as occlusal adjustments, repositioning splints, orthodontics, orthognathic surgery, and full mouth rehabilitation and TMJ surgery are generally not needed and should not be routinely performed.⁶⁹⁻⁷²

Furthermore, our understanding of how pain is perceived and processed and the emotional, cognitive, and behavioral factors that modulate the pain experience has changed. Our appreciation of how chronification of pain and central sensitization occurs, the influence of comorbidities on TMDs, and the vulnerability of certain patients to experiencing TMD pain increased significantly in the last decade.⁷²⁻⁸²

Traditional methods of assessing the minutia of occlusion, condyle-fossa, and skeletal relationships are no longer components of the contemporary medical and

psychosocial model of TMD care. Instead, the current TMD management approach involves considering genetics of pain vulnerability and hypersensitivity, pain pathophysiology, chronic pain, and behavioral, environmental, and psychosocial factors. It also involves considerations for other appropriate health care professionals such as physicians, psychologists, physical therapists, and orofacial pain specialists to become involved in the overall management of TMD patients.⁸³ As the recent report from the National Academy of Medicine on TMD showed, there is a need for significant change at every level of education, management, and interdisciplinary cooperation for this field to make progress.⁸⁴

WHAT DO CONTEMPORARY ORTHODONTISTS NEED TO DO ON THE BASIS OF THE 30 YEARS OF POST-1992 DEVELOPMENTS IN THE TMD FIELD?

Although the details of diagnosis and management of TMDs⁸³ are beyond the scope of this review, there are several key issues that a contemporary orthodontist needs to consider in clinical practice on the basis of the currently available evidence.⁸⁴⁻⁸⁶

1. Become educated about the incredible developments that have occurred in this field.
2. Avoid diagnosing and treating TMDs within traditional mechanical and dental-orthodontic-based frameworks.
3. Conduct a thorough TMD examination and/or screening at the orthodontic consultation and before commencing orthodontic treatment.
4. Inform your patient of any notable findings and be prepared to discuss possible consequences/prognosis of those findings with and without orthodontic treatment.
5. Provide patient education about the possible appearance of TMD symptoms during or after orthodontic treatment.
6. Document all findings, inform consent dialogue, and procedures and treatments performed.
7. Address TMD pain before commencing orthodontic treatment. This could involve referral to appropriate health care professionals.
8. If TMD symptoms arise during treatment, stop all active treatment and manage TMD pain.
9. Manage TMDs with conservative and reversible therapies.

CONCLUSIONS

Unfortunately, numerous philosophies and schools of thought still exist that advocate nonextraction, expansion, alternative or nontraditional orthodontics, jaw growth, certain occlusal schemes, condyle locations, and

positioning techniques, all in the name of curing or preventing TMDs and, more recently, sleep-disordered breathing. Even today, orthodontists are encouraged to diagnose and manage nonexistent TMDs and/or treat and prevent TMDs from occurring while taking advantage of the associated short-term financial benefits. As attractive as this may seem to the inexperienced practitioner keen to learn or grow their business, clinicians must realize that adopting these unsupported and unfounded TMD practices will not only compromise their patients' well-being but will most certainly result in avoidable and indefensible legal claims.

Self-proclaimed experts and their believers may simply dismiss any evidence put before them that contradicts their beliefs, even after 30 years of quality scientific inquiry and compelling evidence. Although it is now generally recognized and widely accepted by the orthodontic specialty that the issue of orthodontics and TMDs has transitioned toward the biopsychosocial model, there will still be some who will continue to propagate their personal anecdotal concepts that confuse and potentially harm the public.

The likelihood of another orthodontics-related TMD case occurring in the future is small on the basis of what we know today, especially if orthodontic treatment is carried out according to the current best evidence. Clinicians must embrace the significant shift from the oversimplistic occlusal and mechanical-based model of TMD care to the medical and biopsychosocial model of care. This change also means that they must become familiar with the modern usage of conservative and reversible therapies, and if indicated, they should consider the involvement of other health care professionals to better serve their patients.

AUTHOR CREDIT STATEMENT

Sanjivan Kandasamy contributed to conceptualization, methodology, project administration, resources, supervision, validation, visualization, original manuscript preparation, and manuscript review and editing; Donald J. Rinchuse resources, validation, original manuscript preparation, and manuscript review and editing; Charles S. Greene contributed to resources, validation, original manuscript preparation, and manuscript review and editing; and Lysle E. Johnston, Jr contributed to original manuscript preparation and manuscript review and editing.

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