Occlusal interferences and temporomandibular dysfunction

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Disagreement exists regarding the relationship between occlusal interferences and temporomandibular joint dysfunction (TMD). This study sought to determine how a balanced occlusion, providing uniform contact in centric relation, would affect signs and symptoms of TMD. A randomly chosen group of 60 patients with occlusal interferences and signs and symptoms of TMD used a mandibular orthotic to balance their occlusions at centric relation (CR). When the occlusions of symptomatic patients were balanced in CR, there was a significant reduction or elimination of TMD complaints, suggesting a relationship between balancing occlusion in CR and optimum management of TMD.

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A historical perspective is useful for understanding the disagreement regarding the effect (if any) of occlusal interference as an etiological factor for temporomandibular joint dysfunction (TMD).

Several etiologies for TMD have been described in the dental literature. Psychological stress, trauma, occlusal interferences, and parafunctional habits such as bruxism and clenching have been described as etiological factors, although there appears to be disagreement as to the relative significance of these factors.

A number of studies have indicated occlusal interference is not a factor in the development of TMD; however, numerous reports, in addition to consistent and persistent anecdotal clinical experiences, continue to support the position that occlusal interference plays a primary role in the development of TMD. This dichotomy is compounded further by patients who have occlusal discrepancies and no apparent TMD symptoms, while other patients who have similar occlusal disharmonies develop significant symptoms of TMD. This creates a real dilemma for the dentist who intends to restore a patient’s stomatognathic apparatus to improve functional health.

If occlusal imbalance is a primary factor in the development of TMD, occlusal reconstruction could become problematic. Reconstruction could be especially difficult if it is developed in the presence of a symptomatic temporomandibular joint (TMJ), especially when each patient’s unique emotional and physical variability may be significant considerations in a multifactorial milieu.

This study was designed to determine the effect of a balanced occlusion in patients who display signs and symptoms of TMD.

Materials and methods

Approximately 300 patients, with signs and symptoms of TMD that had varied in duration from 1.5 months to 20 years, received a specially designed TMD questionnaire and a computer-generated commercial questionnaire (TMJ Scale, Pain Resource Center, Durham, NC; 800/542-7246). Each patient also was evaluated with a complete dental examination, full-mouth intraoral radiographs, head and neck muscle and TMJ palpation, ranges of jaw motion, mounted diagnostic casts, occlusal analysis, corrected TMJ tomograms, and stethoscope and Doppler auscultation (Imex Pocket-Dop II, Nicolet Vascular, Madison, WI; 800/525-2519).

A test group of 60 patients with occlusal interferences was selected at random from this general patient population. Condylar location was not measured before or after jaw registration, although it was noted in corrected tomograms prior to treatment. All of the patients showed varying degrees of occlusal interference when the mandibular condyle was manipulated bimanually into the most superior position within the glenoid fossa using previously described methods.

The test group was comprised of 52 females and 8 males between the ages of 16 and 80. Of these 60 patients, 50 (83%) described a stressful lifestyle, while 26 (43%) reported previous unsuccessful treatment for TMD involving splint therapy (protocol not known), 24 (40%) reported trauma affecting the jaws, and 18 (30%) reported undergoing previous orthodontic treatment. None of the patients who reported previously undergoing unsuccessful splint therapy recalled having their jaws manipulated to a specific position during the course of treatment other than simply tapping their teeth on occlusal marking paper. No previous splints were available for inspection.

The treatment consisted of two phases. Phase I was a provisional stabilizing treatment period. Reversible procedures were performed to develop a mutually protected occlusion so that all posterior teeth occluded on an orthotic after bimanual manipulation had placed the mandibular condyles in their most superior position within the glenoid fossa.

The passive occlusal positioning orthotic was used to eliminate/minimize signs and symptoms of TMD. This phase also allowed the dentist to provide a realistic prognosis, to educate the patient regarding probable limitations of the treatment’s outcome, and to determine if the patient’s expectations could be met. Because reversible procedures were employed, treatment could be terminated comfortably if a patient’s expectations became unreasonable or unattainable. As a result, Phase I therapy provided an opportunity to develop a knowledgeable and cooperative patient and allowed a suitably accurate predictive prognosis to emerge for Phase II.

Phase II involved irreversible treatment that provided long-term stabilization of a patient’s occlusion and/or articual apparatus, as determined by Phase I provisional therapy. Phase II therapy
incorporated five possible dental treatment modalities: repositioning of teeth, reshaping of teeth (occlusal adjustment), restoration of teeth, arthroscopic and/or orthognathic surgery, and deferring treatment.

While this therapy could have involved virtually any area of dentistry, it most commonly employed restorative dentistry (including occlusal equilibration and odontoplasty) and, to a lesser degree, orthodontics. Surgery was not commonly utilized. Two patients received arthroscopic surgery and one received orthognathic surgery. This report deals essentially with Phase I therapy.

Centric relation (CR) was considered obtained when the TMJs could be loaded bimanually with no sign of tension or tenderness while the condyles were in their most superior position within the glenoid fossa. CR position also was defined as an adapted centric posture when intracapsular dysfunction was asymptomatic and the patient could function in a productive manner. Treatment was considered successful when the TMJs were asymptomatic after load testing (by clenching in maximum intercuspation) with no tension, tenderness, or tightness in the joints and when the patient remained free of any functional discomfort for at least three months with a stable occlusion.

A wire-reinforced, heat-polymerized, acrylic resin (Lucitone, Dentsply Trubyte, York, PA; 800/877-0020) mandibular orthotic was fabricated for each patient (Fig. 1). All occlusal and incisal surfaces were covered with acrylic resin (Fig. 2); orthotics were relined with autopolymerizing acrylic resin (Motloid Cold Pack, Yates & Bird, Chicago, IL; 800/662-5021) when necessary to maintain maximum stability. Each patient’s orthotic was equilibrated occlusally to his or her individual CR (Fig. 3). CR was considered an adapted centric posture or treatment position in a structurally altered joint.

Several reliable methods for achieving centric relation may be employed. This study utilized a commonly described bilateral, bimanual mandibular manipulative method. Orthotics were adjusted with the patient in both the supine and upright positions. Anterior guidance was built into each prosthesis (Fig. 4) so that posterior teeth would be discluded by anterior teeth in protrusive and lateral excursions (Fig. 5). Patients were instructed to wear their orthotics as often as possible.

When occlusal interferences and muscle bracing were present during initial appointments, patients were instructed to wear their orthotics only until they became uncomfortable. By the third or fourth appointment, all of the patients were comfortable with their prostheses. Some patients wearing the orthotics experienced difficulty with speech; as a result, they did not wear their orthotics while working. These patients were instructed to wear the orthotics at night and at other times when they felt stress.

Patients were evaluated and questioned weekly regarding their progress and any signs or symptoms of TMD. Each orthotic was equilibrated until all opposing teeth had made equal contact with the prosthesis in centric relation and canine disclusion was present in both
Results

Patient profile prior to Phase I therapy

Prior to Phase I treatment, the patients in the test group had chief complaints that usually are associated with TMD. All patients reported experiencing myofascial pain. Forty-nine (82%) of the patients reported bilateral pain; the remaining 11 patients reported experiencing unilateral pain. Their pain history and pain perception upon muscle palpation was well-distributed within the group (see Table 1).

Occlusal analysis of the test group indicated that all 60 patients had various occlusal interferences in their arc of closure when condyles were seated fully in the most superior position within the articular fossa. These interferences resulted in condylar displacement, as visualized on corrected tomograms during maximum intercuspation. Twenty (33%) of the patients displayed interferences on the balancing side, while 15 (25%) demonstrated interferences on the working side.

Anterior guidance was demonstrated by the immediate discusion of all posterior teeth upon lateralrusive contact of the opposing canines and possibly the incisors as well; 24 (40%) of the patients demonstrated bilateral anterior guidance, while 14 (23%) displayed unilateral anterior guidance. For 22 (37%) of the patients, anterior guidance was absent, although posterior occlusion was present. Parafunctional dental wear facets were present in 55 (92%) of the patients while 15 (25%) had functional facets (see Table 2). Table 3 lists the patients’ dental relationships. The group was examined for TMJ dynamics and jaw movement (see Table 4).

Doppler auscultation is a helpful adjunctive diagnostic aid that appears to show potential merit. Certain joint sounds detected by Doppler auscultation suggest the possibility of the condyle perforating the articular disc, along with adhesions, an anteriorly displaced articular disc, and other degenerative joint pathology. Corrected tomography of the test group’s TMJs was taken as part of the patient’s initial examination (see Table 5).

Table 1. Chief complaints of test patients prior to Phase I treatment.

<table>
<thead>
<tr>
<th>Complaint</th>
<th>No. of patients (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMJ pain</td>
<td>47 (78%)</td>
</tr>
<tr>
<td>Headaches</td>
<td>46 (77%)</td>
</tr>
<tr>
<td>Neck pain</td>
<td>43 (71%)</td>
</tr>
<tr>
<td>Ear pain</td>
<td>34 (57%)</td>
</tr>
<tr>
<td>Facial pain</td>
<td>27 (45%)</td>
</tr>
<tr>
<td>Eye pain</td>
<td>15 (25%)</td>
</tr>
<tr>
<td>Tinnitus</td>
<td>10 (17%)</td>
</tr>
<tr>
<td>Vertigo</td>
<td>10 (17%)</td>
</tr>
<tr>
<td>TMJ clicks and pops</td>
<td>10 (17%)</td>
</tr>
<tr>
<td>Difficulty opening the jaws</td>
<td>4 (7%)</td>
</tr>
<tr>
<td>Slight myofascial pain (MFP)</td>
<td>7 (12%)</td>
</tr>
<tr>
<td>Slight-to-moderate MFP</td>
<td>14 (23%)</td>
</tr>
<tr>
<td>Slight-to-severe MFP</td>
<td>4 (7%)</td>
</tr>
<tr>
<td>Moderate MFP</td>
<td>16 (27%)</td>
</tr>
<tr>
<td>Moderate-to-severe MFP</td>
<td>12 (20%)</td>
</tr>
<tr>
<td>Severe MFP</td>
<td>7 (12%)</td>
</tr>
</tbody>
</table>

Table 2. The admitted habits of patients in this study.

<table>
<thead>
<tr>
<th>Habit</th>
<th>No. of patients (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bruxism</td>
<td>3 (5%)</td>
</tr>
<tr>
<td>Clenching</td>
<td>11 (18%)</td>
</tr>
<tr>
<td>Bruxism and clenching</td>
<td>30 (50%)</td>
</tr>
<tr>
<td>Patients unaware of bruxism and/or clenching</td>
<td>16 (27%)</td>
</tr>
</tbody>
</table>

Table 3. Class I and Class II dental relationships of the patients in this study.

<table>
<thead>
<tr>
<th>Class</th>
<th>No. of patients (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>26 (43%)</td>
</tr>
<tr>
<td>Class II, division 1</td>
<td>23 (38%)</td>
</tr>
<tr>
<td>Class II, division 2</td>
<td>6 (10%)</td>
</tr>
<tr>
<td>Class III</td>
<td>5 (8%)</td>
</tr>
</tbody>
</table>

These adjustments were accomplished first with the patient in a supine position. At the end of each appointment, the patient was placed in an upright position and the occlusion was checked again using a different color occlusal indicator ribbon to denote any changes from the supine position; all newly detected interferences were removed.

Weekly evaluation and equilibration periods lasted approximately 10–12 weeks on average, while appointment times ranged from 1.5 hours at the onset to 10 minutes as Phase I neared completion. To facilitate stabilization of the stomatognathic and articular apparatus, it was necessary for certain patients to wear an orthotic for a year or longer.

Patients who reported no feeling of discomfort and demonstrated no occlusal changes in CR occlusion (that is, simultaneous equal contact of the orthotic with opposing teeth) for three to four appointments were considered ready to begin Phase II.

Each appointment, as perceived by the patient, was reported verbally at

44 Using those parameters, 35 (58%) of patients found their mandibular range of motion to be improved, while 23 (38%)—including the 15 patients who started Phase I with a normal range of motion—
reported a normal range of motion. Two (3.0%) of the patients saw no improvement; these were the two patients who left before Phase I was complete.

While this report deals primarily with using reversible Phase I therapy for treating TMD, it is useful to know how patients were treated in Phase II (irreversible treatment). Phase I therapy was reversible because occlusal interferences were eliminated temporarily by altering an acrylic interim splint. To eliminate these interferences permanently without requiring an interim splint, irreversible occlusal modifications were necessary. Occlusal equilibration was completed on 42 patients (70%), while 11 patients were treated using orthodontics (18%), 3 received a combination of orthodontics and orthognathic surgery (5.0%), 2 received arthroscopic surgery (3.0%), and 1 underwent full-mouth reconstruction (2.0%). Three patients (5.0%) elected not to proceed to Phase II because they were uncomfortable (this included the two patients who left before the completion of Phase I).

Discussion

Clinically acceptable occlusion is possible with either canine guidance or group function. However, compared to group function occlusion, there is a significant reduction in electromyographic (EMG) activity of elevator muscles with canine occlusal guidance.\textsuperscript{65-69} While such a canine-protected occlusion does not affect muscular coordination patterns during mastication, it does markedly reduce EMG activity significantly and to predispose a patient to parafunctional activity such as clenching and/or bruxism.\textsuperscript{12,58,70-75}

An occlusal splint reduces muscular activity of the stomatognathic mechanism by eliminating premature occlusal contacts.\textsuperscript{79} In addition, an acrylic resin occlusal splint allows a dentist to observe treatment outcomes resulting from occlusal equilibration or alterations between group function and canine occlusal guidance. Based on these observations, it is necessary to develop a reliable prognosis before irreversible changes are pursued.

It may not be possible to attain CR with a joint that is altered structurally; a more accurate term in such cases might be adapted centric posture or treatment position, where the condyles are seated in the most superior position that can be attained within the articular fossa.\textsuperscript{54,57}

The 95% rate of success in this study likely was due to reduced muscle activity, the elimination of premature occlusal contacts, and, when possible, the development of canine-guided occlusion.\textsuperscript{65-69} This success rate was maintained after occlusal splints were removed and Phase II therapy was completed.

Haber claimed that occlusal interference is not a significant etiological factor for TMD because occlusal discrepancies are relatively prevalent among the general population, who also are free of TMD signs and symptoms.\textsuperscript{77} By contrast, individuals in the general population display “normal” occlusion while also demonstrating signs and/or symptoms of TMD.\textsuperscript{78}

This situation may be explained in part by the fact that teeth usually do not touch, except during swallowing or eating. If teeth are in contact at other times (regardless of the degree of force), the patient is practicing occlusal parafunction. Dental parafunctional wear may be detected by altered occlusal morphology and recent wear facets that exhibit a brilliant surface.\textsuperscript{79}

Parafunctional habits (for example, clenching and/or bruxism) will increase muscle activity that is heightened already because of the occlusal discrepancies. This response is modified further by both individual biological diversity and an individual’s ability to adapt to biological and psychological stress within the general population. Perhaps the real issue involves determining when the sequela of occlusal interferences (muscle hyperactivity and so forth) exceeds a patient’s physiologic tolerance.\textsuperscript{79}

Obviously, not all TMD cases are caused by occlusal interferences and/or parafunctional habit patterns, although these may be contributing factors. TMD appears to be a multifactorial condition involving several etiologies.\textsuperscript{1,5,17,28,81} Not all of these etiologies need to be present and some may or may not be interactive. This study was limited to determining how normalizing occlusion with a splint

<table>
<thead>
<tr>
<th>Table 4. TMJ dynamics and jaw movement within the test group.</th>
</tr>
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<tbody>
<tr>
<td>Dynamic</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td><strong>Stethoscope TMJ ausculation</strong></td>
</tr>
<tr>
<td>Clicking</td>
</tr>
<tr>
<td>Clicking/popping</td>
</tr>
<tr>
<td>Popping</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td><strong>Doppler ausculation</strong></td>
</tr>
<tr>
<td>Crepitation</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>No deviation</td>
</tr>
<tr>
<td><strong>Jaw deviation</strong></td>
</tr>
<tr>
<td>Deviation</td>
</tr>
<tr>
<td>No deviation</td>
</tr>
<tr>
<td><strong>Joint loading</strong></td>
</tr>
<tr>
<td>Painful</td>
</tr>
<tr>
<td>No pain</td>
</tr>
<tr>
<td>Not recorded</td>
</tr>
<tr>
<td><strong>Muscle palpation</strong></td>
</tr>
<tr>
<td>Tenderness</td>
</tr>
<tr>
<td>No discomfort</td>
</tr>
<tr>
<td><strong>Bimanual manipulation into CR, adapted centric, or treatment position</strong></td>
</tr>
<tr>
<td>Resistant</td>
</tr>
<tr>
<td>No resistance</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Table 5. Results of corrective tomography from the test group.</th>
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<tbody>
<tr>
<td>Result</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td><strong>Condylar morphology</strong></td>
</tr>
<tr>
<td>Superior surface flat</td>
</tr>
<tr>
<td>Osteophytic activity or “beaking” at anterior border</td>
</tr>
<tr>
<td><strong>Angle of the eminence</strong></td>
</tr>
<tr>
<td>Steep</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>Shallow</td>
</tr>
<tr>
<td>Flattened</td>
</tr>
<tr>
<td>Not recorded</td>
</tr>
<tr>
<td><strong>Condylar/fossa relationship</strong></td>
</tr>
<tr>
<td>Anterior</td>
</tr>
<tr>
<td>Normal</td>
</tr>
<tr>
<td>Superior and distal</td>
</tr>
<tr>
<td>Distal</td>
</tr>
<tr>
<td>Inferior and distal</td>
</tr>
</tbody>
</table>
affects TMD. In addition to providing normal occlusion, an occlusal splint also may provide additional effects, such as a placebo effect, although 43% of the patients in this study had previous splint therapy that was unsuccessful, while 95% of the patients in this study experienced significant relief after normalizing occlusion with splint therapy.

A precise cause-and-effect relationship between occlusal factors and TMD is not entirely clear; however, it appears that a relationship does exist and is a realistic and pragmatic consideration in the daily practice of individualized optimum dentistry.

Additional controlled and randomized clinical trials regarding specific TMD diagnostic groups are required; these should involve splint therapy and its effects upon EMG, jaw tracking, pain, masticatory efficiency, and so forth.

**Summary**

A patient's adaptive capacity is a prime factor in the development of the multifactorial condition of TMD. When patients with signs and symptoms of TMD had their occlusal interferences eliminated with a mandibular orthotic (allowing for the simultaneous contact of all posterior teeth with equal intensity and pressure) there was a significant (95%) reduction or elimination of pain and the popping and clicking noises associated with TMJ.

While occlusal interference may not be the only factor in TMD, this study suggests that a significant relationship does exist and that it is a practical consideration in the course of optimum treatment.

**Acknowledgement**

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**Author information**

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**References**


44. Adler RC. What do a leech and a handpiece have in common? Craniol 1993;11:1.


1. What was one of the considerations in determining when centric relation was obtained?
   A. The condyles were in their most inferior position in the glenoid fossa
   B. Maximum intercuspation resulted in no lateral deviation of the mandible
   C. Bilateral condylar loading resulted in no lateral deviation of the mandible
   D. The condyles were in their most superior position in the glenoid fossa

2. The initial phase of this study employed
   A. orthodontic movement.
   B. occlusal equilibration of natural teeth.
   C. restoration of teeth.
   D. provisional stabilizing treatment.

3. Which of the following results was anticipated by using an orthotic to eliminate or minimize signs and symptoms of temporomandibular dysfunction?
   1. Development of a realistic prognosis
   2. Knowledgeable patient
   3. Termination of treatment if patient has unreasonable expectations
   4. Long-term stable balanced occlusion
      A. 1, 2, and 3 only
      B. 1, 3, and 4 only
      C. 1, 2, and 4 only
      D. 2, 3, and 4 only

4. Treatment in Phase I was considered successful when the patient remained free of symptoms for at least how long?
   A. Three weeks
   B. Six weeks
   C. Three months
   D. Six months

5. Orthotics were adjusted with the patient in
   1. supine position.
   2. upright position.
   3. treatment position.
   4. centric occlusion.
      A. 1, 2, and 3 only
      B. 1, 3, and 4 only
      C. 1, 2, and 4 only
      D. 2, 3, and 4 only

6. At each appointment, the orthotics were equilibrated
   A. with right and left group guidance.
   B. with anterior contact only.
   C. with equal contact between all opposing teeth and the prosthesis.
   D. only if the patient was experiencing discomfort.

7. In the patient profile, working side interferences were more prevalent than balancing side interferences. Bilateral pain was experienced more than unilateral pain.
   A. Both statements are true.
   B. The first is true; the second is false.
   C. The first is false; the second is true.
   D. Both statements are false.

8. Certain joint sounds, as detected by Doppler auscultation, may suggest the possibility of
   1. perforation of the articular disc.
   2. a posteriorly displaced articular disc.
   3. adhesions.
   4. degenerative joint pathology.
      A. 1, 2, and 3 only
      B. 1, 3, and 4 only
      C. 1, 2, and 4 only
      D. 2, 3, and 4 only

9. Success was reported as pain reduction. What percentage of the patients reported significant reduction in pain or no pain at all?
   A. 96
   B. 90
   C. 85
   D. 80

10. Mandibular range of motion was considered to be improved or normal in what percentage of the patients?
    A. 96
    B. 78
    C. 58
    D. 38

11. Clinically acceptable occlusion is possible with either canine guidance or group function. Canine-protected occlusion markedly reduces bruxism and clenching.
    A. Both statements are true.
    B. The first is true; the second is false.
    C. The first is false; the second is true.
    D. Both statements are false.

12. Occlusal interferences have been shown to
    A. increase electromyographic (EMG) activity.
    B. decrease EMG activity.
    C. disrupt EMG activity.
    D. reduce bruxism tendencies.

13. The success in this study was due to reduced muscle activity through development of balanced occlusal contact. The elimination of premature occlusal contacts was accomplished through the use of an acrylic resin occlusal splint.
    A. Both statements are true.
    B. The first is true; the second is false.
    C. The first is false; the second is true.
    D. Both statements are false.

14. Stethoscope auscultation of temporomandibular joint sounds revealed marked improvement in what percentage of the patients?
    A. 95
    B. 83
    C. 75
    D. 58

15. Which of the following findings were present in all of the patients selected for this study?
    1. Occlusal interferences
    2. Joint sounds
    3. Condylar displacement
    4. Myofascial pain
       A. 1, 2, and 3 only
       B. 1, 3, and 4 only
       C. 1, 2, and 4 only
       D. 2, 3, and 4 only