Long-term treatment of disk-interference disorders of the temporomandibular joint with anterior repositioning occlusal splints

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The management of temporomandibular (TM) disorders is difficult and controversial. Part of this controversy arises because various types of TM disorders are confusingly similar in clinical presentation. Furthermore, the precise etiology of some of the encountered disorders remains unclear and dentists sometimes have to contend with an inadequate scientific justification for proposed treatment methods.

The disorder type associated with a dysfunctional condyle-disk complex has been called a disk-interference disorder1 or an internal derangement2 and is commonly associated with anterior and medial displacement or dislocation of the disk. It may be associated with clicking, sounds and catching and/or locking during jaw movement and may or may not be associated with pain.

Working on the presumption that this condition necessitates treatment, dentists have proposed various techniques for treating disk-interference disorders. One of the more common approaches requires the fabrication of an occlusal splint that anteriorly repositions the mandible in order to reestablish a normal condyle-disk relationship.3-5 Some reports6-8 and preliminary research9 suggest that this method frequently results in the reduction or elimination of the joint symptoms. The dentist is then faced with the decision regarding the future location of the “new” condyle position. It has been suggested that after anterior repositioning (AR) splint therapy, the mandible must be permanently maintained in the resultant forward position.9

Some of the suggested methods to maintain this forward position include orthodontic treatment,7 full mouth reconstruction,8 fixed overlay splints,9 or an overlay removable partial denture.10 Another approach in treating disk-interference disorders with AR splint therapy is to gradually modify and eliminate the splint to allow a return to a normal or near normal condylar position without additional treatment or permanent alteration of the occlusion.

Although not generally considered conservative, surgical repair of the condyle-disk complex has also been suggested.11 Relatively short-term reports of surgical treatment reveal a repeated success rate ranging from 70% to 85%,12-16 although these reports examine a heterogenous group of joint problems, and the criteria for success are quite varied. Even in the presence of this success rate most would agree that conservation methods should be attempted before surgery is considered.17

For the most appropriate treatment to be selected, long-term studies of various conservative treatment must be examined for effectiveness. Unfortunately, few of these studies have been reported. Moloney and Howard18 have provided some insight regarding the effectiveness of AR splint therapy. They reported on 241 patients 3 years after treatment for disk-interference disorders. The success criteria were: (1) patients had to be free of pain; (2) patients could no longer be wearing an anterior repositioning splint (they could be wearing a muscle relaxation splint for bruxism at night); and (3) patients also had to be free of clicking and locking. A 70% success rate was reported after 1 year, a 53% success rate after 2 years, and only a 36% success rate after 3 years. Within the limits of the authors’ determined criteria, this study does not support the popular belief regarding the successful use of AR therapy for disk-interference disorders.

Williamson and Sheffield1 evaluated 300 consecutive patients with disk-interference disorders 3 years after treatment with AR splints followed by orthodontics. In contrast to Moloney and Howard’s study, they reported a 90% success rate. It should be noted that Williamson and Sheffield1 evaluated only the symptoms reported from the patient (pain and clicking) and did not report objective findings. The difference in the results between these two studies suggest the need for more controlled, objective long-term evaluation of treatment methods for disk-interference disorders.

This study subjectively and objectively evaluated the effects of AR splint therapy in patients with disk-interference disorders, followed by a gradual elimination of the splint without permanent alteration of the occlusal condition.
Table I. Results after 8 weeks of anterior repositioning splint therapy

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of patients</th>
<th>Patients free of pain, clicking, and locking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displaced disks</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Successfully recaptured disks</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Permanently dislocated disks</td>
<td>8</td>
<td>5 (free of pain)</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>32</td>
</tr>
</tbody>
</table>

Table II. Joint sounds 2½ years after anterior repositioning splint therapy

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of patients</th>
<th>Patients with clicks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displaced disks</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td>Successfully recaptured disks</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Permanently dislocated disks</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>35*</td>
<td>23</td>
</tr>
</tbody>
</table>

*Five additional patients received treatment after the AR splint therapy. Three of these reported having joint sounds before the follow-up treatment was begun. Therefore joint sounds continued in 65% of the 40 patients.

METHODS AND MATERIAL

The subjects in this study were patients with a diagnosis of a disk-interference disorder for whom treatment with an AR splint was prescribed. Past medical records of patients treated in the Orofacial Pain Center at the University of Kentucky were reviewed and their selection was based on their meeting the following criteria:

1. The patients all had a primary diagnosis of a disk-interference disorder. The diagnosis of muscle dysfunction was acceptable only if it was believed to be secondary to the disk-interference disorder.
2. Each patient had completed an 8-week period of AR splint therapy during which time the splint was worn 24 hours a day. The splint was then gradually modified to allow the mandible to return to its original occlusal position. The modification procedure normally took 2 to 4 weeks.
3. Each patient in the study was available to return to the clinic for follow-up examination and evaluation.

Patients were placed in one of three diagnostic categories: (1) disk displacements, (2) disk dislocations that could be "recaptured" by mandibular manipulation, and (3) permanent disk dislocation on the basis of the following criteria.

Criteria for diagnosis of disk displacement
1. The presence of single episodes of joint sounds associated with disk movement in one or both joints (not multiple or grating sounds such as crepitation)
2. Pain associated with the joint sounds
3. A normal range of mandibular movement

Criteria for diagnosis of disk dislocation with recapturing of the disk by mandibular manipulation
1. A positive history of locking of the jaw
2. A sudden restriction of jaw opening (Typical maximum open was between 25 and 30 mm.)
3. Restriction of eccentric movement to the contralateral side

RESULTS

Forty patients met the criteria for the study. There were 25 patients with a diagnosis of disk displacements, eight with permanently dislocated disks, and seven with dislocations of the disk that were successfully manipulated and recaptured. The average age of the patient group was 29.7 years with a range of 19 to 46 years of age. Ninety-five percent of the patients were women. The average length of time from the initial visit to the
follow-up visit was 2 years and 5 months with a range of 21 months to 48 months.

Each patient was initially evaluated for elimination of symptoms after the 8-week period of continuous AR splint therapy. The criteria for success at that time were freedom from pain as well as freedom from clicking, catching, and locking of the temporomandibular joint (TMJ). Eighty percent of the patients met these criteria after the initial phase of treatment (Table I). The modification or step-back procedure was then completed to allow gradual return to the pretreatment mandibular position. No attempt was made to alter the patient's occlusal condition.

Five patients sought additional treatment after the AR splint therapy, three of whom underwent TMJ surgery and two orthodontic treatment. It was assumed for the purposes of this study, that AR splint therapy was unsuccessful in these patients. This assumption may not be valid because it was the referring dentist and not the dentist providing the splint therapy who suggested the additional treatment in three of the patients.

Two important symptoms evaluated in this study were pain and joint sounds (clicking). Sixty-six percent of the patients who received only AR splint therapy had a return of the joint sounds (Table II). Of the five patients who received additional treatment after the AR splint therapy, three reported that joint sounds were present before the follow-up treatment. Therefore, of the 40 patients, joint sounds persisted in 65%.

Patients were then questioned regarding the presence of joint or facial pain. Only 23% of the patients who received only AR splint therapy reported having joint pain 2½ years after the treatment (Table III). Of the five patients who received treatment after the AR splint therapy, two had additional treatment because of pain. Therefore, when considering all 40 patients, pain continued in 25%.

Part of the questionnaire consisted of repeating six questions that were also asked on the initial visit to the clinic. The questions required the patient to report any pain in the region of the ears, cheeks, neck, or the temples. Patients were also asked whether it hurt to chew and how many headaches per week they were experiencing. Table IV lists these findings. As can be seen there was overall improvement in all regions of pain during the 2½ years since the initial visit.

Originally the patient group averaged 2.7 headaches per week. After 2½ years the patient group reported only an average of 1.4 headaches per week (Table V) representing a 48% decrease in the number of headaches experienced by the group of patients in this study.

In addition, the clinical examination revealed objective findings of pain or tenderness on palpation of the masseter and temporal muscles and the TMJ, maximum comfortable mandibular opening, and maximum mandibular opening. On the initial visit 48% of the patients revealed tenderness or pain on palpation of the masseter
Table VII. Success rate according to various criteria of success for patients treated only with anterior repositioning splint therapy

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of patients</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displaced disks</td>
<td>25</td>
<td>4</td>
<td>16</td>
<td>11</td>
<td>44</td>
<td>17</td>
<td>68</td>
<td>19</td>
<td>76</td>
</tr>
<tr>
<td>Successfully recaptured</td>
<td>7</td>
<td>3</td>
<td>43</td>
<td>7</td>
<td>100</td>
<td>7</td>
<td>100</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td>Permanently dislocated</td>
<td>8</td>
<td>3</td>
<td>38</td>
<td>4</td>
<td>50</td>
<td>6</td>
<td>75</td>
<td>6</td>
<td>75</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>10</td>
<td>25</td>
<td>22</td>
<td>55</td>
<td>30</td>
<td>75</td>
<td>32</td>
<td>80</td>
</tr>
</tbody>
</table>

Table VIII. Patients who failed to respond to anterior repositioning splint therapy alone

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Patients who continued to have pain or sought additional therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>Displaced disk</td>
<td>25</td>
</tr>
<tr>
<td>Successfully recaptured</td>
<td>7</td>
</tr>
<tr>
<td>Permanently dislocated</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
</tr>
</tbody>
</table>

Pain, however, continues only 25% of the time. Moloney and Howard reported a 3-year success rate of only 36%. These success rates are not encouraging for practitioners treating disk-interference disorders with AR splint therapy. To better evaluate these results one must look at the criteria used for success. In Moloney and Howard's study the criteria for success were (1) patients had to be free of pain, (2) patients could no longer be wearing the splint (except for a muscle relaxation splint at night time only), and (3) patients had to be free of clicking and catching. When these criteria are applied to the data in this study a 25% success rate is noted (Table VII). This rate is similar to Moloney and Howard's findings. It is of interest to note the change in success rates when the criteria for success are altered. For example, if a painless joint sound is an acceptable sign after treatment, the success rate of AR splint therapy rises to 55% (Table VII). If only pain is considered and asymptomatic joint sounds and catching are acceptable, a success rate of 75% is achieved. When the patients were asked to evaluate their perception of the treatment they received, still another success rate was achieved. In this study the patients were asked whether the treatment they received had cured them, made them feel better, made no change, or the pain had worsened. A response of cured or better was considered successful treatment. If they reported that they were the same or worse, the treatment was considered a failure. Eighty percent of the patients thought the treatment was successful (Table VII).

To accurately judge treatment success, the criteria for success must be determined (Table VII). One of the main variables in the criteria for success is the acceptance of asymptomatic joint sounds and/or catching of the joint. My opinion is that the presence of asymptomatic joint sounds should not be viewed as a failure of treatment. The presence of joint sounds in epidemiologic studies is a relatively common finding. Many studies report the presence of joint sounds in a range of 28% to 50% in the adult population. It has also been reported that joint sounds can resolve independent of treatment or worsening symptoms. Magnusson et al. reported
that joint sounds equally appear and resolve between the ages of 15 and 20 and appear to be unrelated to major symptoms. With such data, the dentist must evaluate the patient not only for joint sounds, but for pain related to the joint sounds. It is my opinion that painful joint sounds or evidence of progression of the joint dysfunction is an indication to treat the joint condition. On the other hand, a painless, unchanging joint sound does not require treatment. The results of this study suggest that the structures of the TMJ have the ability to adapt to various conditions within the joint. The persistence of joint sounds in two thirds of the patients would suggest that the diskal ligaments do not tighten or shorten during this adaptation process. What is more likely is that highly innervated tissues such as the retrolabial tissues become less innervated through a metamastic process of tissue adaptation (fibrosis). This adaptation is likely to be encouraged by anterior positioning of the condyle off of the retrolabial tissues for a "therapeutic" period. After this period the condyle can be reintroduced to the adapted retrolabial tissues with little or no recurrence of pain. Of course, the success of such a procedure is dependent on factors such as the amount of diskal displacement, the degree of tissue damage, the amount of continued loading of the joint, and the patient's inherent ability for tissue repair. It is likely that some patients require longer periods of AR splint therapy for successful adaptation.

Thirty-three percent (13 of 40) of the patients sought additional treatment for their problems or continued to have pain. This finding suggests that AR splint therapy as a sole treatment method for these patients was not successful (Table VIII). Another way of stating this observation is that solely AR splint therapy appeared to be a satisfactory treatment in 66% of the patients with symptomatic disk-interference disorders. These results would question the need for follow-up procedures that permanently alter the occlusal condition.

It is of note that the patients with disk dislocation who had the disk successfully recaptured were the most asymptomatic. This is likely to be related to the acuteness of the tissue injury. Disks that were permanently dislocated (could not be manually recaptured) were likely to be more chronic conditions. Yet even with permanent disk dislocation, 75% of these patients were comfortable and needed no more treatment. Patients with the poorest results were those with disk displacement.

SUMMARY

Forty patients with three different types of symptomatic disk-interference disorders were treated with anterior repositioning splint therapy for 8 weeks. At the end of that period 80% of the patients were free of joint sound and pain. Each patient's splint was then gradually modified until the patient's original occlusal condition was reestablished. Each patient was then allowed to function in that position. The patients were reevaluated an average of 2½ years later. Seventy-five percent of the patients had no joint pain and 66% had a return of joint sounds. Sixty-six percent of the patients did not find the need to seek additional treatment for jaw pain and dysfunction.

REFERENCES

CT Assisted evaluation of variation in length and angulation of the lateral pterygoid muscle and variation in angulation of the medial pterygoid muscle: Mandibular mechanics implications


Loma Linda University, School of Dentistry, Loma Linda, Calif.; University of Pennsylvania, School of Dentistry, Philadelphia, Pa.; University of Lund, School of Dentistry, Malmo, Sweden; and Loma Linda University Medical Center, Loma Linda, Calif.

The form and function of masticatory muscles have been investigated by anatomists, muscle physiologists, and stomatognathic physiologists.1 Orientation of the muscles, cross-sectional area, wet and dry weights, fiber dimensions, and types have been described with dissection studies.2 Electromyographic (EMG) studies have been used to determine patterns of masticatory muscle activity,3,5 bite force potential,6,7 and to assess the importance of the size of the muscle in generating joint reaction forces.8 The distinctive activities of the superior and inferior bellies of the lateral pterygoid muscles have also been defined by electromyography.9,11

Computed tomography (CT), widely used for imaging numerous disease conditions, also finds application in depicting the stomatognathic system, including the temporo-mandibular joints12,13 and the cross-sectional area of the masticatory muscles.18 Magnetic resonance imaging

is also applied to the study of the muscles of mastication.19 To our knowledge, this is the first investigation to use the capabilities of CT in a comparative study of the variations in the length and deployment of the lateral and medial pterygoid masticatory muscles.

One important advantage of CT over a dissection study of the masticatory musculature is the method's ability to generate detailed soft tissue images of specific regions of the stomatognathic system in the same subject(s), in various anatomic planes, with different jaw positions and without disturbing or distorting anatomic relationships.

In this study we undertook a descriptive investigation of variations in the lengths and/or deployment (angulation with respect to an intermeatal line) of the lateral and medial pterygoid muscles with the jaws closed and open. The possible implications of these morphologic variations on mandibular mechanics are discussed.

MATERIAL AND METHODS

Five groups (I through V) of individuals were included in this retrospective investigation. For group I, 106 adults (64 men and 42 women) were selected for study from patients referred for craniomaxillofacial CT for reasons other than temporo-mandibular joint (TMJ) pain and dysfunction. CT scanning of the patients in group I was done with the patient's mouth closed or at rest although jaw position was not monitored during the scan. Groups