Mandibular Repositioning Can Be Effective in Treatment of Reducing TMJ Disk Displacement. A Long-term Clinical and MR Imaging Follow-up

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ABSTRACT: In order to evaluate the long term clinical and morphologic results of recapture of a displaced TMJ disk, we recalled for follow-up MR imaging 75 patients who had been treated by attempted disk recapture based on pre-treatment MR imaging 1-6 years earlier. The treatment included a day appliance with inclines to guide the mandible into the therapeutic position and a telescopic night appliance which prevented retraction of the mandible during sleep. Appliance treatment was followed by rebuiding or resurfacing the posterior teeth of one arch to permanently support the mandible in the therapeutic position. After treatment of 115 joints with displaced disks, 52% of the disks were normally positioned, 35% were improved in position, and 26% showed persistent disk displacement. Symptom relief was 92% in patients with normalized (recaptured) disks, 84% in patients with improved disk position, and 49% in patients with persistent disk displacement. Failure to improve disk position occurred in 7% of the joints with anterior disk displacement and in 44% of the joints with a transverse (sideways) component to the displacement. Forty-five percent of the recaptured disks improved in contour. We concluded that anterior mandibular repositioning was effective in the treatment of patients with reducing displaced disks primarily when the disks were displaced only in an anterior direction. This treatment can be recommended in anterior disk displacements if the patient has failed more conservative treatment measures, permanent occlusal reconstruction can be justified, and the patient understands that long-term use of a night appliance may be necessary. Anterior mandibular repositioning appears much less effective in cases with a transverse component to the disk displacement.

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Dr. Per-Lennart Westesson has been working on temporomandibular joint imaging since the late 1970s. He developed double contrast arthrography of the TMJ and has contributed scientific articles on imaging and pathophysiology of the joint.

Displacement of the disk in one or both of the temporomandibular joints is found in the majority of patients with symptoms of temporomandibular disorders. In about half of these patients, the displaced disk can be held in a normal (reduced) relationship to the condyle by positioning the mandible anteriorly. With the mandible held in this anterior position, clicking and locking are eliminated, and pain relief is usually obtained within a few days. Consequently, anterior mandibular repositioning by maxillary appliances with pull-forward ramps has been used to treat reducing disk displacement.

In most of the early studies of this treatment, the appliance treatment was followed by attempts to “walk back” the mandible towards its original intercuspal position. The long-term success, as judged by the elimination of joint noises and other signs of disk displacement, was rather low. Some of the failures were attributed to the “walk back” part of the treatment, and better success was attained when the occlusion was permanently restored to the anterior therapeutic position.
The consensus at this time is that permanent stabilization of the mandible in an anterior therapeutic position is necessary for long-term successful restoration of normal disk position. However, such treatment may involve extensive dental work, and there are only a few studies demonstrating its long-term effectiveness with post-treatment imaging to verify an improvement in disk position. This has resulted in controversy concerning the effectiveness of anterior mandibular repositioning for treatment of reducing disk displacement. Further, claims of good clinical success with treatment “off the disk” have resulted in controversy regarding the importance of restoring normal disk position as a part of treatment.

In order to shed more light on these controversies, we studied 75 patients with reducing disk displacements who underwent anterior mandibular repositioning treatment. In this study, the findings of pre- and post-treatment MR images were correlated with changes in patient symptomatology.

Materials and Methods

This study was based on 75 patients (115 joints) with reducing disk displacement. All patients had pre- and post-treatment MR imaging of their temporomandibular joints. Forty of the patients had both joints included in the study, and the other 35 had only one joint included in the study. Of those with only one joint in the study, 21 had a second joint which was normal, and 14 had a second joint which had a displaced disk that was either nonreducing or non-recapturable in a clinically obtainable therapeutic mandibular position. Of the joints included in the study, 58 had anterior disk displacements (partial or complete), and 57 had disk displacements which included a transverse (medial or lateral) component. The average age of the patients in the study was 36 years, with a range of 13 to 56 years. Eighty-four percent of the patients were female.

The patients were selected from the private practice of one of the authors. In that practice, from 1988 to 1994, about 250 patients were clinically diagnosed with uni- or bilateral reducing displaced disks and were treated with mandibular orthopedic appliances for symptoms such as facial pain, headache, neck pain, idiopathic ear pain, dizziness, tinnitus, and blocked or stuffy ears. The symptoms were often not highly localized to the area of the affected joint, but in most cases could be associated with jaw function by findings from the patient history such as aggravation of the symptoms by chewing or onset of the symptoms shortly after a major dental experience. About half of the patients were referred by other providers, and about one-third of the patients had already received some treatment involving oral orthopedic appliances or physical therapy for their temporomandibular disorder symptoms.

Of these 250 patients with reducing disk displacement who were treated, almost all who were seen after 1993 and a few who were seen before 1993 received a stabilization appliance to wear at night for at least a week prior to any repositioning of the mandible. These stabilization appliances covered all the teeth of the maxillary arch and occluded with all the teeth of the mandibular arch. As a result of wearing the stabilization appliance, most of the patients experienced at least a little relief. About one-fifth described themselves as much better, they were advised that disk recapturing may not be needed to obtain adequate relief of their symptoms, and they were told to keep wearing the stabilization appliance at night as needed.

The reducing displaced disk patients who did not experience satisfactory relief from wearing the stabilization appliance and could keep the displaced disk reduced by holding the mandible anteriorly while opening and closing were advised to try undergoing disk recapturing treatment by means of anterior mandibular repositioning. They were informed that, if the initial phase of this treatment was successful, finishing treatment involving permanent build-ups of at least some of the back teeth would be necessary. They were further advised which back teeth, if any, had large enough fillings to require permanent restoration in the future. Patients without multiple posterior fillings were told that orthodontic treatment which erupted the back teeth was an alternative way to increase the height of those teeth, but that it may not be able to support the new mandibular position adequately without some kind of occlusal restoration, therefore disk recapturing treatment might require extensive dental work which they would not otherwise need.

Of the approximately 200 patients who underwent this disk recapturing treatment between 1988 and 1994, 89 had received pre-treatment MRI to verify the diagnosis of reducing displaced disk. In 17 patients, the imaging was performed primarily because documentation of joint damage was needed for liability related to a motor vehicle accident. In 44 patients, (all of whom began treatment before 1993) the imaging was performed because joint noises and other clinical signs of joint pathology were not completely clear, and pre-treatment MR imaging was deemed necessary for making a clinical diagnosis. In the remaining 28 patients, (all of whom began treatment after 1993) the imaging was performed even when joint noises and other clinical signs were clear.

For the purposes of this study, all patients who underwent disk recapturing treatment and received pre-treatment MR imaging were asked to return for follow-up...
At least one year after the start of their treatment, the vast majority of the 89 patients who could be contacted were able to return for the recall request. Upon retrospective analytical review of MR imaging, six joints (in five patients) were excluded from the study because pre-treatment images were not available. Of the remaining 83 joints (in 82 patients), their disks were nonreducing (diagnostic criteria 1), and seven joints (in six patients) were excluded because the disk displacement in the intercuspal position was not clear on the pre-treatment images (diagnostic criteria 2). Thus, the results of reciprocal clicking due to other causes, poor positioning quality caused by motion or sub-optimal imaging quality in the earlier patients, or possibly false negative due to inability of imaging to demonstrate some degrees of anterior displacement confined to the anterior (medial pole). Thus the study was based on the remaining 75 patients.

The treatment consisted of anterior mandibular repositioning by means of oral orthopedics. Drugs and physical therapy were not prescribed. The patients were not restricted in exercises or home care, and they were not advised to change their diet. The primary reason for the lack of adjunctive therapies in these patients was that all patients in early stages of orthopedic treatment were encouraged to undergo only one mode of treatment at a time so that we could accurately determine the treatment's effects on their symptoms.

**Initial Construction Bite**

At the initial appointment, a polyvinylsiloxane putty construction bite was established in a mandibular position which effectively eliminated clinical signs of disk displacement and reduction by forcing the mandible to open and close along an anterior trajectory. In this construction bite, contact of the natural anterior teeth was maintained so that increases in occlusal vertical dimension were kept to a minimum. The amount of anterior repositioning in the construction bites averaged 3 mm, with a range of 2-6.5 mm, measured at the anterior teeth.

**MR Imaging**

Next, sagittal MR images were obtained with the mandible fully closed in the habitual intercuspal position and then braced anteriorly in the construction bite. Additional coronal imaging was used if some or all of the sagittal images failed to reveal a disk (empty fossa). All scanning was performed in a 1.5 T magnetic resonance unit (Signa, General Electric Co., Milwaukee, WI) with unilateral surface coil. The scanning parameters varied early in the study, but later we consistently used a TR of 700 ms and a TE of 30 ms. The field of view was 16 cm, the slice thickness was 3 mm, and there was no gap between the slices.

All images were interpreted by one of the authors. Disk displacements were evaluated independently in both sagittal and transverse planes.

In the sagittal plane, disk displacements were categorized as partial anterior or complete anterior. On sagittal MR images, disks which were displaced anteriorly in only their lateral or medial aspects and were normally positioned in other aspects were considered to have a partial anterior displacement. Disks which were displaced anteriorly in all sagittal sections were considered to have a complete anterior displacement.

In the transverse plane disk displacements were also categorized as partial or complete. Complete transverse disk displacement was diagnosed on coronal MR images if the entire disk could be seen displaced medially or laterally relative to the condylar head, and on sagittal images if disk tissue could only be visualized at the peripheries of the joint in the direction to which the transverse displacement had taken place. Partial transverse disk displacement was diagnosed on coronal images if a portion of the disk could be seen displaced medially or laterally relative to the condylar head, and on sagittal images if disk could be visualized only in the portion of the joint (medial or lateral) toward which the partial transverse displacement had taken place.

**Removable Appliance Treatment**

For the first phase of treatment, all patients were fitted with removable day and night appliances. The patients were told to wear one or the other at all times, and to be very careful not to bite down when changing appliances.

Day appliances were generally made as two separate segments (right and left) which covered only the molars and premolars of either the maxillary or mandibular arch. The use of two unconnected posterior segments allowed incisal function on the natural anterior teeth, avoided interfering with tongue posture, and permitted removal of only one side at a time for brushing or bite transfer techniques. A mandibular segment of a day appliance is shown in Figure 1, and a maxillary segment of a day appliance is shown in Figure 2. The choice of mandibular or maxillary segments for the day appliance depended on the patient’s dental needs, since the teeth which it covered would later be built-up prosthodontically. For example, if a patient needed bridges on the upper left and lower right quadrants, the day appliance would consist of an upper left and a lower right segment.

Initially, the day appliances had steep occlusal inclines designed to brace the mandible against retrusion, while allowing a little freedom for movement anteriorly and laterally. Mandibular day appliances were usually made with prominent pull-forward inclines located over the
lingual side of the premolar areas (so that they engaged the mesial facing slope of the lingual cusp of the maxillary first premolar) and the lingual side of the distal most mandibular molars (so that they engaged the mesial facing slope of the palatal cusp of the terminal maxillary molar), as seen in Figure 1. Maxillary day appliances were usually made with prominent pull-forward inclines located over the first premolars or canines (so that they engaged the distal facing inclines of the mandibular first premolars or canines) and posteriorly at the end of the arch where they often extended far beyond the crowns of the maxillary terminal molars to engage the distal surfaces of the terminal mandibular molars, as seen in Figure 2.

For use while sleeping, all patients were given a telescopic appliance (Great Lakes Orthodontics, Tonawanda, NY) (Figure 3). As the rod anchored behind the canine area of the lower baseplate engaged the tube anchored to the second molar area of the upper baseplate, all of the envelope of mandibular movement posterior to the arc formed by the rods was eliminated. In this manner, the mandible was braced anteriorly even when the mouth was open. The telescopic components used in this study could be adjusted very precisely by turning the tubes. They were carefully adjusted so that they forced the mandible to open and close on the same trajectory which was also supported by the inclines of the day appliance. By absolutely maintaining this therapeutic trajectory all night, the telescopic components habituated the mandible to the therapeutic anterior trajectory rather than simply preventing it from closing along a posterior trajectory far enough to displace the disk, like conventional maxillary pull-forward appliances.

While most patients used the telescopic appliance only for sleeping, five patients in whom restoring normal disk position was judged to be difficult, were instructed to wear the telescopic appliance continuously for one to three weeks in the initial phase of treatment. Once their joints were thought to be stable, these patients were given the same type of day appliances used by the other patients at the onset of treatment.

In nine patients, orthodontics performed during the first phase of treatment involved a maxillary daytime appliance which carried springs and/or an expansion screw, as well as anchors, for attaching the tubes needed for telescopic mechanics at night. Two of these appliances with their tubes on are seen in Figure 4.

When the patients first received their appliances, they were instructed to return to the office on an emergency basis if they had not noticed some dramatic relief of symptoms within a week. Seven patients returned with
eral guidance was developed by means of group function involving as many posterior teeth as possible. In almost all cases anterior guidance was made shallow and uniform on the natural anterior teeth. In all cases posterior guidance, formed by the inclines which constituted a CR-CO slide in an asymptomatic normal, was gradually reduced but still maintained to some degree—especially on the side of the attempted disk recapture.

Occasionally, flattening the occlusal surface too quickly allowed the mandible too far back and led to a return of clicking, usually accompanied by a rapid return of symptoms. In such cases, the day appliances were immediately resurfaced to set the mandible forward again. Patients were maintained by steep inclines at edge-to-edge for months if necessary.

In three patients who underwent redispacement and could not return to the office right away, treatment seemed to become more difficult. Either the mandible had to be repositioned further anteriorly to maintain disk reduction or the redispacement of the disk occurred more readily during lateral excursions. Even after resurfacing the day appliances, some clicking was still reported, often during eating. In these cases, the telescopic appliance was worn continuously for several days before returning to alternate day and night appliance wear.

**Finishing Treatment**

Phase 2 (finishing) treatment began after the symptoms had been in remission for at least two months and a new habitual occlusal position for the mandible against the contours of the splint was stable. Indications of this stability were smooth group function and a readiness of the jaw muscles to use the new occlusal position as judged by the ease with which the mandible closed repeatedly into it. Most patients seemed relatively stable after two months without an incident of redispacement, but a few patients needed up to six months to become stable. The average time between initiation of phase 1 treatment and finishing was 3.8 months.

In 27 joints, follow-up MR imaging was taken in the final therapeutic occlusion with the day appliances in place just before finishing began. This imaging was performed to verify the improvement in disk position before beginning the process of permanent prosthetic alteration of the teeth or whenever there had been some return of symptoms and therefore some suspicion of redispacement.

In the finishing process, the same therapeutic occlusal table which had been established in acrylic was transferred to the natural posterior teeth by a technique which duplicated all the occlusal slopes present on the day appliances. This finishing process involved bonded
onlays (usually on molars), crowns (usually on molars with large pre-existing amalgams), and composite resin build-ups (usually on unrestored premolars). Fourteen patients were finished entirely with crowns and/or onlays, 11 patients were finished entirely with composite resin build-ups, and 37 patients were finished with a combination of these two types of restorations. Twelve patients (all of whom were treated before 1993) had no finishing due to financial limitations but continued to wear their appliances, and one patient was finished orthodontically.

Immediately after finishing, in some of the earlier cases and all of the later cases, the telescopic appliances were re-lined at chairside so the patients could continue wearing them every night without interruption. Patients were advised to continue nightly wear for six months, and then to gradually reduce wear to one night a week or during stressful periods.

**Recall and Evaluation**

Recalls took place in the last three years of the study. The average time between pre-treatment imaging and recall was 1.9 years with a range of one to six years.

At recall, follow-up MR imaging was taken with the mandible fully closed in the new habitual therapeutic occlusal position, and the patients were questioned about their symptoms and night appliance use. Before learning the results of follow-up imaging, the patients were asked to estimate the percentage of relief they had experienced in their chief complaint as well as in any of the other symptoms which are commonly associated with temporomandibular disorders and which were indicated as present on their original medical history form. The symptoms about which the patients were questioned included headaches, face pain, neck pain, ear pain, tinnitus, dizziness, and stuffed eustachian tubes (described as difficulty clearing the ears).

By comparing pre- and post-treatment images, each joint was categorized into one of three outcome groups—recaptured, improved, and unimproved. A joint was considered recaptured if its disk was superiorly positioned after treatment, improved if its disk had shifted significantly toward a superior position but was still not normal, and unimproved if its disk was in about the same position or a more displaced position than before treatment.

Based on the post-treatment MR findings the patients were categorized into one of three outcome groups. They were assigned to the recaptured group if they had at least one joint recaptured, the improved group if they had at least one joint improved, and the unimproved group if both joints were unimproved.

**Results**

Table 1 correlates morphologic changes in the joints with relief of symptoms as reported by the patients. Symptom relief was 92% in those with normal disk position at follow-up, 84% in those with improved disk position at follow-up, and 49% in those with persistent disk displacement at follow-up.

Of the 115 displaced disks, 52% were normalized, 23% improved, and 25% unimproved at follow-up. The relationship between pre- and post-treatment disk position is shown in Table 2. Normalization of anterior disk displacements was more frequent than normalization of disk displacements with a transverse component of displacement, as illustrated in Figure 5. At follow-up, 81% of anterior displacements were fully normalized, while only 21% of transverse displacements were fully normalized. Figures 6-8 show pre- and post-treatment images with normalization of disk position.

In pre-treatment images, about half of the displaced disks were deformed by thickening of the posterior band and intermediate zone. In about 70% of the normalized joints and about 30% of the improved joints with such deformed disks, treatment was accompanied by improvement in the contour of the disk. Examples of such improvement of disk configuration are seen in Figures 7 and 8. Improvement of disk shape was not seen in any of the joints with persistent disk displacement at follow-up. Some joints with persistent disk displacement did not show the expected improvement.
Intercuspal deviation in form due to bone remodeling, change not seen in any of the joints with normalized positions.

Of the joints from the improved group, 58% had an anterosuperior component which was fully normalized and transverse component which remained displaced. Examples of such improvement in disk position by correction of only the anterior component of displacement are seen in Figures 9 and 10. In this improved group, 43% had a transverse component of displacement which was not fully reduced in the pre-treatment construction bite or the follow-up imaging (Figure 10), while 36% had a transverse component of displacement which was fully reduced in the pre-treatment construction bite but recurred sometime before the follow-up imaging (Figure 9). This relationship between the two different types of improved joints can be seen in Figure 5.

The three treatment outcome groups did not differ significantly in age, gender, or amount of anterior mandibular repositioning. At recall, about 80% of the patients in each group were still wearing a night appliance regularly.

In all patients, except some of the ones in the unimproved group, the mandible's habitual occlusal position at follow-up was still anterior to the original pretreatment intercuspal position. In Figures 6-10, it can be observed that the mandibular condyles (relative to the anterior border of the auditory meatus) and the mandibular dentitions (relative to the maxillary dentitions) have retruded somewhat from the construction bite positions to the final post-treatment positions. Generally, they appear more fully seated in the glenoid fossae. However, in none of the recaptured or improved cases were the mandibular condyles or dentitions retruded back to the original intercuspal position. Excluding patients who had received orthodontics, there was a 2 mm (range 0.5 mm to 4.0 mm) anterior mandibular repositioning at follow-up compared to the pre-treatment intercuspal position measured at the anterior teeth.

**Discussion**

This study found that symptom relief was positively correlated with the degree to which normal disk position was restored, and the frequency with which normal disk position was restored was positively correlated with the direction in which the disk was displaced before treatment. Anterior disk displacements were usually normalized and often accompanied by dramatic symptom relief. Disk displacements with both anterior and transverse components were frequently improved in position but not fully normalized and were accompanied by significant symptom relief. Transverse disk displacements were most frequently unimproved in position and were accompanied by symptom relief which was only moderate—probably about what could be expected from almost any nonspecific TMD therapy, including the long-term use of a simple stabilization appliance at night and physical therapy as needed.

Our finding that anterior disk displacements were normalized much more frequently than transverse disk displacements agrees with a study by Westesson and Lundh. Their study found that medial disk displacement was present in none of the joints in which disk position was normalized by treatment but was present in two-thirds of the joints in which the attempt to normalize disk position was unsuccessful.

**Anterior disk displacements**

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<th>reduced in construction bite</th>
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**Transverse disk displacements**

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<th>reduced in construction bite</th>
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<td>57</td>
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**Figure 5**

Effect of repositioning on anterior and transverse components of disk displacement.
Figure 6
Recapture of a disk which was completely displaced anteriorly. Arrows indicate the anterior and posterior borders of the disk. Arrowheads indicate the intermediate zone. A. Shows a central slice through the joint with the back of the posterior band at a 10:00 position relative to the head of the condyle. B. Shows the disk held in reduction in the construction bite at the same imaging appointment. C. Shows the disk recaptured after finishing with the back of the posterior band at the 12:00 position. The post-treatment occlusion shows composite resin buildups on 14, 15, 20, 28, 29, and 30. For the illustrations of the occlusion, polyvinylsiloxane impressions were poured to the gingival margins with blue inlay wax before being poured with stone.
Figure 7
Recapture of a disk which was anteriorly displaced only in its lateral aspect. In pre-treatment MR images, the lateral aspect: A. shows anterior displacement and deformation of the disk, while the more central aspect B. shows only minimal displacement with better disk shape. In the construction bite, MR imaging of the lateral aspect C. shows full reduction with the foot of the disk extending anteriorly slightly beyond the dark signal produced by the cortical bone of the articular eminence. In post-treatment MR images, the lateral aspect D. shows normalization of disk shape. Post-treatment occlusion E. shows little interdigitation due to lack of finishing after maxillary expansion used in phase 1. F. shows pre-treatment maxillary arch. G. shows maxillary arch four years after expansion.
It is not surprising that anterior disk displacement responds better to anterior mandibular repositioning treatment than does medial or lateral disk displacement. Anterior mandibular repositioning in the presence of an anteriorly displaced disk would tend to place the condyle under the central thin zone of the disk, while anterior mandibular repositioning in the presence of a transversely displaced disk would tend to bring the condyle further along the side of the disk and thereby increase the transverse component of disk displacement relative to the condyle. The fact that most disks from the improved group achieved normal positions in a sagittal plane but not in a transverse plane suggests the increased difficulty of making transverse corrections in disk position.

In spite of the positive correlation between improvement in disk position and symptom relief, many patients...
with unimproved disk position still reported significant relief. One cause of this relief may be the tendency of acute symptoms to regress toward the mean as seen in control groups of other studies. A second cause may be the natural course of the disease to attain quiescence as shown by long term follow-up studies. A third cause may be an ability of anterior mandibular repositioning to facilitate adaptation of retrodiscal tissues which have been pulled into the articular zone. Such adaptation is suggested by histologic studies showing fibrosis of retrodiscal tissues in some joints with displaced disks.

It is difficult to know how many of the redispacements during treatment were due to a failure of compliance rather than a problem with anatomy or treatment technique. All patients were told they must adhere to a strict protocol for appliance wear, although some probably did not need to be so careful. Frequently, in spite of the advice they were given to always wear the night appliance to sleep and never remove the day appliances for eating, patients occasionally slept with only the day appliance or ate without any appliance. Some of those patients reported that such compliance failure produced a sudden return of symptoms, and they resumed strict compliance. A few experienced no return of symptoms and probably made their own judgements about when to wear the appliances. Since some compliance failures still resulted in improved or normalized disk position, no attempt was made to eliminate compliance failures from the study.

It is also difficult to know how many patients experienced no significant relief after initial placement of the anterior repositioning appliances and therefore did not
return for further treatment. Although these patients had disk displacement and symptoms which were commonly associated with disk displacement, neither the disk displacement nor the alteration of jaw muscle tensions caused by disk displacement appeared to be an important cause of their symptoms.

Eighteen percent of the patients in this study blamed their symptoms on injuries caused by an automobile or other compensable accident, and they may have either understated or overstated their symptoms for personal gain. However the findings of these accident patients were not substantially different from the findings of the rest of the patients in the study.

Because of its retrospective nature and its selection of patients from a private practice, this study did not include a control group which would have been desirable.
to be an aggressive and risky form of treatment. However, in this study, the occlusion was not altered haphazardly. In all patients who received permanent alteration of the occlusion, the relief from temporary alteration of the occlusion was first established and maintained for at least two months, and the new occlusion was fully established in acrylic before any work was done to the teeth. Furthermore, most of the patients who were advised to try disk recapturing treatment had pretreatment occlusions which were judged to be inadequate either dentally or orthopedically. An occlusion was considered orthopedically inadequate if the patient found it difficult to brace strongly against the posterior teeth, even after the relief of acute symptoms and the resolution of any joint swelling which could have caused a temporary posterior open bite. An occlusion was considered dentally inadequate if it was unstable or there were edentulous areas or multiple large posterior fillings which would soon need replacement.

Conclusions

Our study suggests that temporomandibular joint disks which have been displaced only in an anterior direction can be restored to a normal or improved position in the joint with a good success rate if the disk displacement is fully reduced in the construction bite. In these cases, treatment by anterior mandibular repositioning can restore physiologic disk shape along with normalized disk position. The treatment may require adherence to a strict protocol, careful occlusal reconstruction of six or eight teeth, and indefinite use of an orthotic at night.

Acknowledgements

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References