Long-term stability of mandibular orthopedic repositioning

Donald R. Joondeph, DDS, MS

Abstract: Mandibular anterior repositioning appliances attempt to diminish temporomandibular joint pain, soft tissue noise, and myofascial discomfort by altering condyle-disc relationships. Secondary stabilization of the occlusion to this arbitrary anterior position through orthodontic tooth movement may significantly alter functional and muscular relationships. A case report is illustrated to show that as the functional environment attempted to reestablish equilibrium through adaptation, relapse occurred as the condyles "seated" posteriorly and superiorly toward their original relationship within the fossa. For all practical purposes, complete relapse of the orthodontic treatment result took place over time.

Key Words: Stability, Anterior mandibular repositioning, Internal derangements, Anterior positioning appliances

The rationale for mandibular anterior repositioning is to diminish temporomandibular joint pain, soft tissue noises, and myofascial discomfort. Repositioning appliances affect the temporomandibular joints by decreasing adverse loading and by altering the condyle-disc relationship.[1] Prior to selecting this therapeutic approach, however, occlusal consequences in all three planes of space must be evaluated because mandibular repositioning can result in irreversible occlusal changes. Articulated study models allow the clinician to simulate the amount of anterior mandibular repositioning anticipated and more thoroughly evaluate secondary changes in occlusal relationships. Most commonly, anterior mandibular repositioning will create a bilateral posterior openbite as the path of the mandibular advancement is determined by the patient's incisal guidance and the slope of the articular eminence. Additionally, since both arches are in the form of a parabola, as the mandible is advanced, a wider portion of the mandibular arch will approximate a narrower portion of the maxilla, resulting in a relative maxillary transverse deficiency and a tendency toward crossbite. The extent of the occlusal change is related to the amount of mandibular advancement, the steepness of the incisal guidance, and the patient's arch form. For instance, the more tapered the arch, the greater the secondary transverse discrepancy created with a given amount of mandibular protrusion.

Anterior repositioning appliances should be fabricated with full occlusal coverage and vertical stops for all teeth in the opposing arch. Failure to do so may result in irreversible iatrogenic occlusal change. An example of such a change is supraeruption of posterior dental segments into the mechanically created posterior openbite. This type of uncontrolled vertical dentoalveolar change is often irreversible and may result in a clockwise rotation or "hinging open" of the mandible. Subsequently, when an attempt is made to reposition the mandible posteriorly into pretreatment occlusal relationships, the resultant occlusion may be more Class II with concomitant anterior openbite and maxillary transverse excess.

Following resolution of joint pain and dysfunction, the repositioning appliance should be adjusted to or replaced by a stabilization appliance to allow the mandible to reposition posteriorly to pretreatment occlusal relationships.[1] If this cannot be accomplished successfully due to recurrence of joint symptoms, anterior stabilization of the occlusion with adjunctive restorative, prosthetic, or orthodontic therapy may be a viable treatment option. Tallents et al.[2] evaluated 68 treated and 18 untreated subjects and concluded that protrusive splint therapy followed by anterior stabilization with either orthodontic or restorative treatment is a viable option for treatment of meniscal displacement with reduc-

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Figure 1A


Figure 1B

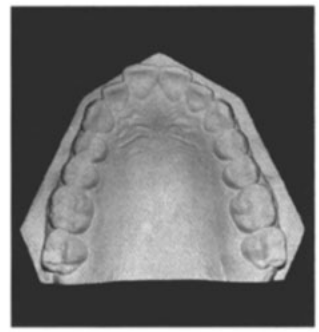
Figure 1C

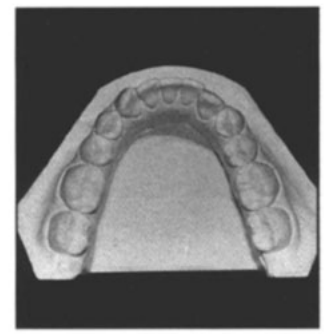
Figure 1D


Figure 1E


Figure 1F

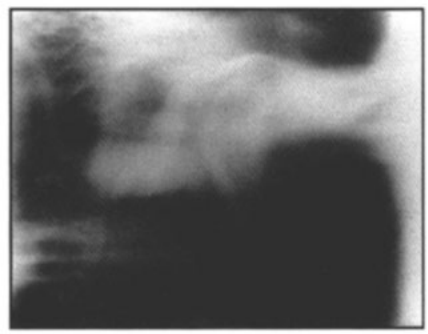
Figure 1G


Figure 1H

Figure 1A-H
Initial records of patient DC. Note excess anterior overbite and overjet due to a missing mandibular incisor. Oriented tomograms show the condyle-fossa relationship in maximum intercuspal position.

tion. Their results indicated that, with anterior repositioning and stabilization, statistically significant reductions occurred in the intensity of joint pain, temporal headache, ear pain, and pain in front of the ear. The probability of a closed lock condition developing also decreased. This study evaluated the frequency of posttreatment symptoms only.

The patient's response to repositioning therapy is, of course, a major criterion for evaluating successful treatment. However, it is also important to evaluate long-term changes in the condyle-fossa relationship that take place with the condylar distraction associated with mandibular anterior repositioning. One must be aware that mechanical alteration of the mandible to an arbitrary anterior position will most definitely alter functional and muscular relationships. As the functional environment attempts to reestablish equilibrium through adaptation, there is a high likelihood of relapse.

Patient DC is one of 12 patients treated with an anterior repositioning splint followed by orthodontic tooth movement to stabilize the occlusion in an anterior position. This arbitrary position was determined by monitoring patient symptoms while attempting to reposition the mandible as close as possible to the pretherapeutic relationship. The primary plan of treatment for all 12 patients was to continue to adjust the splint, allowing the mandible to reposition posteriorly while converting the splint to a stabilization appliance. Patient DC's inability to tolerate further posterior repositioning, as well as her desire to not wear a splint full-time, necessitated some form of occlusal stabilization in an anterior position. Records for patient DC will be presented to document the stability of this therapeutic modality, but it must be pointed out that all 12 patients treated in this manner responded similarly.

Case Report

Patient DC presented at 26 years 9 months with acute joint symptoms characterized by temporomandibular joint pain and intermittent locking (Figure 1A-H). She had an Angle Class I buccal occlusion with excess anterior overbite and overjet secondary to a congenitally missing mandibular incisor. The missing incisor resulted in a Bolton tooth-size discrepancy reflective of a maxillary anterior tooth-size excess. The oriented tomograms show the relationship of the condyle within the fossa when the patient occluded into maximum intercuspal relationships on the right (Figure 1A, G) and left (Figure 1B, H) sides. Using a submentovertex film, tomograms were oriented on the patient's condylar angle so that future tomograms could be superimposed to evaluate changes in condyle-fossa relationship concomitant with the alteration of mandibular position and the occlusal relationship. All subsequent tomograms were taken at the same condylar angle and at the same depth of cut to minimize errors in superimposition. Note the difference in posterior and superior joint space between the right and left sides in maximum intercuspation. Although

this difference can be noted radiographically, tomograms were taken to document changes in condyle-fossa relationship secondary to alteration in mandibular position, rather than to quantify joint space as a diagnostic tool. It is also evident from patient DC's initial occlusion that altering the mandibular position anteriorly would have resulted in a significant change in the occlusal relationship.

Based on the patient's chief complaint and symptoms of acute pain and intermittent locking, an anterior repositioning splint was fabricated as shown in Figure 2A-B. Initial splint position was determined by advancing the mandible in a protrusive position until the initial click was heard, suggesting reduction of the disc. The mandible was then allowed to reposition distally as far as possible, and the initial splint position was made to a mandibular relationship just anterior to the closing click. The therapeutic objective was to position the mandible as close as possible to the pretreatment occlusal relationship while allowing disc reduction. Mandibular position at the time of initial splint placement can be seen in Figure 2A-B, and the corresponding changes in the condyle-fossa relationship concomitant with the observed alteration in mandibular position can be seen in Figure 2C-D. Note the amount of condylar distraction within the fossa associated with initial placement of the anterior repositioning splint. Tomograms were superimposed on the temporal architecture and articular fossa contour to show the changes in condyle-fossa relationship on the right (Figure 2E) and left (Figure 2F) sides. It should be noted that the initial splint position was determined by the patient's signs and symptoms, and the therapeutic objective was to continue to adjust the splint from that point to allow distal repositioning of the mandible and condyle over time.

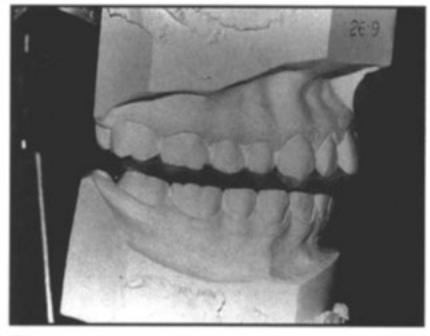

Figure 2A

Figure 2B

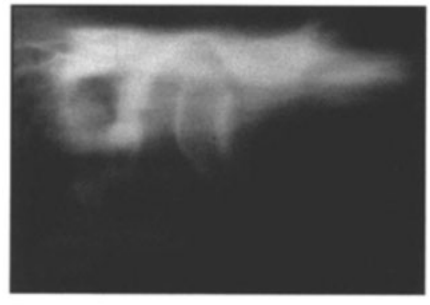

Figure 2C

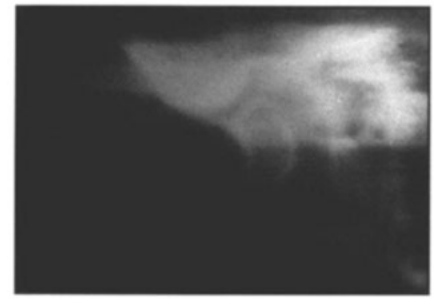

Figure 2D

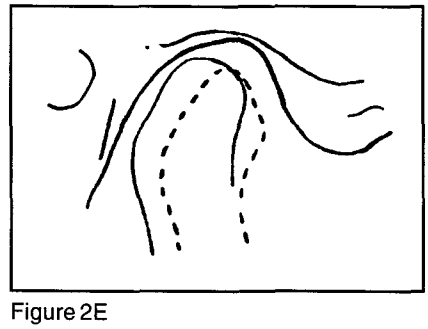

Figure 2E

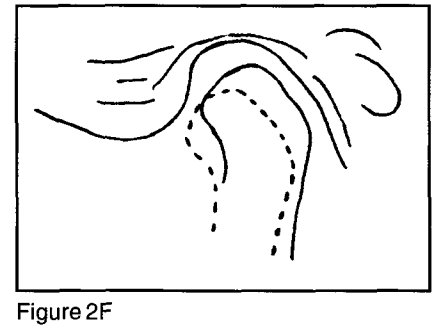

Figure 2F

Figure 2A-F
Initial splint position and corresponding changes in the condyle-fossa relationship. Superimposed tracings show the change from initial condylar position (solid line) to initial splint position.

The patient responded very well to protrusive therapy, and the splint was adjusted to allow distal movement to take place while maintaining symptom control and patient comfort. Figure 3A-B shows patient DC's occlusion at the point where further attempts to distally reposition the mandible through splint adjustment resulted in a return of the initial symptoms. At this time, an attempt was made to maintain symptom control without permanently altering or stabilizing the patient's occlusion. Trials were conducted to reduce splint wear to nights only, with the objective of obtaining patient comfort through intermittent splint wear. Patient DC did not tolerate this change in splint protocol and was comfortable only when wearing the splint on a full-time basis. Her occlusion after 1 year of splint therapy is shown in Figure 3A-B. Note the relative transverse maxillary deficiency and the creation of a bilateral posterior openbite. Treatment options at this time appeared to include full-time maintenance with a protrusive splint or more permanent stabilization of the occlusion in an anterior position. Occlusal stabilization would have required either comprehensive restorative and/or prosthetic therapy or orthodontic tooth movement to achieve a more ideal intercuspal re-

lationship in this protrusive mandibular relationship.

In order to re-establish patient DC's Class I buccal occlusion in a protrusive mandibular relationship, it was necessary to consider controlled differential posterior tooth movement rather than uncontrolled eruption of the posterior teeth into the mechanically created bilateral posterior openbite. As the mandible was positioned anteriorly, it was necessary to prevent vertical eruption or extrusion of the mandibular arch while allowing the maxillary dentition to be moved downward and forward, re-establishing the Class I occlusion as illustrated diagramatically in Figure 4.

Treatment objectives included prevention of mandibular posterior vertical movement, allowing the posterior openbite to be corrected through downward and forward movement of the maxillary buccal segments. This was accomplished using fixed appliances in combination with the existing splint by differentially reducing the splint to facilitate vertical changes. The splint was reduced in the anterior area, allowing maxillary anterior tooth alignment to take place, eliminating distal-driving inclines due to rotations, and achieving more ideal overbite and overjet.

It is important to use the patient's splint during initial phases of tooth movement to maintain both symptom control and a reproducible mandibular position. Figure 5A shows patient DC's final splint prior to instituting tooth movement. Note the full occlusal coverage of the maxillary dentition. The splint was reduced anteriorly to allow alignment of maxillary incisors and canines. Additionally, the splint could be either reduced or eliminated completely posteriorly to facilitate the previously described vertical tooth control and movement. A portion of the splint was maintained to provide retention in the maxillary premolar area (Figure 5B). Additional ball clasps or retention devices can be added to ensure maintenance of the splint during this phase of treatment. It is important to consider using bonded appliances for this type of therapy so that the natural tooth anatomy can provide lingual and occlusal retention. Mandibular anterior indexing was maintained so that the patient had a mechanical index of the amount of anterior mandibular repositioning desired.

Initial treatment objectives were to align the maxillary incisors and achieve a "tripoding" of the occlusion by maxillary posterior vertical movement. Figure 6A-B shows frontal views of the patient with the modified splint in place during initial (Figure 6A) and progress stages (Figure 6B) of alignment. Note that the splint was reduced facially, incisally, and to some extent, lingually, in the maxillary anterior segment to allow alignment of the anterior teeth. Indexing for the mandibular incisors was maintained so the patient could continue to be positioned in an anterior relationship during initial phases of orthodontic tooth movement. Mandibular appli-

Figure 3A

Figure 3B

Patient DC's occlusion at the point where further attempts to reposition the mandible through splint adjustment resulted in return of symptoms.

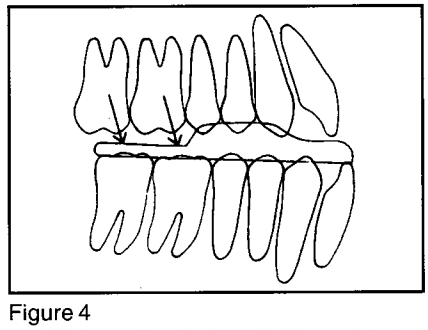

Figure 4

Figure 4
Diagram of splint modifications necessary to allow maxillary incisor alignment and extrusion of maxillary molars while maintaining mandibular anterior position.

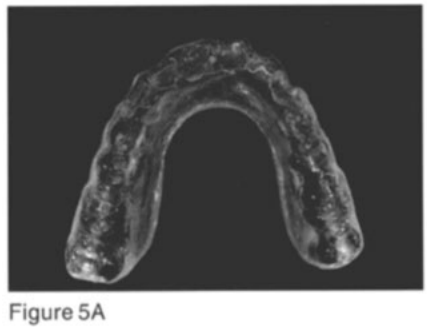

Figure 5A

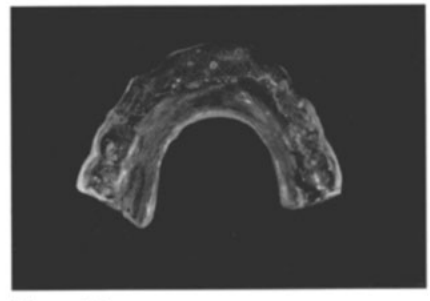

Figure 5B

A: Maxillary splint prior to initiation of tooth movement. B: Modified splint with acrylic reduced anteriorly to allow alignment of the maxillary anterior segment and eliminated posteriorly to facilitate vertical tooth movement.

ances were not placed until a stabilized occlusion was established. Figure 7A-B illustrates vertical control of the posterior buccal segments. Mandibular first molar bands were placed with soldered occlusal stops to the occlusal of the second molars. The splint was reduced posteriorly to allow the maxillary posterior teeth to be moved downward and forward, but extended posteriorly sufficiently to contact the mesial surfaces of the mandibular first molars to prevent vertical change of the mandibular buccal segments. Light elastics were worn from the mandibular to the maxillary molars only, with the splint in place (Figure 8A-B). The splint, in combination with the occlusal rests to the mandibular second molars, prevented eruption or extrusion of the mandibular buccal segments. The posterior acrylic was contoured to facilitate downward and forward movement of the maxillary molars. This phase of tooth movement was done in a very controlled manner, and the patient was kept under close supervision to ensure that treatment objectives were met.

Once anterior and posterior stabilization of the occlusion was achieved, the splint was eliminated and appliances were placed on the mandibular arch and maxillary intermediate segments to detail final occlusal relationships (Figure 9A-B). Figure 9A shows patient DC's occlusion on the left side following stabilization and placement of the mandibular appliances. Note the good Class I molar relationship and canine positions while the maxillary premolars were still out of occlusion. Treatment objectives at this point were to bracket and reposition the maxillary intermediate segments and move them downward and forward into occlusion (Figure 9B).

Treatment time was 1 year 3 months, and final records were taken on patient DC at 29 years of age (Figure 10A-F). Overbite and overjet were reduced, and the patient's buc-

Figure 6A

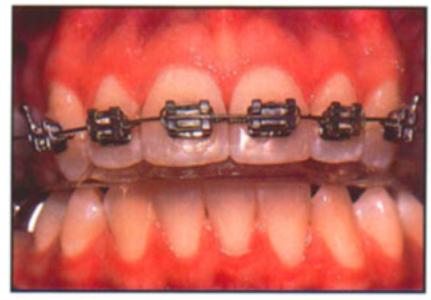

Figure 6B

Frontal views of patient DC with modified splint in place during initial (A) and progress stages (B) of alignment.

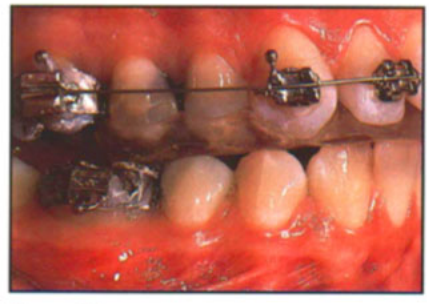

Figure 7A

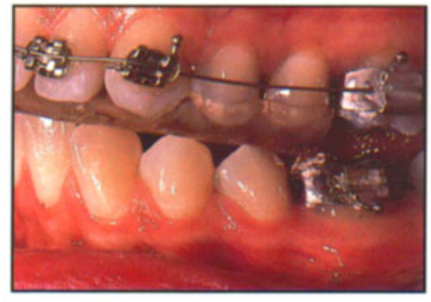

Figure 7B

Buccal views illustrating how vertical control of posterior segments was managed. Note extension of splint posteriorly to contact the mesial occlusal surface of the mandibular first molars when in occlusion.

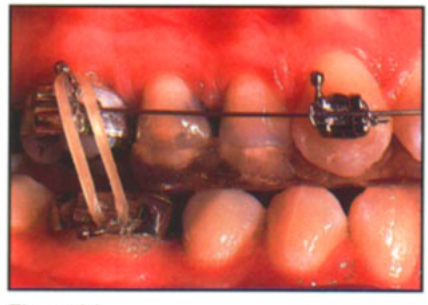

Figure 8A

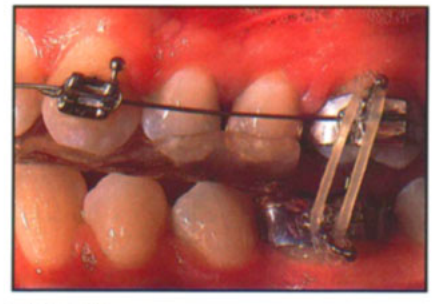

Figure 8B

Light elastics were worn only with the modified splint in place to move maxillary first molars downward and forward into occlusion. The splint prevented extrusion of mandibular molars.

Figure 9A

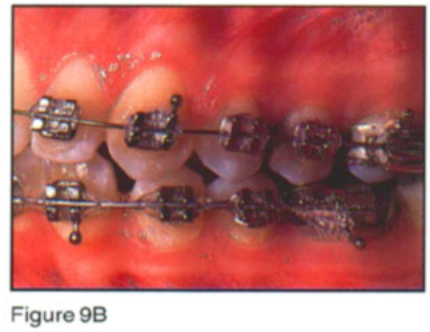

Figure 9B

Patient DC's occlusion on left side following stabilization (A) and subsequent to placing brackets on maxillary intermediate segments and moving them downward and forward into occlusion (B).

cal occlusion was re-established in a Class I relationship (Figure 10A-B) The relationship of the condyle within the fossa at this posttreatment interval is illustrated on the right (10C) and left (10D) sides. Superimposition of the right tomograms from pretherapy to postorthodontic treatment (10E) and the same interval on the left side (10F) indicate that both condyles were positioned more anteriorly and inferiorly than their pretreatment positions. The amount of change in the condyle-fossa relationship appears symmetric, as attempts were made during therapy to maintain symmetry of the occlusion. When comparing the pretreatment cephalogram at age 26 years 9 months (Figure 11A) with the posttreatment film at 29 years (Figure 11B), note the change in overbite and overjet relationships concomitant with treatment to a more anterior mandibular position.

DC was retained with maxillary and mandibular removable appliances and followed until progress records were taken 1 year posttreatment (Figure 12A-F). The study models show that the posterior occlusion was maintained in a Class I intercuspal relationship, but overbite and overjet relationships had increased. Figure 12C-D shows tomographically the relationship of

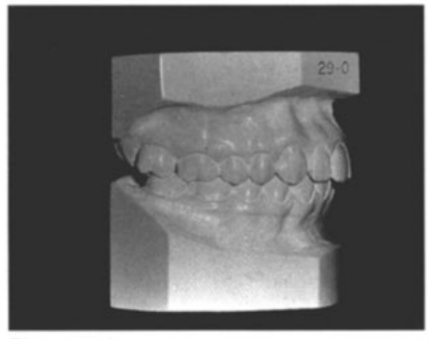

Figure 10A

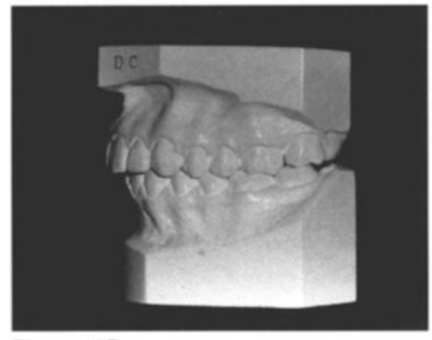

Figure 10B

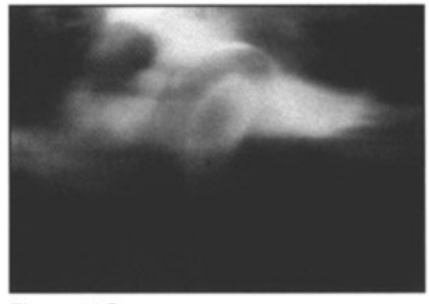

Figure 10C

Figure 10D

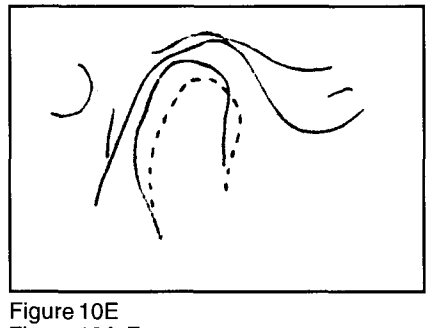

Figure 10E

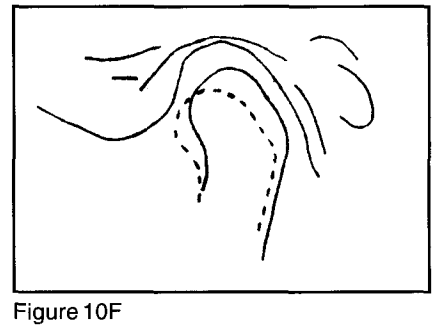

Figure 10F

Figure 10A-F
Postorthodontic occlusion with corresponding condyle-fossa relationship (A,C: right; B,D: left). Superimposition of oriented tomograms from pretherapy (solid line) to postorthodontic treatment (broken line) indicate that both condyles were positioned anterior and inferior to their pretherapy positions.

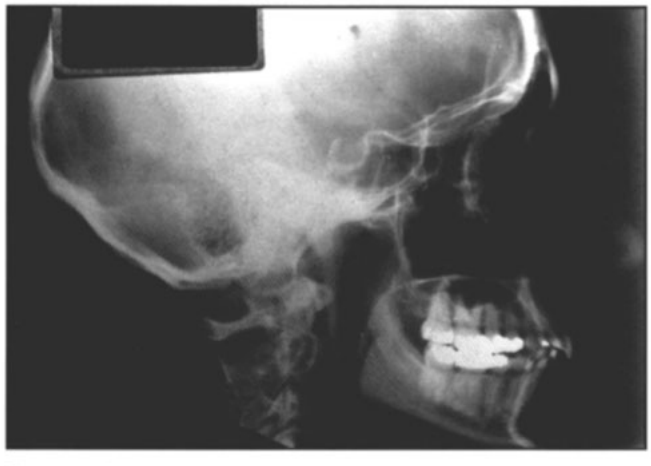

Figure 11A

Figure 11B

Comparison of initial cephalogram (A) and posttreatment film (B). Note the decrease in overbite and overjet concomitant with treatment.

the condyle within the fossa at this 1-year interval on the right (Figure 12C) and left (Figure 12D) sides. Superimposition of the oriented tomograms from immediate posttreatment to 1 year later reflect the changes in condyle-fossa relationship that took place (Figure 12E-F). The condyles initiated relapse or "seating" posteriorly toward their original relationship within the fossae.

Patient DC returned for retention visits, and retainer wear was decreased to nights only after the 1-year interval. Additional records were taken at age 33 years 0 months. Figure 13A-B shows the patient's occlusion 4 years 1 month after removal of orthodontic appliances. Note that the buccal occlusion still intercuspates satisfactorily, but the overbite and overjet relationships are more excessive than at the 1-year posttreatment interval. One can compare the relationship of the condyle within the fossa on the right side from the initial pretherapeutic position at age 26 years 9 months (Figure 14A) with the position at 33 years 0 months (Figure 14B). Similarly, Figure 15 shows the relationship of the left condyle within the fossa from its pretherapeutic position (15A) to the position 4 years 1 month posttreatment (15B). Superimposition of the tomograms from initial to 4 years 1 month posttreatment is illustrated in Figure 16A for the right joint and Figure 16B for the left. Over this time period, the condyles continued to seat toward their original position, so that 4 years 1 month following orthodontic stabilization of the occlusion, the condyles were approximately in their original relationship within the fossae.

The treatment of patient DC can be documented cephalometrically by reviewing the superimpostion from initial to postorthodontic treatment (Figure 17). The mandible was treated to an arbitrary anterior position as determined by patient comfort and symptom control. The

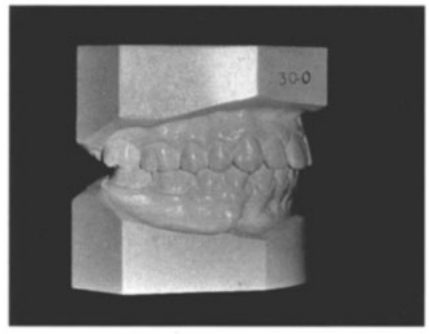

Figure 12A

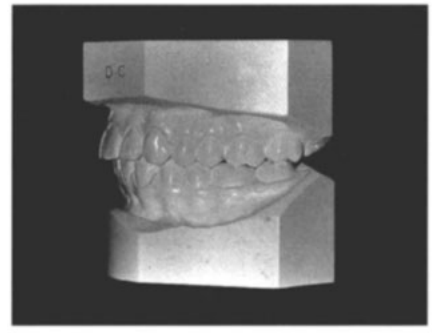

Figure 12B

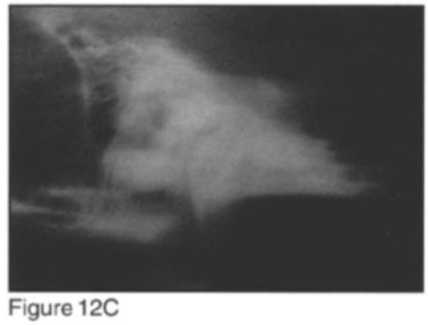

Figure 12C

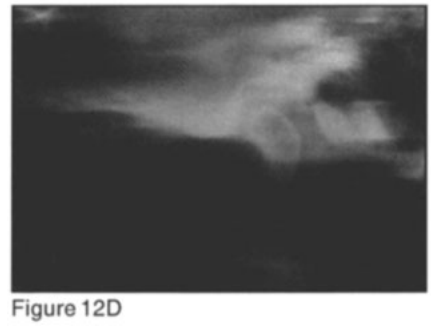

Figure 12D

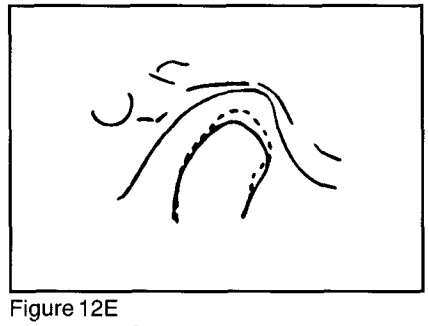

Figure 12E

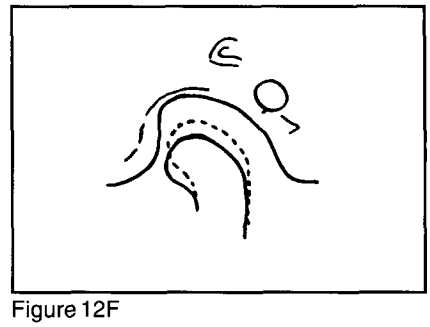

Figure 12F

Figure 12A-F
One year posttreatment occlusion of patient DC with corresponding condyle-fossa relationship. Superimposition of oriented tomograms from immediate postorthodontic treatment (solid line) to 1 year later (broken line) show the condyles relapsing or "seating" posteriorly back toward their original relationship within the fossae.

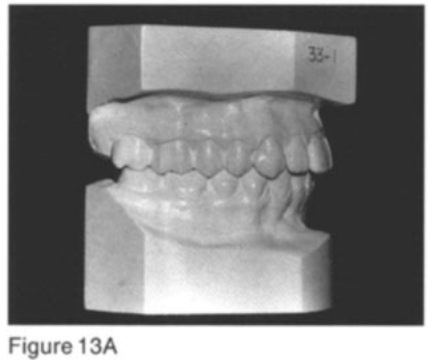

Figure 13A

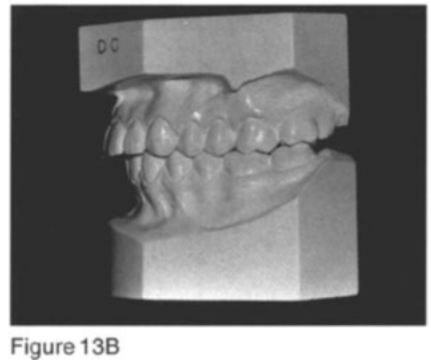

Figure 13B

Occlusal relationship of patient DC 4 years 1 month following removal of orthodontic appliances. Note that, although buccal relationships have been maintained, overbite and overjet have continued to increase.

posterior occlusion was re-established in a Class I buccal relationship by prevention of mandibular posterior vertical tooth movement, while achieving closure of the posterior openbite through downward and mesial movement of the maxillary buccal dentition. Overbite and overjet were decreased when the mandible was positioned anteriorly.

The changes that took place during the 4 year 1 month posttreatment interval can also be documented by superimposition (Figure 18). As the mandible repositioned distally, there was a concomitant increase in overbite and overjet. The relapse was facilitated by reintrusion of the maxillary posterior teeth, allowing a decrease in posterior vertical facial dimension and seating of the condyles posteriorly and superiorly toward their original relationship within the fossae. For all practical purposes, complete relapse of the postorthodontic treatment result took place over time. It appears that mechanical alteration of the functional and muscular relationships resulted in instability, and as the functional environment attempted to re-establish equilibrium, that adaptation took place at the dental and temporomandibular articulations.

Although all 12 patients treated in this fashion showed complete relapse of the treatment, it is interesting to note that in confirmation of the findings of Tallents et al.,[2] the patients

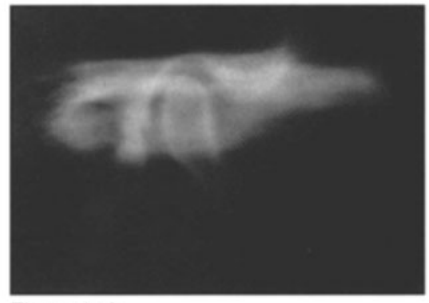

Figure 14A

Figure 14B

The condyle-fossa relationship on the right side as viewed from oriented tomograms from the pretherapeutic relationship at age 26 years 9 months (A) to the relationship 4 years 1 month following treatment (B).

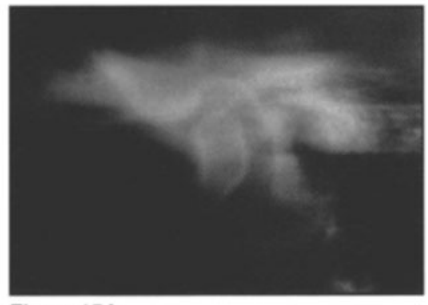

Figure 15A

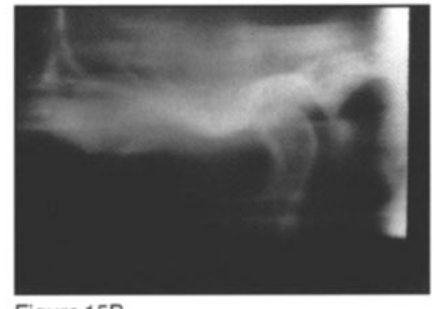

Figure 15B

The condyle-fossa relationship on the left side as viewed from oriented tomograms from the pretherapeutic relationship at age 26 years 9 months (A) to the relationship 4 years 1 month following treatment (B).

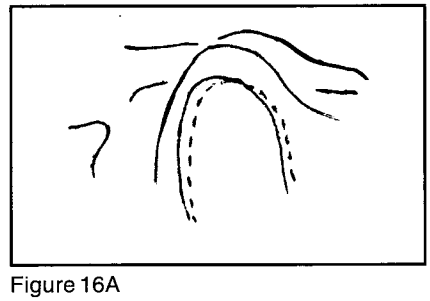

Figure 16A

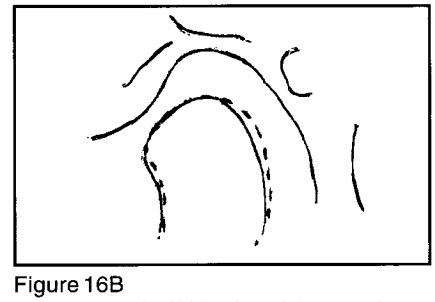

Figure 16B

Superimposition of oriented tomograms from pretherapy (solid line) and 4 years 1 month posttreatment (broken line). Note that the condyles are approximately in their original position within the fossa.

also remained relatively asymptomatic following mechanotherapy and relapse. One could hypothesize that this long-term improvement in patient symptoms could be due to the condyle-disc-fossa relationship being altered for an extended period of time. Changes in function and parafunction secondary to splints, fixed appliances, and retainers could also be factors in maintaining patient comfort. Finally, education, instruction, and perhaps lifestyle changes could have incidentally eliminated or reduced other stimuli that might have been etiologic factors. The observed improvement in patient symptoms may not be related to the alteration of mandibular position. Accordingly, if this treatment modality is selected, the clinician must be aware of the high relapse potential and the possibility that if adaptation does not take place at the dental level through localized tooth relapse, adaptive changes may occur in the joints through remodeling or degenerative changes.

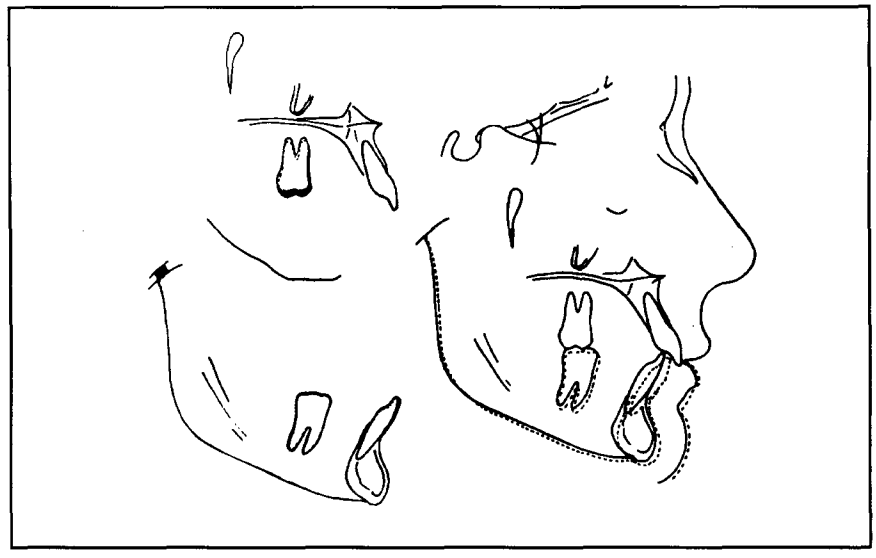

Figure 17
Cephalometric superimposition from initial to postorthodontic treatment. Note anterior repositioning of the mandible with extrusion of maxillary molars.

Figure 18
Cephalometric superimposition from postorthodontic treatment to 4 years 1 month later. Note distal repositioning of the mandible with reintrusion of maxillary molars.

References

1. McNeill C, ed. Temporomandibular disorders: Guidelines for classification, assessment and management. Chicago: Quintessence, 1993:91.
2. Tallents RH, Katzberg RW, Macher DJ, Roberts CA. Use of protrusive splint therapy in anterior disc replacement of the temporomandibular joint: A 1 - 3 year follow-up. J Prosthet Dent 1990;63: 336-41.