Prerestorative minor axial tooth movement

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ABSTRACT Restoration of severe and localized tooth wear is not a straightforward procedure. Minor axial tooth movement is one of the many methods that have been advocated to create space for restorations. It is a safe, simple, conservative, and predictable method for creating space locally, either due to tooth wear or supra-eruption. The author provides an overview of the technique; discusses the type of appliances available, indications, and contra-indications; and presents two clinical cases.

Introduction

Localized loss of space can hamper the esthetic or functional restoration of affected teeth. Such loss is often due to excessive tooth wear or compensatory growth 1, or supra-eruption of the unopposed teeth.

Many methods have been advocated for the treatment of localized loss of space, including (1) minor axial tooth movement; (2) reducing the opposing teeth; (3) increasing the overall occlusal vertical dimension (OVD); (4) lengthening the surgical crown; (5) elective root canal treatment and restoration with post-retained restorations; (6) axially moving posterior and/or anterior teeth by orthodontic means; (7) distalizing the mandible; and (8) a combination of two or more of the above.

Minor axial tooth movement

Essentially, minor axial tooth movement involves a combination of overeruption of the unopposed teeth and intrusion of the supra-occluding teeth. Intrusion is the typical response in older people, whereas in younger people the response is quicker because both eruption and intrusion take part.

The concept was first described by Anderson in 1962 2. A 0.5-mm metal bite-raising cap was placed on the occlusal surfaces of lower right first molars in five adults. After 23 days to 41 days, the patients were able to bring their teeth together with the cap in position. This idea was later reinforced by Dahl et al 3 that an 18-year-old man was asked to wear a removable 2-mm thick cobalt-chromium appliance for 24 hours a day; after 8 months same amount of space was created. Other studies 4-6 demonstrated that spaces could usually be created within 2 to 4 months, with the appliance producing insignificant protrusion of the upper incisors or retroclination of the lower incisors.

Effects on occlusal stability and changes in occlusal vertical dimension

Encroachment on the interocclusal space has led to the fear of relapse 7 and the danger of altering the OVD 8. However, in patients followed up for 5.5 years 6, although some relapse did occur, mainly in the first 6 months, in no case did increased face height revert completely.

The fear of altering the OVD may stem from teaching (in relation to edentulous patients) that a freeway space of about 4 mm should be maintained 8,9. However, this would not lead to neuromuscular or temporomandibular joint (TMJ) problems because of afferent feedback from periodontal mechanoreceptors 10. An interocclusal space of 4 mm, as advocated, is not applicable in dentate cases as the postural position of minimal muscle activity has been found to be 4.5 mm to 12 mm greater than the OVD 11,12. Even if there is an increase in OVD in patients who have temporomandibular disorder (TMD), an alteration of the interocclusal space does not aggravate the problem; in most cases the TMD symptoms are relieved.

Gough and Setchell’s retrospective study 13 of 50 cases over a period of 13 years showed a very high success rate of 96% without TMD or periodontal problems, and no problems of wear on antagonist teeth. Dahl and Krogstad 4 stated that no patient reported any muscular fatigue, and other studies altering the OVD 14-16 also reported no development of TMD.

Adverse tooth movements, such as splaying of the anterior teeth, were not observed in a study utilizing
placement of composite at an increased OVD over a
period of 30 months. Differential axial tooth movement
between anterior and posterior teeth with appliances that
encroach on the interocclusal space is unlikely to give rise
to neuromuscular or TMJ problems.

Predictability

The success rate of minor axial tooth movement is very
high (89-96%, 13,14,17). Redman et al 16 obtained 61%
complete and 39% partial re-establishment of posterior
contact after 1.5 months to 18.5 months (mean, 7.0 months).
Continued occlusal re-establishment may occur and, as
Gough and Setchell 13 suggest, virtually all appliances will
produce localized space if sufficient time is allowed.
Depending on the amount of space required, the space is
created in a median of 5.9 months 13. Failure of space
closure is usually associated with poor patient compliance
with removable appliances 4,13.

Appliance design

The design incorporates an even occlusal contact in
the retruded contact position, with no interference in
lateral excursions. Opposing teeth are not loaded at an
gle to the long axes of the roots. In the anterior
teeth, intrusion of the lower incisor teeth is by means of
an occlusal platform at right angles to the long axes of the
lower incisors 18. However, Hemmings et al 14 showed
that an inclined platform did not produce any adverse
results, such as splaying of the opposing teeth. The
thickness of the appliance is correlated to the amount
of space required 6. A slightly thicker splint will hasten
movement 18.

Monitoring axial tooth movement

The amount of space created can be measured by
using crown thickness measuring callipers on the occlusal
indices 18. When the required space has been created
using a slightly thicker appliance, the appliance can be
removed and definitive restorations made without
delay. This is more applicable for restoring anterior and
localized tooth wear cases.

Clinical techniques

Clinical techniques for producing minor axial tooth
movement include: (1) provisional restorations (composite
restorations or provisional crowns) deliberately
encroaching on the interocclusal space; (2) a fixed metal
(nickel-chromium) bite-plane; (3) a removable cobalt-
chromium or clear acrylic (Dahl type) bite-plane; (4)
definitive restorations (e.g. cast metal veneers, crowns)
deliberately encroaching on the interocclusal space; and
(5) removable conventional orthodontic appliance
incorporating an anterior bite-plane.

Fixed-metal appliances

A fixed-metal appliance is essentially a nickel-chromium
plate (with the features described above) cemented
onto the affected teeth with glass ionomer cement.
More retentive resin-luting cement (e.g. Panavia cement)
is contra-indicated due to subsequent difficulty of
removing the appliance without damaging the teeth. The
fixed metal appliance is more resistant to wear and
debonding. It requires shorter chairside time, provides
simpler control of occlusal relationships and the ability
to control tooth alignment by splinting units together,
while not being affected by patient compliance. However,
it is difficult to remove, and there is a risk of fracturing the
teeth.

Composite build-ups

Composite restorative material is added to the affected teeth
to the predetermined vertical dimension. Features such as
placement of the mandible in the retruded contact position,
axial loading, and no interference in lateral excursions,
are incorporated into the design. The material is cheap,
restorable, quick-setting, and esthetically pleasing
(particularly when the incisal edges are also affected). In
addition, patient compliance is not a factor because there
is no need to remove it: the composite material is treated
as tooth tissue and prepared for the crown when the
required space has been acquired. The composite build-
up may be debonded or fractured, and may experience
excessive wear (especially in patients with bruxism or
parafunctional activities). Nevertheless, provided the
patient is reviewed regularly and any defects are repaired,
the technique poses no problems. This technique may
require more clinical time in the hands of inexperienced
practitioners.

Removable appliances

Cobalt-chromium appliances are often used for removable
appliances. A 2-mm thick splint is placed over the worn
surfaces of the teeth to be treated. Retention is provided
by buccal clasps on the canines and premolars, obtained
from the buccal undercut areas of the worn teeth. The
patient is required to wear the appliance 24 hours a day 3.
For esthetic reasons, alternative materials such as heat-
cured clear or tooth-colored acrylic may be used. The
advantages of the removable appliance are less chairside
time and cost. However, patient compliance is essential,
and removable appliances are less esthetically pleasing,
less stable, and bulky making fixed appliances more
common.

Provisional crowns

Ricketts and Smith 18 described the use of full-coverage
provisional restorations to create the interocclusal space—an especially useful technique in cases where the teeth need to be crowned anyway. Once the disclused teeth make contact, the provisional crowns are removed and replaced with permanent crowns. This method is more esthetically pleasing and makes the evaluation of appearance possible and the transition to definitive restoration straightforward. However, the method is irreversible and some patients may find it traumatic. Unless the patient is determined to have permanent crowns made, reversible means may be more appropriate.

Definitive restorations
For permanent crowns at the predetermined OVD, a palatal platform should be incorporated into the metal work to put axial loading on the lower incisors. A definitive adhesive cantilever bridge can be used to replace one missing tooth in the absence of interocclusal space. In such cases, an occlusal platform must be present to apply axial loading to both upper and lower teeth. This saves the time required to make a permanent restoration after the space is created, and the appearance is good from the beginning. However, there is a risk that tooth movement may not occur in the anticipated manner; or that the patient may not be able to tolerate the initial discomfort.

Indications
Minor axial tooth movement is indicated for localized tooth wear cases affecting a single tooth or a group of teeth, either anteriorly or posteriorly. Sufficient teeth must also be present to allow differential tooth movement. Application in supra-erupted teeth has also been found to be very effective. Sometimes, a provisional crown may be dislodged resulting in loss of space, which may be considerable if the patient defaults from follow-up. If there is axial loading, no interference in the lateral excursion of the mandible, and the periodontal condition of the abutment is good, such loss may be treated by cementing a permanent crown. Axial tooth movement will often occur unevenly; of course, the patient must be informed of the transient discomfort.

Contra-indications
This technique should not be used on teeth with questionable prognoses or active periodontal disease, and minor axial tooth movement procedures must be used cautiously or be deferred in the presence of TMD. Minor axial tooth movement may be contra-indicated in cases where there is a large horizontal to a small vertical ratio sliding from the retruded contact position to the intercuspal position as it may result in losing the ability to function comfortably in a more anterior position after treatment. Other contra-indications include missing teeth in the area of tooth wear, absence of stable posterior support, and insufficient teeth to allow differential tooth movement. The following two clinical cases demonstrate the use of minor axial tooth movement in the management of severe and localized tooth wear.

Case 1
A 30-year-old woman presented with severe anterior tooth wear due to a history of bulimic nervosa. Clinical examination revealed severe wear on the palatal and incisal surfaces of teeth 13 to 23 and 25 (Figures 1a and 1b). The teeth were sensitive. Alveolar compensation had occurred, and space was lacking for restorations. Minor axial tooth movement using a fixed nickel-chromium appliance was used (Figure 1c). The plate extended from the upper right canine to the upper left canine and was cemented with glass ionomer cement. By a process of intrusion/extrusion, vertical space was created after 3 months (Figure 1d). Provisional crowns were made to the acquired vertical dimension (Figure 1e). Posterior teeth requiring crowns were restored first. Anterior teeth were then restored with Procera crowns using a customized anterior guidance table constructed from the provisional crowns. A 6-month review showed no untoward findings (Figure 1f).

Localized axial tooth movement was used to create space for the anterior crowns; this approach was the simplest and the least destructive. Measures like orthodontic treatment, crown lengthening, trimming the opposing teeth, or increasing the OVD of the whole arch would have been more destructive and thus were not selected. Axial tooth movement was monitored using the occlusal indices at each recall appointment. Definitive treatment commenced once the required dimension was obtained and the occlusion was stable. Posterior teeth were restored first as they were heavily restored and anterior guidance was provided by the anterior teeth.

Case 2
A 55-year-old man presented with severe tooth wear in the upper anterior region (Figures 2a and 2b). Minor axial tooth movement was planned to create space for teeth 12 to 22. Composite build-up was performed on the palatal surfaces of the affected teeth (Figure 2c). In less than 3 months, the space required for crown construction was created (Figure 2d), and definitive metal/ceramic crowns were made (Figures 2e and 2f).

As this was a referral case, only the four front teeth were treated. The procedure was uneventful and the required space was created in less than 3 months. Provided all the features for this type of tooth movement are taken...
Figure 1  Photographs showing (a) severe anterior tooth wear before treatment; (b) stained palatal surfaces of the teeth; (c) nickel-chromium plate cemented to upper front teeth; (d) appliance removed and space created 3 months after cementation; (e) provisional crowns; and (f) the front view after 6-month review

Figure 2  Photographs showing the (a) close-up and (b) occlusal view of severe anterior tooth wear before treatment; (c) front view of teeth performing composite build-up; (d) closure of space in less than 3 months; (e) front view and (f) occlusal view of metal ceramic crowns constructed for teeth 12 to 22
into consideration, the space is normally created as planned. However, it is important to note that the initial discomfort must be well understood by the patient as perseverance is essential.

Conclusion

If the design features, indications and contra-indications are attended to, the procedure is carried out carefully, and the patient maintains good oral hygiene and is able to tolerate the initial discomfort, minor axial tooth movement is a simple, conservative, predictable, and safe way to create occlusal space for the restoration of involved teeth.

References