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Consequences of Tooth Loss: 2. Dentist Considerations – Restorative Problems and Implications

Abstract: Partial tooth loss is much less well tolerated by patients than was previously the case and, on occasions, when extraction is inevitable, they may seek prosthetic replacement. This paper explores some of the consequences of tooth loss that may cause difficulties in tooth replacement, particularly if replacement is delayed for some time.

Clinical Relevance: An awareness of potential difficulties, particularly with posterior tooth replacement, will allow clinicians to make treatment decisions in the light of current evidence.

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As discussed previously, patients expect to keep their teeth and have them remain aesthetically pleasing for their entire lives. On occasion, this may not be possible and some teeth may be lost as a result of caries, periodontal disease or trauma. Most anterior teeth are likely to be replaced soon after their loss and prostheses are usually well tolerated, if only for aesthetic reasons. We therefore rarely see changes to the position of adjacent teeth following anterior tooth loss. The exception to this is when a missing anterior tooth in a child is replaced with a removable prosthesis which is not worn by the patient.

Patients are not always aware of the options for tooth replacement at the time of extraction, may not feel that it is necessary to replace the tooth, or be unable to afford replacement at that time. It is therefore not uncommon to encounter sites for restoration where teeth are not in positions conducive to straightforward tooth replacement.

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Vertical positional changes

Research has shown that most teeth will develop some degree of overeruption if they remain unopposed for a period of time. Craddock *et al*[1] found that up to 92% of unopposed posterior teeth may demonstrate some degree of overeruption from the occlusal curve. Earlier, Craddock and Youngson[2] and Kiliaridis *et al*[3] had found that up to 83% of unopposed posterior teeth showed signs of overeruption.

The extent of the overeruption can be quite significant, with two studies[1,2] demonstrating that between 27% and 32% of unopposed teeth had overeruption in excess of 2 mm. In terms of management of the interocclusal space when planning a replacement for the edentulous space, this could have significant clinical implications. Overeruption was statistically greater in maxillary unopposed teeth than mandibular.[2]

In addition to posing problems with vertical dimension, there may be other factors to consider in terms of the type of overeruption encountered. A number of authors[2,4] have sought to define the different features encountered in overerupted teeth. Few studies have investigated the type of eruptive process. Compagnon and Woda[4] studied the unopposed upper first molar in both healthy mouths and those with periodontal pathology present. In healthy individuals they noted that the gingival margin remained at its original level on the tooth during this occlusal tooth movement. This movement (where the periodontal ligament and bone develop together with tooth movement) was described as periodontal growth. Active eruption was defined as the situation where the tooth continued to move in an occlusal direction

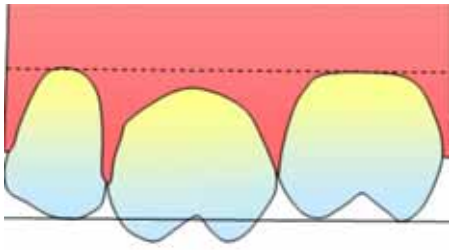

Figure 1. Eruptive movement with migration of the periodontal supporting structures – Periodontal Growth.

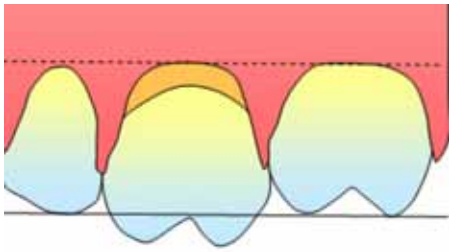

Figure 2. Eruptive movement with the supporting structures remaining at their original position, exposing root surface – Active Eruption.

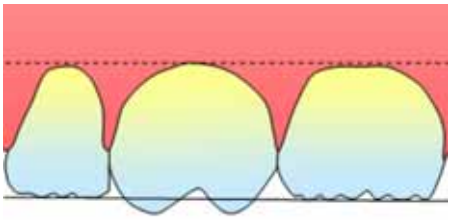

Figure 3. Relative Wear – unopposed tooth remains with the attachment apparatus at its original level, no exposed root surface, but has not worn at the same rate as the adjacent teeth.

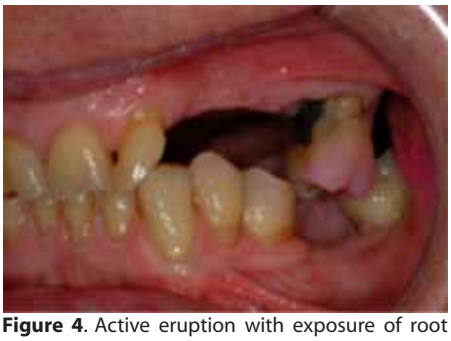

Figure 4. Active eruption with exposure of root surface, caries and periodontal breakdown.

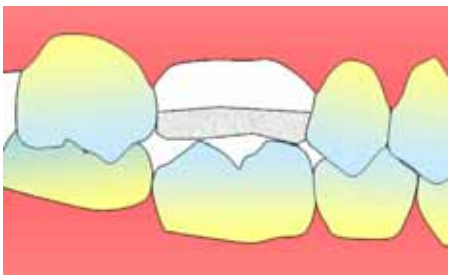

Figure 5. Overeruption prevented with adhesive occlusal platform/pontic.

in the absence of periodontal growth, exposing root surface and increasing the length of the clinical crown. From the findings of this study, it is evident that the clinical appearance of overeruption may have several components, including periodontal growth, passive eruption and active eruption. Although Compagnon and Woda[4] mention 'passive eruption', they recognized that it is not true eruption but merely an apical migration of the gingival margin, without any change in vertical tooth position. Craddock *et al*[1] defined a further presentation of overeruption 'relative wear', where the non-functional tooth was not subject to wear and gave the appearance of overeruption relative to the adjacent teeth. These three types of overeruption are demonstrated in Figures 1, 2 and 3. Of the 92% of subjects with measurable overeruption, only 55% displayed a single type of eruption. Other patients had combinations of eruptive features. Active eruption was the most prevalent form of overeruption, followed by periodontal growth. Relative wear was the least prevalent of the three categories.

Bearing in mind the prevalence of periodontal attachment loss (70–90%, depending on the population studied[5,6]), the cumulative effect of attachment loss throughout life, and the age at which tooth loss now occurs in many patients, it would be unwise to ignore the role of periodontal attachment loss in the clinical presentation of active eruption. It could be postulated that active eruption and periodontal growth are the same process but, in the case of active eruption, periodontal breakdown and recession are responsible for the increase in the length of the clinical crown.

The paper by Craddock *et al*[1] investigated factors associated with each type of overeruption. These factors may assist clinicians in predicting which patients or oral sites may have an increased tendency to tooth positional changes. Investigation of factors associated with periodontal growth demonstrated that it is less common with increasing age and attachment loss, and was more likely to be seen in the upper arch, involving premolar teeth, more frequently in females than males. As one might expect, active eruption had an association with attachment loss. It also had a negative correlation with peridodontal growth. Further work is needed to establish whether active periodontal breakdown was taking place at the same overall time and rate as eruptive tooth movement. The presence of active eruption will inevitably alter the crown-root ratio, affecting the mechanical characteristics of the tooth and its behaviour under functional loading. This alteration in crown-root ratio may be the major factor in the production of drifting in teeth with reduced periodontal support.[7]

The anatomy of the overerupted tooth may have prognostic implications where active eruption is encountered. In teeth with root furcations, these may become exposed, and create plaque traps which may compromise the periodontal health. Exposure of root surface may also precipitate pulpal sensitivity, root caries and create aesthetic compromise (Figure 4).

Relative wear was found to have an association with increasing age and was more prevalent in unopposed lower teeth.[3] Again, from clinical experience and current evidence, both tooth loss and wear increase with age.

Following tooth loss, dentists may wish to assess an individual patient's risk of developing overeruption of an unopposed tooth. If replacement of the missing tooth is envisaged at some point in the future, and the clinician feels that the opposing tooth is likely to overerupt, some form of preventive strategy may be sought. This may be a removable partial denture, although the disadvantages of using this type of prosthesis for a single missing posterior tooth are obvious. A better tolerated and biologically less damaging option would be the use of an adhesive metal bite plane, either in the form of an adhesive or conventional bridge with a self cleansing pontic, for the unopposed tooth to contact during function (Figure 5).

Gierie *et al*[8] found that light intermittent forces were capable of deflecting or halting eruption. This fits well

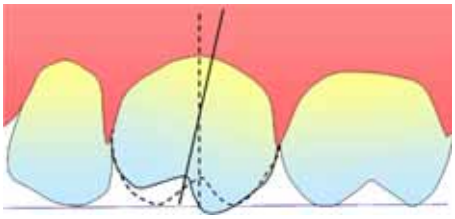

Figure 6. Tipping of partially opposed upper molar, allowing the distal cusp to extend below the occlusal plane.

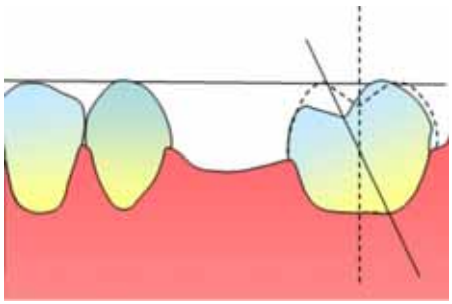

Figure 7. Tipping of a second molar following loss of the first molar adjacent to it.

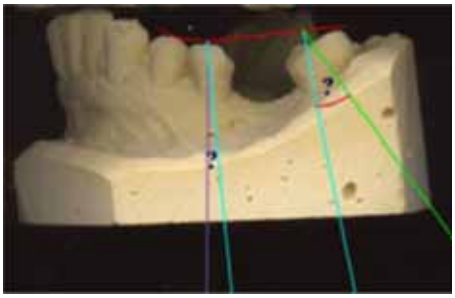

Figure 8. Mesial tipping of the tooth distal to the edentulous space and distal tipping of the tooth mesial to it create a space likely to create difficulties in tooth replacement.

Figure 9. Aesthetic and occlusal compromise due to rotation of an upper premolar.

with the Equilibrium Theory postulated by Weinstein *et al*[9] in relation to determination of tooth position. This theory postulated that teeth remained in a position within the jaws where forces, acting in equal and opposite directions, cancelled each other.

There is very little evidence on how much of the occlusal surface of a partially unopposed tooth needs to be in contact with an antagonist in order to prevent overeruption. One currently available study[10] demonstrates that teeth with only partial occlusal contact (30% or less horizontal overlap) may also appear to erupt beyond the occlusal plane due to tipping of the partially opposed tooth (Figure 6). This may allow the partially unopposed part of the tooth to overerupt to a similar extent to that of fully unopposed teeth. This study also found that the overeruption was largely due to tipping of the partially opposed tooth. As would be expected, overeruption has also been demonstrated to cause changes in the occlusal plane.[11]

Horizontal positional changes

As well as changes in position of the unopposed tooth following loss of an antagonist, a number of positional changes of teeth adjacent to the site of tooth loss may also take place. These spontaneous movements are clinically useful in some situations that may be beneficial to an orthodontic outcome.[12] They usually take the form of drifting and tipping of teeth adjacent to an extraction site. We may define drifting as the bodily horizontal movement of a tooth within the alveolar bone, which can be in a mesial, distal, lingual or buccal direction, whereas tipping may be defined as the rotational movement of a tooth within bone about an axis located on its root length (Figure 7). Teeth commonly drift or tip unless restrained by contact with adjacent teeth or occlusal contacts in the opposing arch, and the direction of tip or drift will also be under these influences. A number of authors[13,14,15] have described tipping and drifting, but have not attempted to quantify these positional changes. More recent evidence[16] demonstrates that tipping, particularly at sites distal to the site of tooth loss, is very common following posterior tooth loss and is particularly extreme in the lower arch where tipping of such a tooth may be up to 43°, with a mean tip of 20°.

Tooth positional changes, whether they are vertical, horizontal, rotational or tipping, will affect the relative alignment of the crowns and roots of teeth, which may be involved in restoration or prosthodontic replacement. These positional changes may be of sufficient magnitude to complicate restorative treatment in a number of ways (Figure 8), including:

- Reduction in space or interocclusal clearance for placement of a replacement tooth;
- Divergent angulation of abutment teeth;
- Changes in occlusal loading; and
- Poor embrasure contour around pontics.

Obviously, change in the position of the tooth crown is clinically visible, but the changes in position of the root and therefore the apex may be of clinical relevance. Tipping may increase the proximity of roots of adjacent teeth and other anatomical structures, which can create difficulties should surgical treatment become necessary. Changes in root position may also affect the interdental space available for implant placement and make endodontic access more difficult owing to changes in relative anatomical position.

Rotation of teeth mesial to and distal to sites of tooth loss have been observed.[16] Rotation was found to be more

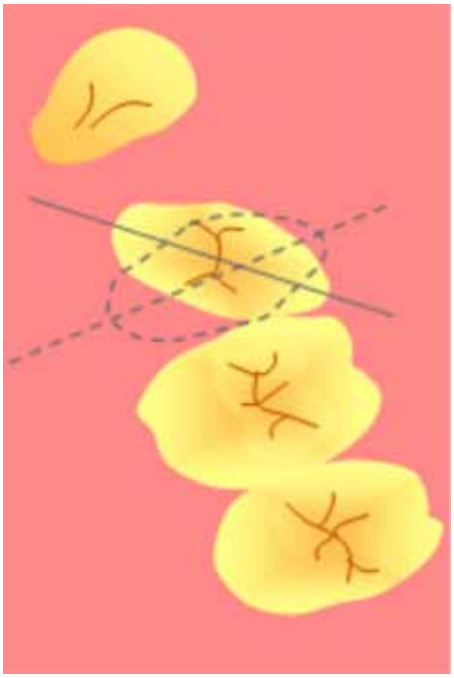

Figure 10. Rotation of an upper premolar following loss of a mesial contact point.

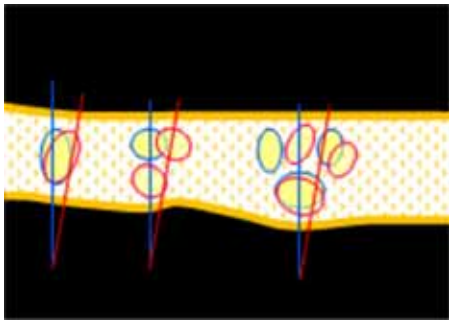

Figure 11. Change in relative root position of multi- rooted teeth following rotation.

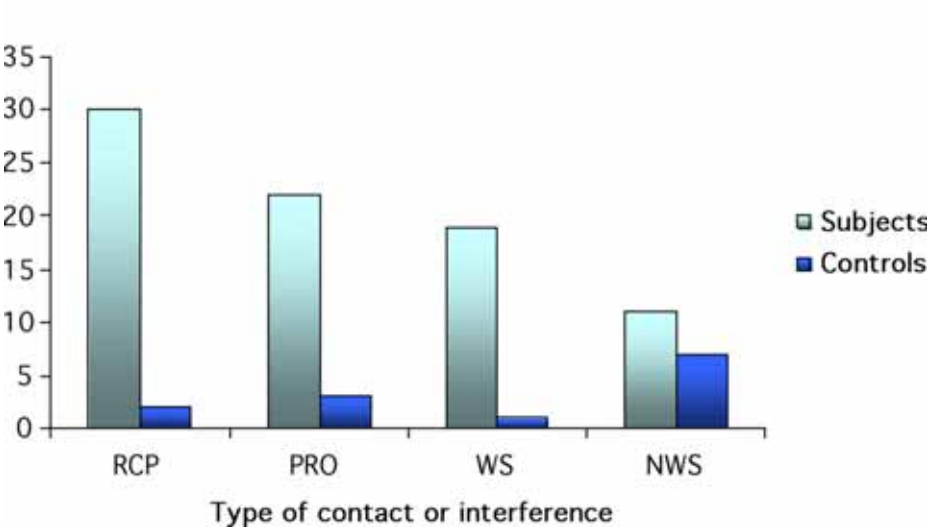

Figure 12. Relative incidence of occlusal contacts and interferences at sites of posterior tooth loss. (RCP = retruded contact position; PRO = protrusive interference; WS = working side interference; NWS = non-working side interference.)

prevalent in the upper arch, particularly in premolars. What is also of interest is the magnitude of rotation seen in some of the teeth in this study; up to 50°. This will have a number of undesirable clinical consequences, including:

- Compromised aesthetics of the rotated tooth (Figure 9);
- The amount of horizontal space available for replacement (Figure 10); and
- Changes in root position that may complicate surgical procedures and implant placement (Figure 11).

It could be postulated that root form and/or root surface area may influence a tooth's potential to rotate. It could be that the differences between upper and lower root forms have a role to play.

A couple of papers[1,17] have demonstrated an increase in prevalence of occlusal interferences associated with unopposed posterior teeth relative to that found in intact arches (Figure 12). Over 50% of unopposed teeth will be involved in a premature occlusal contact or interference. This may be of particular interest to practitioners who are about to restore teeth adjacent to extraction sites or replace missing teeth. Of sites with one or more missing posterior teeth, 53%[17] will be involved in a retruded contact position (RCP) contact and the removal of this contact during tooth preparation may allow condylar repositioning, compromising the occlusal harmony of the finished restoration. This may also be true of preparation of teeth involved in protrusive interference, as preparation of these teeth may affect the path of anterior guidance.

A recent study by Craddock[17] also attempts to investigate patient and tooth positional factors associated with the presence of occlusal interference. This study has shown that the presence of RCP contacts displays a correlation with the extent of overeruption of the unopposed tooth.

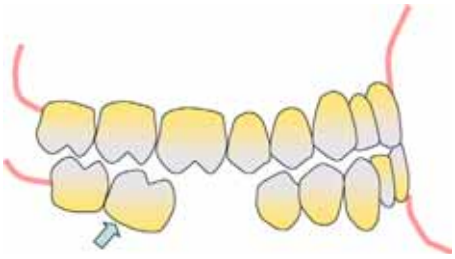

Figure 13. Tipping of the tooth distal to the extraction site, preventing a protrusive interference occurring with an overerupted unopposed tooth.

The presence of a tooth distal to the extraction site (a bounded site) was found to be correlated with the presence of a protrusive interference. Mesial tipping of the tooth distal to the extraction site had a negative correlation with the presence of a protrusive interference. Therefore tipping, whilst complicating restorative procedures, actually acts to prevent or minimize protrusive interference (Figure 13). There was a correlation between the presence of working side interferences and distal tipping of the tooth anterior to the site of tooth loss, and non-working interferences had a correlation with the presence of a protrusive interference. Ratcliffe *et al*[18] found a statistical association between the presence of lateral excursive interferences and cusp fracture, and further work in this area may strengthen this evidence.

Conclusions

The evidence discussed in this paper indicates that tooth loss is not without consequence, and it is these consequences that need to be carefully evaluated when advising patients on tooth loss. Restoration of teeth adjacent to sites of tooth loss, replacement of missing teeth, investigation of cracked teeth and surgical intervention at sites of tooth loss also need to be considered in the light of current and future evidence.

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CPD ANSWERS

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1. A, B, C
2. B, D
3. A, B, C
4. A, B, C
5. A, B, C
6. A, B, D
7. A, D
8. A, B, C
9. A, B, C
10. A, B