IN BRIEF

- Eruption is both a developmental and adaptive process, and continues throughout life.
- Overeruption can be expected to occur when an opposing tooth is lost.
- Overeruption of an unopposed tooth may present challenges for restoration.
- Eruptive tooth movement may be prevented or modified by a variety of clinical interventions.
- Considerations of the possible consequence of leaving a tooth unopposed, need to be addressed as part of the general treatment planning.

VERIFIABLE CPD PAPER

Eruptive tooth movement — the current state of knowledge

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How the dentition erupts, and what controls it, is fundamental to almost all aspects of clinical dentistry, yet the mechanisms behind this have not yet been fully elucidated. When the process continues into space that has been created through toothwear or tooth loss, problems in placing restorations can be encountered. This review examines the possible mechanisms of tooth eruption. Differences between processes in animals and humans are highlighted. The limitations of conclusions drawn from animal studies are then discussed with reference to human dental conditions. The differing forms of overeruption in humans are described and the treatment options for overerupted teeth, including prevention of the situation arising, are provided with a discussion of the quality of the evidence base behind these.

INTRODUCTION

Understanding of eruptive tooth movement is not only relevant to orthodontists and paediatric dentists, but should also be appreciated by all dentists in order to provide the most appropriate care for some of their adult patients.

Eruptive tooth movements continue throughout life, and are most conspicuously seen in the overeruption of unopposed teeth, and in wear cases, where occlusal vertical dimension is maintained. In the Western population, the numbers of these types of cases are seen with increasing regularity, and an understanding of the effects of these types of movements is important in the management of both the simple and advanced restorative case.

The decision to extract a tooth, which will render the unopposed tooth at risk of vertical positional changes, will be made by members of several dental disciplines, and the possible consequences of this must therefore be appreciated by them all, to aid in both the decision making process, and in the planning of future tooth replacement.

Orthodontists take advantage of this physiological movement at certain stages in corrective treatment, and in the growing patient the extent of this can be fairly predictable. They are equally aware that this predictability is far less in adults. Restorative dentists regularly see what is sometimes a dramatic loss of interocclusal space following an extraction of an opposing tooth. However in order to understand why this takes place a knowledge of the mechanism of eruption is needed.

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Refereed Paper
doi:10.1038/sj.bdj.4811712
Received 20.12.02; Accepted 29.07.03

PURPOSE OF THE REVIEW

This review of the literature was undertaken with a view to increasing the understanding of vertical positional changes that may occur throughout life, including:

- The mechanisms that occur during developmental eruption
- Eruption in the adult
- Factors preventing and limiting eruption, and
- Clinical interventions which may prevent and reverse eruptive movements.

SELECTION CRITERIA

A *Medline* literature search was carried out into the mechanisms of eruption, progress throughout adulthood, physiological factors limiting or modifying eruptive movement and clinical interventions capable of modifying or preventing vertical tooth movement. Key search words were: tooth eruption — physiology, compensatory eruption, overuption, supereruption, supraeruption, hypereruption, axial tooth movement, occlusal vertical dimension, correction of overeruption and Dahl appliance. A total of 433 references were identified from the search.

The vast number of papers on eruptive tooth movement that have been published over the previous century necessitates some criteria for inclusion in this review. Many theories are not yet fully proven and commonly held beliefs cannot be disproved. The review included papers that:

- Were available in English
- Provide clear contemporary evidence
- Form the basis for the commonly taught texts on this subject
- Illustrate limitations of previous studies on which current belief is based
- Suggest hypotheses, backed by strong evidence, but not yet proven

- Suggest clinically useful interventions and recommendations.

Whenever possible human studies were cited, and when animal studies were used their limitations were discussed. Using these criteria 31 papers were selected and are discussed in the following sections.

MECHANISM OF ERUPTION

Eruptive tooth movements are involved in primary eruption, supraeruption, impaction, alveolar compensation following wear, as well as failure of eruption. For the purposes of this paper, eruption into an initial functional position and post-eruptive movement will be considered as two distinct phases of eruptive movement, although some of the mechanisms may be similar.

Meaningful scientific study of eruption is difficult in that tooth structure and eruption vary from one species to another, and that histological studies in humans are rarely possible because of the inaccessibility of tissue for sampling and ethical considerations.

Many of our standard undergraduate texts on eruption rely heavily on the evidence of animal experiments to explain the mechanisms involved in tooth eruption. Whilst providing valuable background knowledge of the processes likely to be involved in eruptive movement, this cannot be directly extrapolated to the mechanisms involved in humans for reasons that will be explained.

ERUPTION

Tooth eruption is defined as the process whereby a tooth moves from its developmental position within the jaws to emerge in the oral cavity. This is usually in an axial direction, but may also occur in other planes during the life of the tooth.

Ten Cate[1] recognized that the process of tooth eruption is not precisely understood, and that text described the four possible mechanisms for eruption, that have been investigated. These are:

1. Root formation, during which space for the growing root is accommodated by occlusal movement of the tooth crown.
2. Hydrostatic pressure within the periapical tissues pushing the tooth occlusally.
3. Bony remodelling
4. Pulling of the tooth in an occlusal direction by the cells and fibres of the periodontal ligament.

Root formation

Clinical experience of the presence of unerupted teeth, showing extensive root development, suggests that root growth alone is unlikely to be responsible for eruption. A study by Marks and Cahill[2] using dogs, showed the tooth itself played no part in the eruptive process. In this investigation tooth germs were removed and replaced with dead crown shells, synthetic substitutes or given no form of replacement. The follicular changes and the path of eruption were no different from that seen in normally erupting teeth, with the exception of the group which used methyl methacrylate replica teeth. The methacrylate substitute group did not erupt, and inflammatory changes were seen in the follicle. Although small sample sizes were used in this study, the results were nonetheless conclusive, and also serve to illustrate that inflammation and disruption of the follicle may impede eruption. This followed on from the earlier study by the same group,[3] designed to assess the relative importance of the gubernaculum dentis, tooth root, tooth crown and the dental follicle in the process of eruption. The dental follicle was found to be the only structure necessary for an eruptive pathway to develop and eruption to proceed. Again, relatively small numbers of subjects produced conclusive evidence. Tooth morphology in the dog is sufficiently similar to that of humans to indicate that this study of primary eruption may also be applicable to humans.

Hydrostatic pressure

A number of studies exist to demonstrate that there is a hydrostatic pressure differential between the tissues investing the erupting tooth crown and its apical extent.

The hydrostatic theory was investigated by Van Hassel and McMinn[4] again using dogs, who found that the tissue pressure apical to the erupting tooth was greater than occlusally, theoretically generating an eruptive force. However, no association was demonstrated between the magnitude of the force and the rate of eruption. This was a relatively small study (six dogs) with fairly crude and invasive methods of measurement, and only compared pressure differentials between the tissues immediately superior to the erupting tooth and the intra-coronal pressure. Less invasive studies, such as those by Moxham[5] in which the tissue pressures were modified pharmacologically, showed changes in the rate of eruption in rabbits, somewhat supporting the hydrostatic theory.

Bony remodelling

The Marks and Cahill[2] study eloquently demonstrated that the dental follicle needs to be present for tooth eruption. Bony remodelling occurs around the erupting follicle regardless of the presence of a tooth crown or tooth, suggesting that the remodelling process may be under the control of the dental follicle. These experiments however, provide no evidence that the follicle is involved in determination of final tooth position.

Periodontal ligament

Ten Cate[1] looked for evidence to support the theory of the periodontal ligament having a major role in determining tooth eruption. Strong evidence exists to show that the periodontal ligament, which is derived from the dental follicle, provides the force required for eruption. The cells thought to be responsible are the fibroblasts within the periodontal ligament, which have contractile potential. An early paper by Ten Cate *et al.*[6] discussed the role of fibroblasts in the remodelling of the periodontal ligament, citing various studies indicating the role of fibroblasts in phagocytosis during re-modelling, increased fibroblastic activity during eruption and the distribution of fibroblasts within the periodontal ligament as indicators that fibroblasts play a key role in physiologic tooth movement. Although informative, this study consisted of histological observations, and did not provide sufficient data on the origins of the tissues studied (ie species, age, whether eruption was occurring) to enable the reader to accurately extrapolate the findings to eruptive tooth movement in humans. Ten Cate's theories have been further studied by Berkovitz,[7] who also agreed that no one hypothesis can fully explain the mechanism of tooth eruption. He proposed a multifactorial concept of tooth eruption, which embraces Ten Cate's favoured theory of fibroblast contraction, although recognising the limitations of *in vitro* tissue studies. He also noted that there was no difference in the quantities of metabolic structures within fibroblasts found in the periodontal ligament of rapidly erupting teeth from those of fully erupted teeth. Berkovitz concluded that there is no evidence that one hypothesis fully explains tooth eruption, and that eruption is likely to be a multifactorial process.

CONTROL OF ERUPTION

Hormonal control mechanisms

Risinger and Proffit[8] investigated premolar eruption in human subjects and determined that a circadian rhythm of eruption existed. Using detailed monitoring of physiological changes, the rate of eruption was measured over an 11-hour period. The methods used were accurate and the eruptive state of the teeth under investigation was less than half erupted, as previous studies had shown that eruption was most rapid in the earlier stages of eruption. The authors concluded that eruption was probably under hormonal control, most likely due to the effects of the late evening secretion of growth hormone and thyroid hormone. Most eruption occurred in late evening, although intrusion tended to occur in the early hours of the morning. There appeared to be no association with haemodynamic changes or functional activity. It would be erroneous to assume that eruptive movement is only present in children and adolescents with developing occlusions, although the rate and control mechanisms may vary.

A study by Leache *et al.*[9] of children with growth deficit concluded that children with delayed growth due to growth hormone deficit or low genetically determined height had delayed tooth eruption. However those with delayed growth for other reasons show normal dental development. This was a large study of children who were shorter than average for their chronological age, although the numbers in each group studied were relatively small. Larger studies are required to support these findings and provide more substantial evidence for the role of growth hormone in eruption.

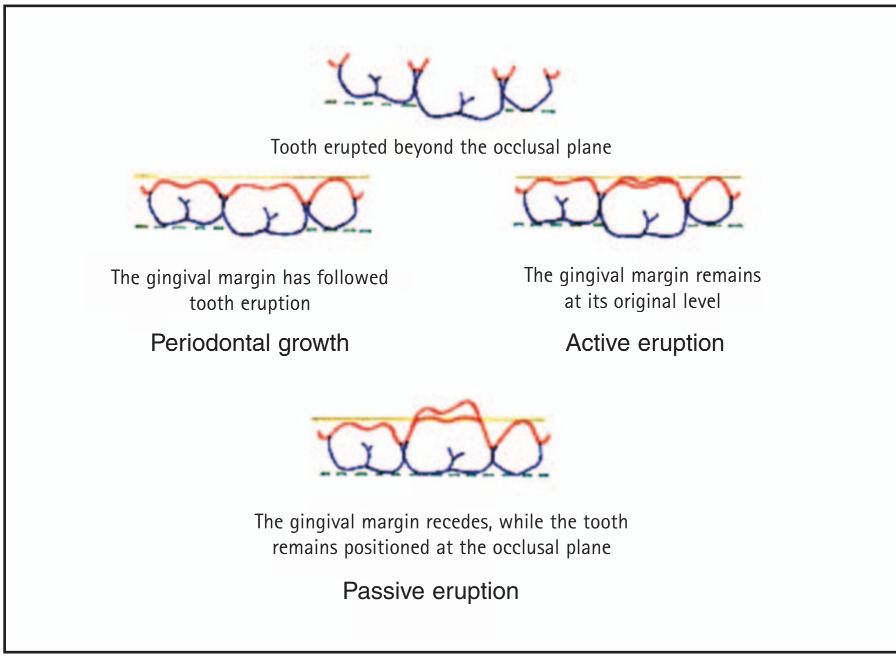

Fig. 1 Classification of eruption/overeruption (after Compagnon and Woda, 1991)

Physical control mechanisms

A number of both animal and (relatively few) human studies have been carried out to determine the forces generated during eruption in order to propel the tooth towards the occlusal plane.

Gierie *et al.*[10] studied the effects of force application to erupting human premolars. This was a relatively small study, (only eight child subjects). Although very accurate measurement was possible, there were difficulties in observing changes over a prolonged period of time due to the somewhat uncomfortable nature of the measurement conditions. The teeth observed were seen to undergo periods of eruption and intrusion. Light intermittent forces such as those produced by soft tissue or muscular contact, were capable of deflecting or halting eruption although they did not increase the rate of intrusion during the intrusive phases. This fits well with the Equilibrium Theory postulated by Weinstein *et al.*[11] 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. These forces are likely to arise from the oral musculature, soft tissue pressures, masticatory forces, and eruptive force. Habits involving extra-oral foreign bodies such as pencils and digits may also have an effect.

POST-ERUPTIVE MOVEMENT

Compagnon and Woda[12] studied the unopposed upper first molar in both healthy mouths and those with some periodontal pathology present. This study involved 85 adult subjects between the ages of 18 and 45, although there are some ambiguities in the number of subjects within each group and a small difference in the upper age limit between groups. The results indicated that the majority of overeruption occurred in the early years following opposing tooth loss. In later years loss of periodontal support may be superimposed on the picture. 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. The study found that after 10 years of remaining unopposed, this periodontal migration reversed and root exposure occurred. Compagnon and Woda described this as passive eruption, (as distinct from active eruption where the tooth continues to move in an occlusal direction in the absence of periodontal growth). From these findings it is obvious that the appearance of over-eruption may have several components, including periodontal growth, passive eruption and active eruption. These are shown diagrammatically in Figure 1.

Not all the groups examined were similar in terms of the time since extraction of the opposing tooth, and some of the results may need to be treated with caution for several reasons. The group with evidence of periodontal disease only comprised ten subjects. The groups investigated were relatively small and the measurement methods were crude. No measure of examiner reliability was mentioned.

Other human studies of post-eruptive movement centre on the maintenance of occlusal face height following tooth wear. The use of post-mortem specimens of ancient and primitive populations where tooth wear was widespread has produced interesting, though limited findings.

An anthropological study by Kerr and Ringrose[13] found that, in order to maintain occlusal vertical dimension, teeth continue to erupt and expose root surface in the absence of breakdown due to periodontal disease. It is open to question however, how periodontal disease, other than bone loss, could be assessed on the dried skulls.

It has long been recognised that the width of attached gingivae increases with age. Ainamo and Talari[14] compared the widths of attached gingiva in two subject groups, 20 in each group, using radiographs to compare the relative distances between the lower border of the mandible, the muco-gingival junction and the cemento-enamel junction. They found that the distance from the muco-gingival junction to the lower border of the mandible remained constant, but the distance from the muco-gingival junction to the cemento-enamel junction increased with age, indicating a continued eruptive tendency of teeth. It is unlikely that this study could be repeated in today's climate of radiation dosage limitation as it relied heavily on the use of marked orthopantomograms. The number of subjects would be regarded as low by today's standards.

The effect of the loss of an antagonist on tooth eruption was investigated by Ainamo and Ainamo[15] looking at the change in the width of the attached gingiva. Again a very small sample size (13 subjects) was used and the authors noted that unopposed teeth continue to erupt following the loss of an antagonist, with the supporting structures also developing vertically to follow tooth eruption. These patients were mainly middle aged. Loss of an antagonist in younger patients (mean age 21–22 years) following orthodontic extraction was observed by Smith.[15] This study incorporated a larger subject group (42 subjects) and the results were compared with an age and sex matched control group. Measurements were also assessed for reliability. Overeruption of the unopposed teeth was found to be statistically significant, and the problem was mainly confined to the distal aspect of the teeth due to tilting. The findings refuted previously held beliefs that tooth position can be maintained by partial occlusal contact, as the study demonstrated that tilting was likely to occur if only partial occlusal contact was maintained mesially with the distal portion of the occlusal surface of the opposing first molar.

Kiliaridis *et al.*[16] identified that overeruption greater than 2 mm occurs in 24% of unopposed teeth, with 18% having no demonstrable overeruption at all. This leaves a group demonstrating some overeruption of 82%, which in terms of restoration could have a clinical significance. As there was no measurement of the overeruption beyond 2 mm, it is conceivable that within these 24% of subjects, some overeruptions may have been extreme. Measurements were made directly on models of the dentition using a fairly crude method, although reproducibility was found to be good. This study has several flaws in that measurement of overeruption was made from straight lines drawn between points, rather than the anatomically determined occlusal curve.

LIMITATIONS OF ANIMAL STUDIES

Many experiments on the mechanisms and rate of tooth eruption have been carried out on other species, mainly rats and rabbits, whose teeth are continuously growing and are anatomically different to the teeth of primates. Steedle and Proffit[17] described three distinct types of mammalian tooth eruption.

1. Continuously growing
2. Continuously extruding
3. Continuously erupting

Anatomically, the continuously growing tooth (Fig. 2) is different from the other two categories in that there is no distinction between the crown and the root structures. The fact that growth is continuous and rapid in these teeth makes them useful for eruption studies, as well as the ease of availability and housing of these small animals. However, because new root formation continues throughout life at a rapid rate, there is no evidence available to show that the histological mechanisms are the same in all species, and therefore the relevance to mechanisms occurring in humans is questionable.

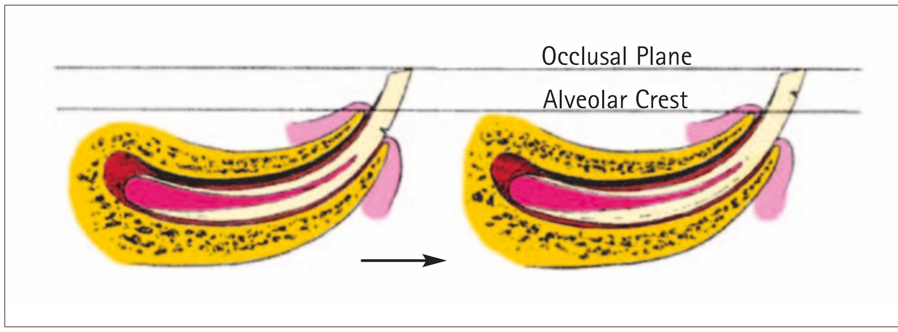

Fig. 2 The continuously growing tooth

The continuously extruding tooth (Fig. 3) will ultimately extrude from the alveolar supporting tissues, exposing an increasing amount of root surface. In species where there is a marked differentiation into crown and root, there will be an occlusally directed movement of the amelocemental junction. This type of eruption is found in grazing animals such as sheep and cattle. Attrition in animals results in the eventual loss of teeth towards the end of their life. It is also seen to some extent in humans. Figure 3 shows a constant occlusal plane, stabilised by tooth wear. However, if the tooth were unopposed, overeruption would be seen.

In the continuously erupting tooth, the alveolar supporting structures follow the occlusally directed development of the tooth, and no exposure of root surface is seen. When wear takes place, the occlusal level may remain constant, with the alveolar bone becoming closer to the occlusal plane (Fig. 4).

Both of the latter types of eruptive movement are seen in humans and are described by Compagnon and Woda[12] using different descriptive terms.

Primate studies may provide us with data most closely applicable to humans. Anneroth and Ericsson[18] conducted a study on 28 monkeys, with a dentition closely resembling that of man. This involved a split mouth trial of tooth positional changes following the extraction of a first molar. During the 2-year follow-up period overeruption occurred in all cases, with no change in attachment levels. Studies such as this on animals with similar dentitions and occlusal arrangement to humans produce a much more accurate model of the probable outcome in humans, yet are still not directly transferable.

PREVENTION OF OVERERUPTION

The work of Gierie *et al.*[10] demonstrated that intermittent light forces can prevent the eruption of an actively erupting tooth and it is a commonly held belief that similar intermittent forces generated during chewing against an antagonst will have the same effect. On this basis, the replacement of an extracted tooth with a fixed or removable prosthesis would prevent the overeruption of its antagonist provided it was carried out before vertical movement had taken place and this principle is described in current undergraduate and postgraduate texts (Davenport *et al.*[19] and Pameijer[20]).

Another option for dealing with an unopposed tooth would be to remove it, should it not be a key tooth for future restorative options. This principle is well illustrated in the concept of the 'shortened dental arch' as described by Kayser.[21]

A more novel concept, described by Solnit *et al.*[22] employed an etched metal splint to bond the unopposed tooth to its

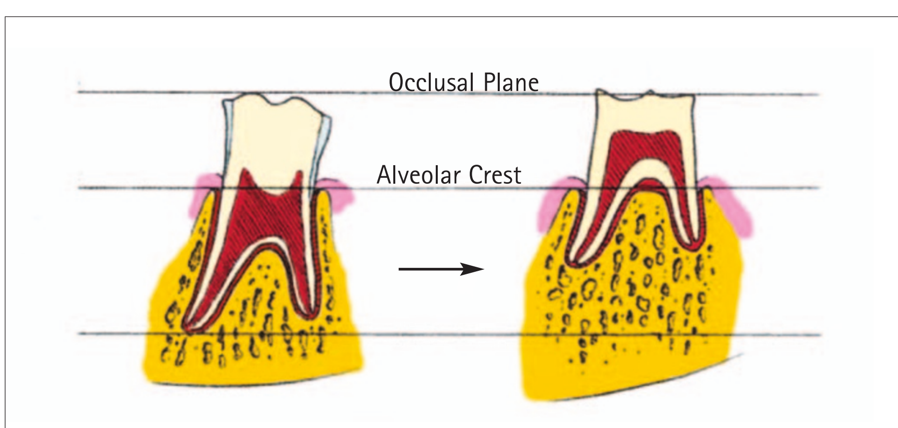

Fig. 3 The continuously extruding tooth

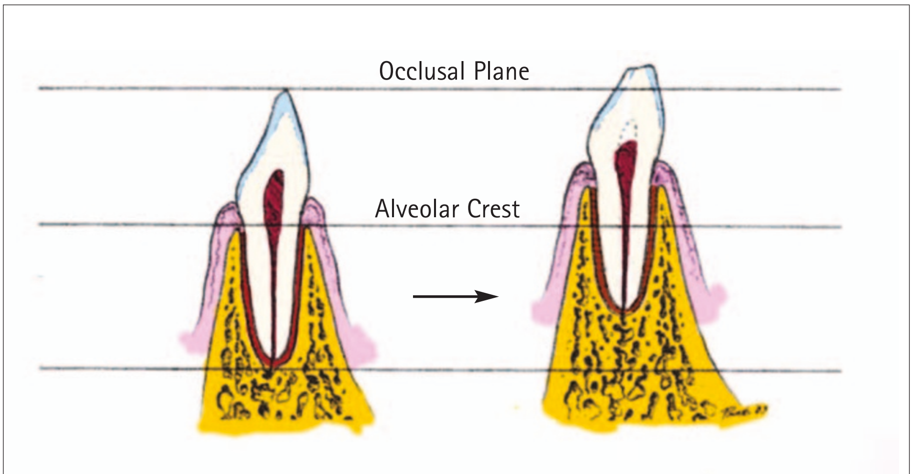

Fig. 4 The continuously erupting tooth

adjacent opposed tooth. Provided the bond between the teeth remains intact this should theoretically prevent overeruption.

Jepson and Allen[23] suggested the use of adhesive distal cantilever bridges to increase the length of shortened dental arches to improve function and aesthetics. An additional use for this type of appliance could be to stabilise the tooth position following extraction and prevent undesirable eruptive movement.

The main considerations to be made when deciding on the necessity of preventing vertical tooth movement could include:

1. Is the tooth a key tooth for future restorative options?
2. Has the tooth remained unopposed for some time without signs of overeruption?
3. Would the overeruption of the tooth present restorative or occlusal difficulties?
4. Overall state of the dentition.
5. Patient preferences and tolerance.
6. Aesthetic considerations.
7. Other planned restorative treatment for the unopposed tooth and the edentulous space.

In many cases the dentist may encounter a situation requiring prosthetic restoration where the tooth has already overerupted to some extent. In this case the options for correction need to be considered. In cases of moderate movement, the overerupted tooth may be safely reduced in length, although where a greater degree of overeruption is encountered repositioning of the tooth may be necessary.

CORRECTION OF OVERERUPTION

Conventional orthodontic treatment adequately corrects many overeruptions, but tends to be more acceptable to children and adolescents than adults, mainly due to peer pressure and aesthetic considerations. Other orthodontic corrections may be indicated in young patients and the correction of overeruption can take place alongside other planned tooth movements. Leveling of the arch, which is the first stage in straight wire fixed orthodontic treatment, often deals with overeruptions without any specific movements of these teeth. There are a number of novel approaches to the orthodontic correction of overeruption in adults. Gazit *et al.*[24] reported on a treated adult case where all the interocclusal clearance for prosthetic replacement of missing teeth was lost to overeruption. Interocclusal space was created by the intrusion of several mandibular teeth with fixed orthodontic therapy. In adults, the need for orthodontic repositioning may be due to teeth drifting following loss of periodontal support. A particularly useful case report by Steffensen and Storey[25] describes the intrusion of an incisor with a fixed/removable orthodontic appliance, following the elimination of active periodontal pathology. Following treatment a good level of periodontal attachment was maintained. It must be recognized that these are merely case reports and not controlled studies, and further research is needed in this area.

As already intimated, the wearing of conventional orthodontic appliances by adults is not always acceptable. The orthodontic ‘intrusion’ of lower incisors using a bite plane is a well accepted, and generally successful, way of reducing an increased overbite. This principle has been adopted in the development of the ‘Dahl’ appliance in the treatment of tooth wear. This was initially a single case described by Dahl *et al.*[26] where an anterior bite plane was placed between the upper and lower incisors, and they concluded that the interocclusal space gained between the incisors after wearing the appliance, was due not only to incisal intrusion, but also caused by the eruption of the posterior segments. This group performed two further studies into the effect of increasing the occlusal face height in adults using this type of appliance. The findings of their 1980 study,[27] investigating 20 patients with attrition, were that intrusion was on average 1.05 mm and eruption was1.47 mm, and that more eruption than intrusion appeared to take place in the younger subjects. They also noted that the use of the splint did not initiate symptoms of TMD and was well tolerated by the wearer. The methodology relied on measurement of radiographic reference points located with metallic implants, before and after appliance treatment, and did not appear to have good inter-examiner reliability. It was suggested that this was caused by difficulties in agreeing reference points on the implants. This study did highlight large differences between subjects in intrusion and eruptive potential. Dahl and Krogstad[28] observed the effects of permanently increasing the occlusal vertical dimension in adults, over a five and a half year period. In some cases there was a reduction in the initial increase in vertical dimension, but in no case did the OVD return to its pre-treatment level. Again, no precipitation of TMD occurred in the patients involved.

Other workers have sought to modify and improve on the basic Dahl appliance described above. Briggs *et al.*[29] described the original removable metal onlay appliance, a fixed modification using metal adhesive anterior onlays, and definitive restorations prepared at an increased vertical dimension. The authors stressed the need for further study into this concept. Ricketts and Smith[30] mentioned the above treatment options and provide the clinician with a useful means of measuring and monitoring the relative axial tooth movement taking place. Another variation on the Dahl appliance is described by Gough and Setchell,[31] this time producing axial tooth movement in both anterior and posterior teeth. These authors reported on observations in 50 adult subjects and found that:

1. 94% of patients had no pulpal symptoms in the treated teeth, although 2% had symptoms requiring endodontic treatment.
2. 4% of the teeth suffered loss of vitality.
3. 94% of patients reported no new TMD symptoms.
4. 10% of patients reported mild periodontal symptoms in the form of tenderness on biting.

The overall success rate for this treatment group was 96%, appearing to make this procedure very predictable in its outcome. The duration of treatment was from 0.93 to 24 months with a median of 5.9 months. This study was a retrospective clinical audit, with no randomisation of subject selection, and which did not quantify the total relative tooth movement. There was a mixture of fixed and removable appliances, and the relative efficacy of each was not stated. Only 16 subjects were undergoing treatment for the distortion of the occlusal plane following undesirable eruptive changes. Further work in this area would add weight to these findings, and give guidance as to which patients would most benefit from this type of appliance.

In all of the papers using anterior 'Dahl' appliances, a flat cingulum surface was designed to permit vertical transmission of occlusal forces down the long axis of the tooth, to prevent proclination or forward drifting of the teeth. This is highlighted clearly by Briggs *et al.*[29]

It would appear that we can expect overeruption to be the norm when opposing teeth are lost[16] and this has the potential to significantly reduce the space available for fixed or removable tooth replacement. Traditional methods of dealing with this problem have the potential disadvantages of being either very destructive (crowning to a new occlusal plane) or protracted (orthodontic treatment).

More novel techniques appear, from the limited data available, to be associated with few complications, are relatively simple and are also less expensive. As with most conditions however, prevention of the problem arising is often the best solution and this review aims to raise awareness of the complications of overeruption and preventive measures, by the profession.

Fig. 5 Periodontal growth altering aesthetics and available space for restoration

Fig. 6 Active eruption with dentinal exposure UL6 (26)

SUMMARY

Two types of post-eruptive tooth movement may take place:

- Periodontal growth, where the attachment apparatus moves in an occlusal direction with the tooth.
- Active eruption where the tooth erupts and the attachment apparatus comes to lie apically to its original position.

Both of these scenarios may create problems in restoration. Periodontal growth may change the dento-gingival proportions, creating changes in aesthetics that may be unacceptable to the patient and difficult to correct (Fig. 5). The exposure of dentine and cementum, and the changing cervical morphology may complicate treatment in the latter scenario (Fig. 6).

Although when viewed individually many of the studies on tooth eruption appear weak, the evidence as a whole suggests interesting concepts to be considered by members of all dental disciplines. Further research is needed to support existing evidence, and current ethical guidelines may prevent the repeat of early studies involving x-ray exposure and invasive procedures. In any literature review, the reader needs to be aware of publication bias, ie only positive findings tend to find their way into publication, and many studies never reach the public forum.

From the evidence reviewed in this paper, several trends appear:

1. Eruption is both a developmental process, bringing an erupting tooth into its functional position, and an adaptive process, maintaining occlusal vertical dimension following wear.
2. Primary eruption appears to be controlled by the secretion of growth and thyroid hormones, there is no evidence as to whether this is the case in post-eruptive tooth movement.
3. The dental follicle, from which the periodontal ligament is derived, is essential to the eruptive process.
4. A cyclical pattern to eruption, involving both eruption and intrusion at different times of the day, seems to occur.
5. Eruption may be halted or reversed by intermittent or continuous force application.
6. Direction of eruption may be modified by uneven application of occlusal loading during eruption.

Bearing in mind the processes involved in eruption outlined in this paper, dentists may well wish to use some of the techniques described to predict, prevent, modify or treat undesirable tooth movements, and thereby create a mechanical and biological environment more conducive to successful restorative treatment. Awareness of the likelihood of undesirable tooth movement following the loss of an antagonist, may encourage practitioners to plan for the sequelae of tooth loss, or perhaps counsel their patients in the benefits of avoiding extraction.

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