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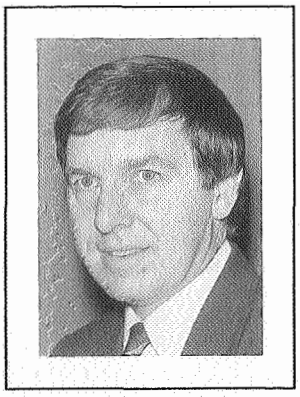

Interproximal reduction in the molar/premolar region: the new approach

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ABSTRACT: Interproximal reduction in molar and premolar region is discussed and the questions of the amount of enamel that can be removed, the effect of fluoride on the altered tooth surface, the periodontal considerations and the effect on pulp tissue of cutting enamel are addressed. Moreover a fine diamond bur suitable for air-rotor stripping of posterior interproximal enamel is also described.

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MeSH words: tooth abrasion;
Key words: air-rotor stripping, reproximation, diamond bur

INTRODUCTION

The development of resin bonded full arch orthodontic appliance systems has allowed the interproximal surfaces of all teeth to be available for reduction at any time. In the past, interproximal stripping has usually been restricted to hand-held abrasive strips (e.g. tooth stripper, Lancer Pacific Inc., Carlsbad, California, USA), handpiece mounted rotating diamonds (e.g. Horico, Hopf, Ringleb and Co., GMbH and CIE, Berlin, West Germany) and abrasive discs (e.g. Sof-lex, 3M Australia Pty Limited, Sydney, Australia).

Sheridan (1985, 1987) has advocated a technique where the interproximal enamel is removed to create space with commercially available water-cooled tungsten carbide burs in an air-rotor handpiece (Air-Rotor Stripping - ARS). This procedure uses a lateral approach (buccal or lingual) to the interproximal area. The amount of enamel reduction can be directly correlated with the amount of crowding pre-existing in a malocclusion such that a predetermined amount of space can be created and the case treatment planned accordingly: for example, the use of a diagnostic set-up as first proposed by Kesling (1956). However, for successful orthodontic reproximation, the altered tooth surfaces should resemble the original interproximal morphology with regard to marginal ridge height, embrasure form and contact with approximal teeth. It should differ only in overall reduction in the mesiodistal width of the altered tooth. This is necessary so that successful occlusal function can be maintained and no deleterious gingival or periodontal effects are produced (for example, food impaction areas brought about by reducing the occlusal height of the contact area).

In practice, it is soon apparent that the lateral approach (buccal or lingual) to the interproximal area is difficult and considerable risk of notching the teeth interproximally exists. Moreover, there is no way of ensuring that the smooth integrity of the enamel surface, so necessary for tooth and periodontal health, can be guaranteed.

The author has described (Jarvis 1989*a*, 1989*b*) an occlusal approach for the alteration of posterior tooth morphology (distal surface of canine to mesial surface of first molar) using a high speed air-rotor and a customised tungsten carbide bur, followed by a finishing system developed for ease of operation (Sof-lex XT series finishing discs - 3M Australia Pty Limited, Sydney, Australia). The enamel surface finish has been demonstrated to be most satisfactory and the occlusal approach easier and less likely to harm the tooth than the alternative technique proposed by Sheridan (1985, 1987). This paper addresses the questions of the amount of enamel that can be removed, the effect of fluoride on the altered tooth surface, periodontal considerations and the effect on pulp tissue of cutting enamel. Moreover, a soon to be available commercial bur (Komet - Gebr. Brasseler GmbH & Co. KG Fabrik fur Dentalinstrumente 4920 Lemgo 1 West Germany) and its application are also described.

THE AMOUNT OF ENAMEL WHICH CAN BE REMOVED

A general consensus exists amongst authors that only half the enamel thickness should be removed when stripping interproximally (DiPaolo and Boruchov 1971; Peck and Peck 1975; Reidel 1975, 1976; Zachrisson 1978; Betteridge 1979; Tuverson 1980; Boese 1980; Joondeph and Reidel 1985; Camilla Tulloch 1986). If further trimming is to be undertaken, it is thought by some authors that discolouration, increased sensitivity to thermal changes and a predisposition to decay may be produced (Reidel 1976; Boese 1980). If this arbitrary value is to be accepted, proximal stripping is limited to the thickness of the enamel on each tooth at its contact point. This enamel thickness is known to vary between individual teeth and even individual tooth surfaces and hence a means of assessing this thickness needs to be available. An easy way to assess this thickness is to use X-rays, as suggested by DiPaolo and Boruchov (1971), Goldman and Cohen (1980), Sheridan (1985) and Joondeph and Reidel (1985). Sheridan (1985) uses bitewing X-rays and believes that the thickness of the interproximal enamel can be estimated by projecting a line vertically from the cervical line of the tooth to the occlusal or incisal plane. Sheridan (1985) also cites Shillinbourg and Grace measurements and states that a 0.8mm reduction per tooth surface is possible. However, it should be appreciated that, as larger amounts of enamel

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are removed, the risk of inadvertently involving dentine is also increased. It is for this reason that an amount of 0.5 mm per tooth surface is advocated by the author (Jarvis 1989*a*, 1989*b*) as the optimum for interproximal reduction purposes.

THE EFFECT OF FLUORIDE ON THE ALTERED TOOTH SURFACE

Interproximal reduction requires the removal of a part of the outer enamel surface of the tooth. This new outer surface of sound enamel, differs only slightly in mineral composition (Verbeek 1986) from the original surface. This new sound enamel surface will take up fluoride if the fluoride is applied topically (Ogaard and Rolla 1986), and retain considerable amounts of it in the form of calcium fluoride. This new outer surface may also end in part of a subsurface lesion which is probably not clinically detectable since early subsurface demineralisation is not apparent in bitewing radiographs (Kidd 1986). Such a subsurface lesion can, if recognised, be remineralised by saliva alone, providing it is kept clear of bacterial plaque. However, the presence of fluoride increases this remineralisation (Ten Cate 1983) and it is known that enhanced remineralisation (Featherstone et al. 1986) is dependent on the fluoride concentration. The Featherstone studies also supported the concept of frequent (daily) applications of low concentrations of fluoride, even in situations of high caries challenge, so that remineralisation is enhanced and demineralisation is inhibited.

From this it can be inferred that frequent plaque removal and local availability of fluoride in the altered interproximal area will tend to arrest any early cariogenic process if present, and convert the area of susceptibility to an area of resistance. However, if plaque cannot be removed (due to a rough or notched surface), it is unlikely that fluoride will have the same effect (Zachrisson 1987).

PERIODONTAL CONSIDERATIONS

The long-term effects of orthodontic treatment on the periodontium have been investigated (Sadowsky and BeGole 1981, Kennedy et al. 1983, Polson and Reed 1984), but no difference in the level of periodontal attachment between treated and untreated persons, or difference in the level of crestal bone between study and control groups has been found. However, Pritchard (1975), Hatasaka (1976) and Kessler (1976) suggest that malposed or rotated teeth may predispose to a more rapid breakdown of the periodontium. This is because they believe that an adequate space between the teeth at the level of the crestal bone is necessary for continued gingival health, particularly where roots are in close proximity and result in a thin interproximal bony septum. This interpretation has resulted in a general belief that inherent danger exists in interproximal reduction whereby orthodontic reproximation could reduce the amount of trans-septal bone between teeth and predispose these areas to periodontal disease (Klassman and Zucker 1969, Hatasaka 1976, Boese 1980). However, until recently (Artun et al. 1986, 1987), no one has attempted to correlate long term periodontal health or tissue destruction with the thickness and configuration of the alveolar bone. These authors found that for anterior teeth 'no statistically significant differences in inflammation, levels of attachment, and bone level were observed between root proximity sites and control sites' and conclude that anterior teeth are not predisposed to more rapid periodontal breakdown when tooth roots are in close proximity. To date, there are no long-term studies that have looked at the effects of root proximity and periodontal health in posterior teeth. In the Artun et al. (1986, 1987) study of 400 patients, only two posterior root proximity sites were recorded, and these authors state that a larger sample is necessary to confirm or disprove the findings for posterior teeth, particularly in view of the fact that the bony architecture, crown form, root morphology and shape of interproximal contacts are different between anterior and posterior teeth. Pritchard (1975) and Hatasaka (1976) also state that a difficulty in curetting the root surface in molars may result in a poor prognosis when periodontitis is involved. However Nyman et al. (1984) using dogs as an experimental model found, in a short-term study (six months), that the presence of bone does not imply an increased resistance to the progression of periodontal disease. This tends to support the hypothesis that a thin bony septum alone, resulting from roots being brought closer together by reproximation, does not predispose a patient to an increased risk of periodontal disease.

THE EFFECT ON PULPAL TISSUE OF CUTTING ENAMEL

Enamel reduction of a tooth is easily accomplished using high speed, high torque dental handpieces and the appropriate cutting burs.

While the effects of cavity preparation on a tooth are well documented in numerous texts (e.g. Brannstrom 1981), the effect on the pulp of cutting enamel only, for the purpose of remodelling teeth, has had little investigation. Zachrisson and Mjor (1975), using premolar teeth that were to be extracted for orthodontic purposes, found that there were no histological changes observed in the pulps of teeth that had undergone enamel grinding (providing that the enamel grinding was carefully done using abundant water cooling). This view on the effect on the pulp of grinding enamel is still maintained by the author (Zachrisson 1987), however, he points out that damage to the pulp can occur if the surfaces have been notched and are not readily cleanable. This pulpal inflammation, which he attributes to notching, is brought about by plaque retention and hence damage to the enamel surface and subjacent dentinal tubules which results in the minor pulpal irritation observed, (odontoblast nuclei displaced into dentinal tubules, increased number of blood vessels, distinct cell-free zone not discernible, slight infiltration of inflammatory cells).

Sheridan (1985) states that there are no studies that indicate how much enamel is needed for adequate protection of the tooth against carious, thermal or chemical damage. He further suggests that the natural variation in the thickness of enamel over the tooth surfaces (e.g. comparatively thin enamel occurs on parts of the labial, buccal and lingual surfaces) indicates that there is no protective advantage of preserving thick enamel interproximally. It is known that ground enamel, if exposed to the oral environment, will acquire the same properties as normal surface enamel (van der Fehr and Steiness 1966); presumably this is due to the ionic exchange that occurs within the oral environment (Woltgens 1986). From the above it may therefore be concluded that the grinding of enamel, leaving readily cleanable enamel surfaces exposed, is not harmful to the teeth.

REPROXIMATING POSTERIOR TEETH

Indications and contraindications for reproximating posterior teeth have previously been explained (Jarvis 1989*a*). What needs to be emphasised is that reproximation of posterior teeth is not without considerable risk and numerous precautions need to be taken. Such risks are those associated with impaired function (food impaction and poor marginal contacts) resulting from an imprecise or careless approach to reduction. Over-zealous reduction may promote caries (the

creation of ledges on the interproximal surfaces which are unable to be cleaned), cause colour changes (if a pulp irritation is sufficient to cause extensive secondary dentine deposits), or result in an increased difficulty in scaling and flossing of the teeth, increasing the risk of periodontal disease. This over zealous reduction may also result in the placement of subgingival contact areas on the reproximated teeth. Ideally these areas should be placed so that the contact area is approximately 1mm above the gingival papilla. If not, the reduced space for the interproximal papilla causes the gingival tissue to be evicted from between the adjacent teeth, creating an oversized col similar to that obtained with overcontoured crowns (Takei 1980, Becker and Kaldahl 1981). The long-term effect of this gives rise to a deepened interproximal col (a non-keratinised area thought to be more susceptible to plaque - Hagen and Osborne 1967) giving rise to possible pocket formation and periodontal disease. Consideration also needs to be given to those teeth which exhibit approximal hypoplasia and hypocalcification in order that iatrogenic dentine involvement will not occur.

POSTERIOR INTERPROXIMAL REDUCTION USING A CUSTOMISED FINE GRIT DIAMOND BUR

The shape of a customised tungsten carbide bur suitable for an occlusal approach to posterior interproximal reduction has previously been described (Jarvis 1989*a*, 1989*b*). The shape of this bur has the inherent advantage of minimising the likelihood of gingival relocation of the contact area. While this bur exhibits considerable advantages over the previously described system for posterior interproximal reduction (Sheridan 1985, 1987) it does have a reduced cutting efficiency which results in an increase in clinical time. In order to overcome this, an ultrafine diamond bur (custom-made by Komet - West Germany) has been obtained (*Figure 1).*

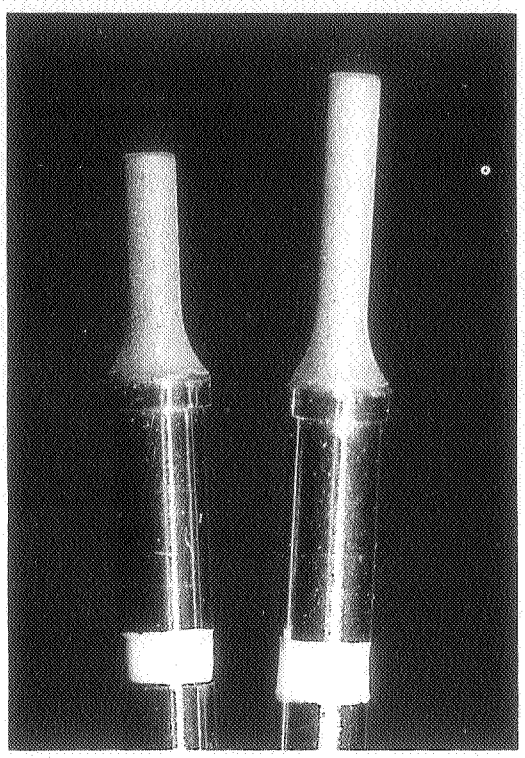

Figure 1. Prototype of a fine diamond bur suitable for an occlusal approach for air-rotor stripping of posterior teeth (developed by Komet-West Germany). Left, the short version (2.5mm in length); right, the longer version (4mm in length).

It has a diameter of 0.9mm and is available in two lengths 2.5mm and 4mm. The stepwise technique for interproximal reduction is described as follows :

1. Alignment - it is imperative for cases of posterior interproximal reduction that the posterior arch form is aligned, all posterior derotations have taken place and marginal ridges are confluent (there is no need to align anterior teeth at this stage). (*Figure 2a)*
2. Interproximal separation 0 modules are placed -(Alastic - Unitek Corporation Montovia, California, U.S.A.) 3-4 days prior to interproximal reduction. N.B. It is not necessary to remove the archwires. (*Figure 2b).* The placement of these separating modules has the advantage of displacing the tissues so that there is less likelihood of tissue trauma.
3. Careful interproximal reduction is carried out using an occlusal approach with a bur of appropriate length in a high speed air-rotor with adequate cooling. The shoulder of the bur is held against the marginal ridge so that the marginal ridge form is maintained and the contact area is not gingivally relocated. This reduction can be staged (one interproximal area at a time) or all interproximal areas altered at the one appointment (*Figure 2c).* Following passage of the diamond from buccal to lingual, care being taken to avoid a sliced preparation, the morphology of the buccal and palatal surfaces of the teeth is then recontoured. Special care must be taken with the distal surface of canines, and it is essential to use the longer bur and not seat it against the marginal ridge. A straight bur of similar grit may be used in such situations. This new enamel surface is then refined using extra-fine finishing discs (Sof-lex XT 3M Australia Pty Limited, Sydney Australia).
4. Conventional orthodontics are used to close the spaces obtained (*Figure 2d).*
5. Even if archwires are removed for interproximal reduction it still may not be possible to appropriately contour the buccal and lingual surfaces of the altered teeth while the brackets are in position. Therefore the buccal and lingual/palatal morphology of the altered teeth needs to be further considered at the time of debonding.

DISCUSSION AND CONCLUSIONS

Certain controversies regarding posterior reproximation have been addressed, namely: the effect of fluoride on the altered tooth surface, periodontal considerations and the effect on pulp tissue of cutting enamel. Further questions will need to be addressed if this technique gains acceptance. These will include : who is most suitable to attend to this procedure, whether the procedure should attract a particular fee schedule, and how such a fee schedule should be applied. With regard to the question of who is most suitable, it is the author's opinion that the technique is suitable for restorative dentists (trained in occlusal crown preparation) who are experienced in maintaining axial crown inclinations, and that orthodontists, less experienced in this field, would do well to consider embarking on some refresher time in high speed techniques prior to contemplating A.R.S., as this procedure is not reversible and the potential for considerable damage exists. However, as the technique evolves, it is hoped that either the general dentist or the orthodontist will be capable of carrying out this procedure.

REFERENCES

ARTUN,J., OSTERBERG,S.K. and KOKICH,V.G. (1986)
Long term effect of thin interdental alveolar bone on periodontal health after orthodontic treatment
J.Periodontol.57:341-346

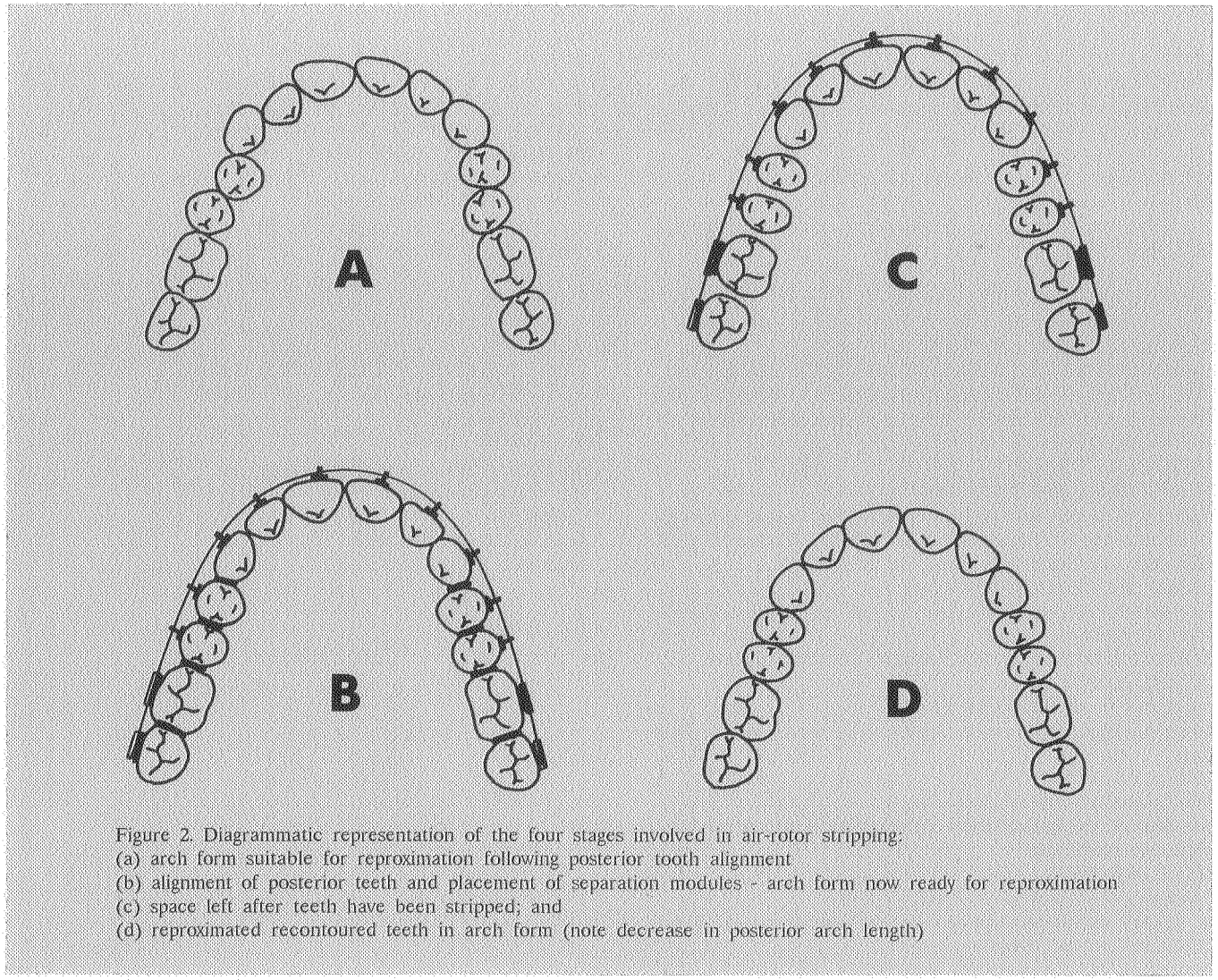

Figure 2. Diagrammatic representation of the four stages involved in air-rotor stripping:
(a) arch form suitable for reproximation following posterior tooth alignment
(b) alignment of posterior teeth and placement of separation modules - arch form now ready for reproximation
(c) space left after teeth have been stripped; and
(d) reproximated recontoured teeth in arch form (note decrease in posterior arch length)

ARTUN,J., KOKICH,V.G. and OSTERBERG,S.K. (1987)
Long term effect of root proximity on periodontal health after orthodontic treatment
Am.J.Orthod.91:125-130
BECKER,C.M. and KALDAHL,W.B. (1981)
Current theories of crown contour, margin placement and pontic design
J.Pros.Dent.45:268-277
BETTERIDGE,M.A. (1979)
A method of treatment for incisor crowding
Brit.J.Orthod.6:43-48
BOESE,L.R. (1980)
Fiberotomy and reproximation without lower retention, nine years in retrospect
Part 1 Angle Orthod.50:88-98, Part 2 50:169-178
BRANNSTROM,M. (1981)
Dentine and pulp in restorative dentistry
Nacka, Sweden: Dental Therapeutics A.B.
CAMILLA TULLOCH,J.F. (1986)
Adjunctive treatment for adults
In: Contemporary Orthodontics. Ed - W.R. Proffit
St Louis: The C.V. Mosby Co. p493
DiPAOLO,R.J. and BORUCHOV,M.J. (1971)
Thoughts on stripping of anterior teeth.
J.Clin.Orthod.5:510-511
FEATHERSTONE,J.D.B., O'REILLY,M.M., SHARIATI,M. and BRUGLER,S. (1986)
Enhancement of remineralisation in vitro and in vivo.
In: Factors relating to remineralisation and demineralisation of teeth.
Ed.- S.A. Leach
Oxford: IRL Press Ltd. p23-34
GOLDMAN,H.M. and COHEN,D.W. (1980)
Periodontal therapy
6th ed. St Louis: The C.V. Mosby Co. p1010-1013
HAGEN,G. and OSBORNE,R. (1967)
Relationship of operative dentistry to periodontal health
Dent.Clin.North Am. 11:245-254
HATASAKA,H.H. (1976)
A radiographic study of roots in extraction sites
Angle Orthod.46:64-68
JARVIS,R.G. (1989a)
Interproximal reduction: A restorative adjunct to orthodontic procedures: Part I
Aust.Prosth.J.3:51-56
JARVIS,R.G. (1989b)
Interproximal reduction: a restorative adjunct to orthodontic procedures: Part II
Aust.Prosth.J.3:57-62
JOONDEPH,D.R. and REIDEL,R.A. (1985)
Retention.
In: Orthodontics, current principles and techniques
Ed - T.M.Graber
St Louis: The C.V. Mosby Co. p873-874
KENNEDY,D.B., JOONDEPH,D.R., OSTERBERG,S.K. and LITTLE,R.M. (1983)
The effect of extraction and orthodontic treatment on dentoalveolar support
Am.J.Orthod.84:183-190

KESLING,H.D. (1956)
The diagnostic set up with consideration of the third dimension
Am.J.Orthod.42:740-748
KESSLER,M. (1976)
Interrelationships between orthodontics and periodontics
Am.J.Orthod.70:154-172
KIDD,E.A.M. (1986)
The diagnosis of dental caries and its relevance to clinical management.
In: Factors relating to demineralisation and remineralisation of teeth. Ed - S.A. Leach
Oxford: IRL Press Ltd p.127-137
KLASSMAN,B. and ZUCKER,H.W. (1969)
Treatment of a periodontal defect resulting from improper tooth alignment and local factors
J.Periodontol.40:401-401
NYMAN,S., EROCSSPM.R., RUNSTAD,L. and KARRING,T. (1984)
The significance of alveolar bone in periodontal disease. An experimental study in the dog
J.Periodont.Res.19:520-525
OGAARD,B. and ROLLA,G. (1986)
Retention of fluoride on sound and demineralised enamel in vivo. In: Factors relating to remineralisation and demineralisation of teeth. (S.A.Leach ed.) Oxford: IRL Press Ltd p191-199
PECK,H. and PECK,S. (1975)
Reproximation (enamel stripping) as an essential orthodontic treatment ingredient
In: Transactions of the third international orthodontic congress. Ed - J.T.Cook. p513-523
POLSON,A.M. and REED,B.E. (1984)
Long-term effect of orthodontic treatment on crestal alveolar bone levels
J.Periodontol.55:28-34
PRITCHARD,J.F. (1975)
The effect of bicuspid extraction orthodontics on the periodontium
J.Periodontol.46:534-542
REIDEL,R.A. (1975)
Retention
In: Current orthodontic concepts and techniques 2nd ed. Eds - T.M.Graber and B.F. Swain
Philadelphia: W.B. Saunders Co. p1110-1111
REIDEL,R.A. (1976)
Retention and relapse
J.Clin.Orthod.10:454-472
SADOWSKY,C. and BeGOLE,e.a. (1981)
Long term effects of orthodontic treatment on periodontal health
Am.J.Orthod.80;156-172
SHERIDAN,J.J. (1985)
Air-rotor stripping
J.Clin.Orthod.19:43-59
SHERIDAN,J.J. (1987)
Air-rotor stripping update
J.Clin.Orthod.21:781-788
TAKEI,H.H. (1980)
The interdental space
Dent.Clin.North Am.24:167-176
TEN CATE,J.M. (1983)
A model for enamel lesion remineralisation
In: Demineralisation and remineralisation of the teeth. Eds - S.A.Leach and W.M.Edgar
Oxford: IRL Press Ltd. p129-144
TUVERSON.D.L. (1980)
Anterior interocclusal relations Part 1
Am.J.Orthod.78:361-370
van der FEHR,F.R. and STEINESS,E. (1966)
The solubility rate of unabraded, abraded and exposed human enamel surfaces studied by means of activation analysis
Arch.Oral Biol.11:1405-1418
VERBEEK,R.M. (1986)
Minerals in human enamel and dentine
In:Tooth development and caries. Vol 1. Eds - F.C.Driessens and J.H. Woltgens
Boac Raton: CRC Press Inc. p95-152
WOLTGENS,J.H. (1986)
Posteruptive eruption
In: Tooth development and caries.
Vol 1. Eds - F.C.Driessens and J.H.Woltgens
Boca Raton: CRA Press Inc. p83-93
ZACHRISSON,B.U. and MJOR,I.A. (1975)
Remodeling of teeth by grinding
Am.J.Orthod.68:545-553
ZACHRISSON,B.U. (1978)
Iatrogenic damage in orthodontic treatment Part 2
J.Clin.Orthod.12:208-211
ZACHRISSON,B.U. (1987)
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