Successive removal of periodontal tissues
Marginal healing without plaque control

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Abstract. The aim of the present study was to compare periodontal healing after
successive removal of periodontal tissue components, from the alveolar bone to
the dentin surface. The prevailing tissue reaction when adhering PDM was left
on the exposed roots was that most of the bone tissue that had been removed from
the buccal surfaces had regenerated and the integrity of the PDM between the
new alveolar bone and cementum surface had been reestablished. On exposed
etched cementum surfaces, 2 prevailing healing results were recorded. In half the
number of the roots, the root surfaces were covered by connective tissue with fibers
running parallel to the root surfaces in a capsule-like arrangement. The other
prevailing reaction was a thin epithelial cell-lining running parallel to the root
surfaces in close contact or partly penetrating the adjacent connective tissue. On
exposed denuded dentin surfaces, gingival retraction was a constant finding,
associated with an epithelial cell-lining of varying thickness sometimes with rete
pegs and cyst-like formations. Gingival retraction was also a constant finding
on etched dentin surfaces. This was associated with pathological pockets outlined
by epithelial cell-layers of varying thicknesses. The significance of these findings
were discussed with special emphasis on dynamics of recurrent periodontitis.

Key words: healing; monkey; periodontal
tissues; surgery.

Accepted for publication 19 November 1991

The ultimate goal in periodontal therapy, surgical and non-surgical, is to en-
courage formation of new attachment with new root cementum and attaching
functional periodontal fibers. However, most recent reports have indicated that
a denuded dentin surface provides an unsuitable surface for the formation of
reparative cementum and a new attachment (Lindskog et al. 1983, Blomlöf et
al. 1987), while others report that this is possible under certain circumstances
(Nyman et al. 1982a, b). There is at present a prevailing opinion that peri-
donital surgery or subgingival scaling invariably results in the formation of a
long epithelial junction (Yukna 1976, Caton et al. 1980, Caton & Nyman
1980, Berg et al. 1990). Some investigations have shown, however, that con-
nective tissue attachment may form after demineralization of the denuded
dentin surfaces during periodontal surgery (Ririe et al. 1980).

Thus, a variety of healing patterns following invasive periodontal therapies
have been reported, although with a high degree of variability. At the ex-
pense of new treatment modalities, the relative importance of the various peri-
donatal tissue components for the healing result appears to have been some-
what overlooked, although preservation of the root cementum layer has indi-
cated the possibility of healing with new attachment as opposed to healing on
denuded dentin surfaces (Blomlöf et al. 1987, 1989).

The aim of the present study was to compare periodontal healing after suc-
cessive removal of periodontal tissue components, from the alveolar bone to
the dentin surface.

Material and Methods
Experimental animals
12 upper permanent 1st and 2nd pre-
molars from three, 3-4 year old mon-
keys (Macaca fascicularis) were used in
the experiment. The teeth were fully
erupted and had closed apices. During
the surgical procedures the animals were
anesthetized with an intramuscular injec-
tion of KethalarTM (50 mg/ml ketam-
in hydrochloride, 10 mg/kg b.w., Park
Davis Co. Inc., Morris Plains, NJ,
USA). After a healing period of 8 weeks
without plaque control, the monkeys
were killed by an overdose of Kethal-
arTM.

Experimental outline
Anaemia was secured in the surgical
areas by local injection of 2% lidocaine
hydrochloride -12.5 µg/ml adrenalin
(Xylocain-adrenalinTM, Astra, Södertäl-
je, Sweden). A buccal mucoperiosteal
flap was raised after an incision along the
gingival margin, thus exposing the
bone covering the two buccal roots. The
experimental teeth were distributed be-
tween 4 treatment groups.

Adhering PDM. The bone plates
covering the buccal 2/3 to 3/4 of the
roots of all first premolars in the 1st
quadrants were gently removed. 2 verti-
cal grooves were prepared on each side
of the root. The alveolar bone was then
carefully fractured off in an attempt to
preserve the periodontal membrane
(PDM) adhering to the roots.

Etched cementum. The roots of all
first premolars in the second quadrants
were prepared in the same way as de-
scribed under Adhering PDM with the
addition of an etching-period of 30 seconds with 37% ortho-phosphoric acid (3M, St. Paul, MN, USA). The root surfaces were then flooded with sterile saline.

Denued dentin. The bone plates, cementum layers and superficial dentin covering the buccal 2/3 to 3/4 of the roots of all second premolars in the first quadrants were gently removed with a round bur (no. 6, ø 1.3 mm). The roots were continuously flooded with sterile saline during this procedure.

Exded dentin. The roots of all second premolars in the second quadrants were prepared in the same way as described under Denued dentin with the addition of an etching-period of 30 seconds with 37% ortho-phosphoric acid. The root surfaces were then flooded with sterile saline.

After the different experimental procedures, the mucoperiosteal flaps were repositioned to their presurgical positions and sutured (Custodin 5-0, SSc. Neujuaen am Reinfall, Switzerland).

Histological preparation and evaluation

After sacrifice, the premolar regions were dissected out and fixed in cold 3% neutral-buffered formalin for 48 h, demineralized in 10% formic acid, infiltrated and embedded in paraffin and sectioned step-sagittally at levels 70 µm apart, parallel to the long axes of the teeth. Each section was 5 µm thick. The sections were stained with hematoxylin and eosin and examined in a light microscope.

Every 3rd sections were used for morphologic evaluation of the prevailing periodontal conditions at the PDM/root interface along the experimental defects. Five to 8 sections from each of the two roots in every premolar were examined.

Results

The monkeys appeared to tolerate the experiments well and no adverse reactions were noted during the observation period. Gingival retraction associated with pathological pocket formation were noted in all groups, although considerably less in the group where the PDM had been preserved. The prevailing healing patterns are summarized in Fig. 1.

Adhering PDM. In 4 out of 6 roots, most of the bone tissue that had been removed buccally had regenerated and the integrity of the PDM between the new alveolar bone and cementum surface had been reestablished (Fig. 2). In the most coronal part of the experimental areas, some gingival retraction and minor pathological pocket formation were noted. In the remaining two roots, gingival retraction had proceeded almost to the apical extension of the defects.

Etched cementum. 2 prevailing healing results were recorded. In about half of the roots, the root surfaces were covered by connective tissue with fibers running parallel to the root surface in a capsule-like arrangement (Fig. 3). Minimized tissue loosely apposed to or in close contact with the root surface was seen in the apical-most 1 mm of the defects. The prevailing reaction seen in the remaining roots was a thin epithelial cell-lining running parallel to the root surfaces in close contact or partly penetrating the adjacent connective tissue (Fig. 4). Some areas of this epithelial-lining were thickened with rete pegs and cyst-like formations associated with inflammatory cell infiltrates in the adjacent connective tissue.

Denued dentin. Gingival retraction was a constant finding in this experimental group associated with an epithelial cell-lining of varying thickness with rete pegs and cyst-like formations along the root surfaces in 4 out of 6 roots. This was associated with inflam-
Fig. 2. Buccal aspect of the healing pattern in a premolar root where the PDM was left intact while the alveolar bone plate was removed. Note the notch on root surface (arrow head). More than half of the bone tissue that had been removed buccally has regenerated (arrow) and the integrity of the PDM between the new alveolar bone and cementum surface had been reestablished.

Fig. 3. Buccal aspect of one of the two healing patterns in a premolar root where the PDM and the alveolar bone plate was removed while the cementum was etched. The root surface is covered by connective tissue with fibers running parallel to the root surface in a capsule-like arrangement.

Fig. 4. Buccal aspect of the other two healing pattern in a premolar root where the PDM and the alveolar bone plate were removed while the cementum was etched. A thin epithelial cell-lining (arrowheads) runs parallel to the root surface. Note the connective tissue-fibers also running parallel to the root surface.

Fig. 5. Buccal aspect of a premolar root where the PDM, the alveolar bone plate, cementum and superficial dentin were removed. Note the excessive gingival retraction.
matory cell infiltrates in the adjacent connective tissue (Fig. 5). Mineralized tissue loosely apposed to or in close contact with the root surface could occasionally be seen in the apical-most 1 mm of the defects. In the remaining two roots, gingival retraction had proceeded almost to the apical extension of the defects.

Etched dentin. Gingival retraction was also in this experimental group a constant finding. This was seen in 5 out of 8 roots and associated with pathological pockets outlined by epithelial cell layers of varying thickness with rete pegs and cyst-like formations associated with inflammatory cell infiltrates in the adjacent connective tissue. Mineralized tissue loosely apposed to or in close contact with the root surface were observed in most defects in the apical-most 1 mm. In the remaining root gingival retraction had proceeded almost to the apical extension of the defects.

Discussion

The periodontium is a complex mixture of connective and mesodermal tissues, both mineralized and non-mineralized. It is formed and behaves as one unit from a physiological point of view (Len Cate 1989). During development of periodontal disease, parts of the periodontium are destroyed, and the remains are often removed as a result of periodontal invasive therapies. In the present study, an attempt was made to describe the relative importance of some integral periodontal tissue components for periodontal healing.

It is well-known that the PDM has an osteogenic capacity (Melcher 1976, Lišaj et al. 1984), and selective removal of the alveolar bone, as in the present study (Fig. 2), will provoke regeneration of the lost bone by the remaining root-associated PDM (Nyman & Karring 1978, Andressen 1980). This is dependent on complications factors, such as degree of infection and subsequent periodontal inflammation (Blomlof et al. 1991), trauma from the surgical procedure affecting the quality of the remaining PDM and flap adaptation (Nyman & Karring 1978, Wiklind & Nilveus 1980). The reason why 2 of the roots with an adhering PDM failed to demonstrate any bone regrowth is probably a combination of these factors.

This emphasizes the importance of accounting for the healing result of each root separately rather than as morphometrical means for different tissue reactions calculated from several roots.

In the remaining 3 treatment groups, repopulation of the hard tissue surfaces of the root was studied. Of the 3 treatments, an etched cementum surface appeared to be less susceptible to epithelial down-growth compared to the dentin surface preparations. Although, the results from the etched cementum surfaces did not involve formation of reparative cementum and alveolar bone as previously demonstrated (Blomlof et al. 1987, 1989), epithelial proliferation was not favoured. Whether or not the connective tissue capsule (Fig. 3) that had established itself on the cementum surfaces is a stable healing result remains to be shown. In a previous study, it was shown that epithelial down-growth in a connective tissue along a dentin surface follows a characteristic growth pattern stimulated by inflammation in the connective tissue (Berg et al. 1990). The connective tissue capsule may, consequently, be regarded as an area of impaired resistance which more easily invites a plaque-induced inflammation. However, it may provide some tooth support as long as it is free from inflammation.

Previously, etching of dentin surfaces has been shown to retard epithelial down-growth and favour connective tissue attachment (Woodward et al. 1984), this was, however, not found in the present study. Instead, an epithelial coverage was seen on these surfaces in-
respectively, at the gingival retraction (Fig. 5) had not totally jeopardized the adaptation of the mucoperiosteal flap. This could have been due to an initially poorer flap adaptation in this group compared to the group with etched cementum surfaces (Wikesjö & Nilveus 1990). However, it should be noted that the experimental animals did not undergo any hygiene treatment during the healing period and, consequently, plaque-induced periodontal inflammation influenced the healing result to a large extent. Individual differences in resistance to infection between the experimental animals is the only remaining uncontrolled factor which can account for the delay in epithelial down-growth as well as the excessive gingival retraction seen on the roots deviating from the prevailing tissue reactions. Some earlier studies have reported different degrees of susceptibility to recurrence of periodontal disease between individuals depending on plaque control following invasive periodontal therapies, ranging from a stable condition (Knowles et al. 1979, Axelson & Lindhe 1981, Phlåström et al. 1983) to total recurrence (Nyman et al. 1977, Axelson & Lindhe 1981). Although these results were obtained clinically in humans, it appears indisputable that they all had long epithelial junctions (Caton & Nyman 1980, Nyman & Caton 1989, Bowers et al. 1989).

Based on the present results and the results referred to above, the dynamics of periodontal recurrences following invasive periodontal therapy is illustrated in Fig. 6. However, it should be noted, as discussed earlier, that individual differences in resistance to infection and plaque control determine the rate with which recurrences occur.

Acknowledgements

This study was supported by grants from the Swedish Medical Research Council (grant no. 6651), the Stockholm County Council and the Faculty of Dentistry at Karolinska Institute.

Zusammenfassung

Zum und nach vorgenommener Entfernung parodontaler Gewebe der Empfang einer solcher Vorgehens an der marginalen Heilungsorgane bei. Entzündungen


Résumé

Enlèvement successif des tissus parodontaux. Effets de la gestion marginale de dents de sagesse.

Le but de la présente étude a été de comparer la gestion parodontale après enlèvement de composants parodontaux, de l’os alvéolaire à la surface dentinale. Les deux groupes des chevauchements ont été réalisés par rapport aux racines exposées. La partie de l’os vestibulaire qui avait été réparée, et la totalité du ligament entre le nouveau os et la surface cémentaire était réhabilité. Sur les surfaces de dents endommagées, deux types de guérison ont été notés. Dans la moitié des cas, les surfaces radiculaires étaient recouvertes de tissu conjonctif avec fibres parallèles aux surfaces radiculaires en un arrangement semblable à une capsule. Une réaction épidémique était une attaque axiale d’un filaire parallèle aux surfaces radiculaires ou à la partie dentaire de la capsule conjonctivale adjacente. Sur les surfaces dentinaire- res, la réaction gingivale était présen- tée, associée à une attaque épidémique dystrophique variable par parois des invagina- tions et des formations semblables à des kystes. La régression gingivale était aussi prés- ente sur les surfaces dentinaires endommagées. Cet effet était associé à des poches parodontales délimitées par des couches cellulaires épithéliales d’épargne variable. La signification de ces découvertes est discutée en insistant sur la dynamique de la parodontite récurrente.

References


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