# Comparison of long-term papilla healing following sulcular full thickness flap and papilla base flap in endodontic surgery

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## Abstract

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**Aim** To compare long-term loss of papilla height when using either the papilla base incision (PBI) or the standard papilla mobilization incision in marginal full thickness flap procedures in cases with no evidence of marginal periodontitis.

**Methodology** Twelve healthy patients, free of periodontal disease, who had intact interdental papillae were referred for surgical treatment of persisting apical periodontitis and included in the study. The flap design consisted of two releasing incisions connected by a horizontal incision. The marginal incision involved the complete mobilization of the entire papilla in one interproximal space but in the other interproximal space the PBI was performed. Further apically a full thickness flap was raised. Following flap retraction, standard apical root-end resection and root-end filling was performed. Flap closure was achieved with microsurgical sutures. The PBI was sutured with two to three interrupted sutures (size 7/0), the elevated papilla was reapproximated with vertical mattress sutures (size 7/0), which were removed 3–5 days after the surgery. The height of the interdental papilla was evaluated preoperatively and postoperatively after 1-, 3- and 12-month recall using plaster replicas. The loss of papilla height was measured using a laser scanner. Papilla paired sites were evaluated and statistically analysed.

**Results** Most papilla recession took place within the first month after the surgery in the complete elevation of the papilla. Further small increase in loss of papilla height resulted at 3 months. After 1 year the loss of height diminished to 0.98 ± 0.75 mm, but there was no statistical difference between the various recall intervals. In contrast, after PBI only minor changes could be detected at all times. There was a highly significant difference between the two incision techniques for all recall appointments ($P < 0.001$).

**Conclusions** In the short as well as long-term the PBI allows predictable recession-free healing of the interdental papilla. In contrast, complete mobilization of the papilla displayed a marked loss of the papilla height in the initial healing phase although this was less evident 1 year postoperatively. In aesthetically relevant areas the use of the PBI is recommended, to avoid opening of the interproximal space, when periradicular surgical treatment is necessary.

**Keywords:** apical surgery, flap design, papilla base incision, papilla healing, recession, sulcular incision.

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## Introduction

Endodontic surgery involves raising a full thickness flap, consisting of gingival and mucosal tissue as well as periosteum. To mobilize the flap, various types of incisions can be selected including horizontal incisions (sulcular and submarginal) and vertical releasing incisions (Gutmann & Harrison 1991).

Although microsurgical techniques have been applied in endodontic surgery for several years, little attention has been given to soft tissue healing following treatment, specifically papilla healing, when no

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pathological changes are present in the periodontal tissues. The care of healthy periodontal tissues is challenging and is of importance to prevent attachment loss and recession of the gingiva following endodontic surgery. Loss of the interproximal dental papillae may cause functional, phonetic and aesthetic problems. Complete and predictable restoration of lost interdental papillae remains one of the greatest challenges in periodontal reconstructive surgery (Blatz *et al.* 1999). It is imperative therefore to maintain the integrity of the papilla during restorative and surgical procedures.

The presence or absence of the interdental papilla depends upon the distance between the contact point to the crest of bone (Tarnow *et al.* 1992). When the distance from the contact point to the bone was 5 mm or less, the papilla was present almost 100% of the time. With a distance of 6 mm, the papilla was present 56% of the time, and when the distance measured 7 mm or more, the papilla was present 27% of the time or less.

In periapical surgery the sulcular full thickness flap is often used (Beer *et al.* 2000). The main disadvantage of the sulcular full thickness flap is recession and, especially, unpredictable shrinkage of the papilla during healing (Zimmermann *et al.* 2001), although Chindia & Valderhaug (1995) found no difference in attachment loss between trapezoidal and semilunar flaps in apicectomy. A persisting endodontic infection following periradicular surgery may be also regarded as a contributing risk factor for progressing marginal attachment loss (Jansson *et al.* 1997). The mean clinical attachment loss in teeth with unsuccessful periapical healing was 0.85 mm and differed significantly from successfully healed cases with a mean of 0.15 mm.

The papilla base incision (PBI) for the marginal mucoperiosteal flap was suggested to prevent loss of interdental papilla height (Velvart 2002). This incision allows the preservation of the entire papilla, thus eliminating any substantial loss of height as a result of the surgical or healing process. A short term (1- and 3-month) comparison of papilla healing when the PBI or standard papilla elevation was performed, found marked recession of the papilla in completely elevated papilla sites (Velvart *et al.* 2003). Most recession was observed in the first month after the surgery and increased slightly at the third month. Although the mean recession value showed a slight increase between 1 and 3 months there were papilla sites where creeping attachment was observed. Creeping is a postoperative migration of the gingival marginal tissue in a coronal direction, covering partially or completely a previously denuded root (Goldmann *et al.* 1964). PBI showed minimal changes during the entire observation period. The difference between the two incision techniques was highly significant. The patients and the study groups were further followed up after 1 year. Therefore, the purpose of the study was to compare the loss of papilla height after 12 months when the PBI or standard papilla elevation was used in sulcular full thickness flap, in patients evaluated in the previous study (Velvart *et al.* 2003).

## Materials and methods

Twelve patients (six women and six men) in good general health, referred for surgical treatment of persistent apical periodontitis, were included in the study. The age, distribution of teeth, treatment and evaluation method were described in Velvart *et al.* (2003). The flaps consisted of two releasing vertical incisions and a horizontal incision in the following way. Initially, the vertical incisions were placed at least one tooth both distally and mesially to the tooth being treated, using a 15C blade (HuFriedy, Leimen, Germany). The horizontal incision involved one interproximal space where the standard, complete mobilization of the entire papilla and in the other interproximal space the PBI was used. The marginal incision started with the preparation of the PBI. The PBI required two different incisions at the base of the papilla as described by Velvart (2002). Buccally over the tooth the interproximal spaces were joined by an intrasulcular incision. The scalpel was moved within the sulcus, dissecting the gingiva to the crestal bone. The sulcular incision reached from the releasing incision to the start of the PBI, or from one papilla to the next papilla. The incision technique applied to the mesial or distal interproximal space was randomly selected. The experimental sites were always the mesial and distal papilla of the tooth with the apical pathology to be treated. The flap was mobilized and retracted, during the root-end resection and filling.

The flap closure was initiated from the releasing incisions. For the vertical incisions polyamide 6/0 (Supramid; B. Braun, Neuhausen, Switzerland) interrupted sutures were used. The PBI was sutured with two or three polypropylene 7/0 (Prolene; Ethicon, Norderstedt, Germany) interrupted sutures depending on the width of the papilla. Great care was taken in passive reapproximation and perfect adaptation of the wound margins without tension to the sutures. The mobilized papilla was adapted with a vertical mattress suture (polypropylene 7/0). The sutures were removed

 

3–5 days postoperatively. The patients were evaluated at 1, 3 and further 12 months postoperatively (Figs 1a,e and 2a,e). One patient could not be contacted for the final recall at 12 months.

In each surgical site alginate impressions were taken before surgery and at all recall appointments except the suture removal. Twelve papilla pair areas, mesial and distal of the endodontically involved tooth, were studied as described by Velvart *et al.* (2003). The technique used for the test site (PBI or complete mobilization of the papilla) was randomly selected. The data were statistically analysed using the pairwise *t*-test between the test methods and Scheffe test for a given method in relation to time.

## Results

All patients displayed uneventful healing at all recall appointments. The loss of papilla height is shown in Fig. 3. The mean recession for the PBI measured between a reference point and the most coronal point of the papilla comparing the preoperative and the recall at 1 month was 0.07 ± 0.09, 0.10 ± 0.15 mm at 3 months and −0.06 ± 0.21 mm at 12 months. For the total papilla mobilization of the papilla the readings were 1.10 ± 0.72 mm at 1 month, 1.25 ± 0.81 mm at 3 months and 0.98 ± 0.75 mm at 12 months. The PBI incision showed significantly less shrinkage than total mobilization of the papilla at all recall appointments (Fig. 3) compared with the preoperative levels ($P < 0.001$).

In complete papilla mobilization at the 3-month recall the retraction had increased in nine sites, whereas in three sites the loss of height had diminished compared with 1 month. Changes between the 3- and 12-month visit were in general small; in two patients further minimal loss of up to 0.2 mm occurred, in all other cases creeping was observed. Of those sites with creeping after 1 year only two sites displayed further creeping to the preoperative level. But four sites still displayed considerable loss of papilla height of 1.4 mm or more compared with the preoperative situation. Statistical analysis of the papilla height changes between the recall appointments, when complete papilla elevation was performed, was not statistically significant ($P < 0.629$).

## Discussion

Healing following sulcular marginal incision may lead to varying amounts of recession. Based on the results of this study, the total elevation of the papilla, generally used in sulcular flaps, results in a recession of 1.10 ± 0.72 mm at 1 month, 1.25 ± 0.81 mm after 3 months and 0.98 ± 0.75 mm at 12 months. This is a considerable amount of recession, especially if aesthetically visible areas were operated on. Although creeping can be expected and some sites may regain their preoperative levels (Fig. 1), in general some recession remains after 12 months (Fig. 2). Matter (1980) and Harris (1997) studied the effect of creeping, when gingival grafting procedures were performed and they found creeping attachment occurred between 1 month and 1 year after surgery, whereas between 1 and 5 years, there were no significant differences between the values. Based on these findings it must be assumed that those sites where recession persisted after 12 months, the loss of papilla height will most likely remain at the 1-year level thereafter.

When a full thickness flap was performed with the total mobilization of the papilla, progressive loss of papilla height resulted, in spite of microsurgical techniques used (Zimmermann *et al.* 2001, 2002). This might be due to the damage to the papilla during the elevation process, despite the use of less traumatic modern techniques. Ideally the buccal papilla should be dissected from the lingual papilla, but especially in narrow interproximal spaces the separation process is technically difficult. Tissue fragments, left behind after the flap elevation process, are often too small to survive and may necrotize leading to recession. Another reason for shrinkage of the coronal portion of the papilla can be due to insufficient adaptation of the papilla to the underlying tissue at flap closure. Vertical mattress sutures do not always allow predictable, close approximation of the papilla to the underlying tissue surface and this might predispose to recession with this design. The dimensions of the papilla (wide or narrow and long or short) might also have an effect on the healing pattern after surgery. Due to limited patient sample no correlations between the dimension of the papilla and the postoperative recession were made.

The main vertical loss of height occurs during the initial healing phase in the first month following the surgical procedure. After 3 months only minor vertical changes took place; in nine sites increases in recession were observed, whereas in three sites a small gain of the papilla height occurred, compared with the 1-month situation. At 12 months two sites exhibited further recession, the remaining sites showed creeping to a certain degree. But the observed gain of the papilla height was not significant, when compared with the


**Figure 1** Clinical view of first mandibular premolar treated. (a) Preoperative situation; (b) post-surgery; (c) healing at 1 month; (d) recall at 3 months; and (e) recall at 12 months. Note the marked recession of the distal papilla, which was completely mobilized in the flap at 1 month (c) and 3 months (d). This recession completely disappeared due to creeping (e).

short-term observation periods and preoperative situation. The mean papilla loss of height after 1 year was 0.98 mm, when complete elevation was performed (Fig. 2).

In contrast to full mobilization of the papilla, the PBI resulted in 0.07 ± 0.09 mm of recession at 1 month, 0.10 ± 0.15 mm at 3 months and −0.062 ± 0.21 mm at 12 months. This is significantly less ($P < 0.001$)


**Figure 2** Clinical view of first maxillary premolar treated. (a) Preoperative situation; (b) post-surgery; (c) healing at 1 month; (d) recall at 3 months; and (e) recall at 12 months. Note the marked and persisting recession of the mesial papilla, which was completely mobilized. The distal papilla, where the PBI was used, demonstrates recession-free healing over the entire observation period.

than the vertical loss of the papilla height after total elevation of the interproximal tissue at each observation period studied. The PBI, which leaves the body of the papilla in place, would eliminate any visible opening of the interproximal space during the healing process. When PBI is performed certain points should

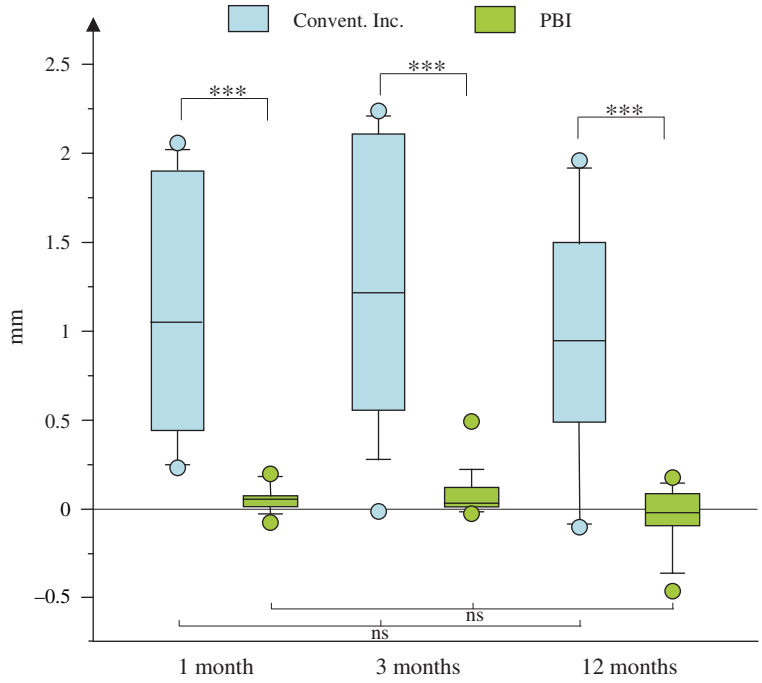


**Figure 3** Bar diagram illustrating the loss of papilla height after 1, 3, and 12 months compared with the preoperative level. ***Highly significant differences between the groups; ns, nonsignificant. The circles indicate ranges and the error bars the standard deviation.

be followed (Velvart 2002). The first shallow incision at the base of the papilla should be placed in a slight curve beginning and ending in 90° angle to the marginal contour of the gingiva. It is further important to avoid thinning out of the split flap. The epithelium of the partial thickness flap should be supported by underlying connective tissue, otherwise this portion of the flap might necrotize and lead to scar formation. However, excessive thickness of the connective tissue layer of the spit flap portion could compromise the survival of the buccal papilla left in place. The ideal thickness of the partial thickness flap has not been studied. The epithelium thickness varies between 111 and 619 μm with a mean of 364 μm (Soehren *et al.* 1973). The recommended thickness of free gingival grafts was reported to be 1–2 mm (Mormann *et al.* 1981, Wennström & Pini Prato 1998). Based on gingival graft studies, a thickness of 1–1.5 mm was chosen for the split flap in PBI. The selected thickness resulted in excellent healing patterns.

The healing potential of the PBI at 1 month, as studied in a previous investigation, was either invisible or slightly visible for the majority of the sites (Velvart 2002). Although not specifically studied in this investigation, the incision line could not be clearly detected after 1 year. This is of importance, when an endodontic surgical intervention is necessary in the anterior region. In aesthetically relevant areas PBI should be used to avoid opening of the interproximal space following marginal surgical exposure of the gingiva.

## Conclusion

The present study has demonstrated that the type of marginal incision has both a short- and long-term effect on the degree of papillary recession. The PBI preserved papilla height following surgery and allowed predictable recession-free healing over the entire observation period of up to 1 year. In contrast, the classical complete mobilization of the papilla to raise a full thickness flap resulted in papilla recession, creating an interproximal open space. Long-term healing after 1 year displayed creeping to a certain level, although the mean recession value of 0.98 mm was still present at 12 months.

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