

Chapter 3

Back to Histology for Predictable Outcomes in Partial Thickness Flap Procedures

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Introduction

Thin gingival phenotype is a risk factor for recession around teeth (Agudio *et al* 2016, Chambrone *et al* 2016). Similarly, thin soft tissue phenotype (Kan *et al* 2011, Nisapakulorn *et al* 2010) and the lack of keratinized mucosa lead to increased risk for recession around dental implants (Lin *et al* 2013, Rocuzzo *et al* 2016). The free gingival graft and the connective tissue graft (CTG) combined with a coronally advanced flap are commonly used to increase the thickness and quality of the soft tissue around teeth and dental implants.

The oral mucosa

The masticatory mucosa in the mouth consists of mucoperiosteum, where epithelium and the underlying lamina propria attach directly to the underlying bone without a submucosa layer. In addition, the attached gingiva contains alveologingival fibres and dentogingival fibres that help attach the gingiva to the underlying cementum surface and alveolar bone. The alveolar mucosa, a lining mucosa, is mobile and distensible because it has a loose lamina propria where the collagen fibres are arranged in a network to allow free movement as well as a high

content of elastin (Berkovitz *et al* 1992; Bourke *et al* 2000). The alveolar mucosa commonly has a submucosa, a layer of loose connective tissue that separates the lamina propria from the underlying bone (Berkovitz *et al* 1992).

Partial thickness flap

A partial thickness flap is made up of a portion of the mucosa not including the periosteum. A partial thickness flap is achieved not simply by making an incision that divides up the thickness of mucosa flap excluding the periosteum. The partial thickness incision can be made deep and close to the periosteum (figure 1). The partial thickness incision can also be made more superficial, at one extreme like a de-epithelialization procedure, and also at different depths through the lamina propria, submucosa or muscle layers (figure 2). Making the partial thickness incision at the correct layer is crucial to the predictability and achievement of surgical objectives. This requires the knowledge of histology of the mucosa and the conscientious application of this knowledge in the surgical design of the flap.

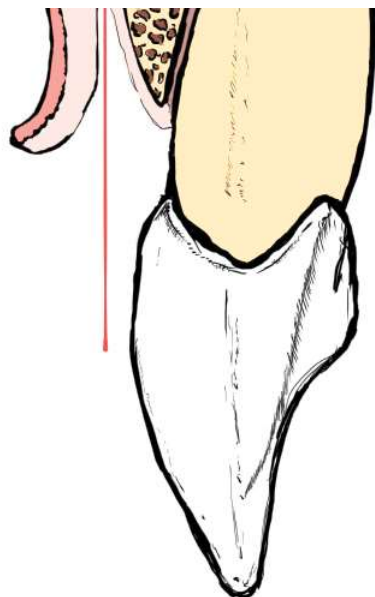


Figure 1. Deep incision close to the periosteum. This incision is made with the blade parallel to the contour of the underlying bone.



Figure 2. Superficial incision. This incision is made with the blade parallel to the contour of the underlying bone.

Free gingival grafts

The keratinization of the surface epithelium is determined by genetic factors inherent in the connective tissue (Karring *et al* 1971). A graft harvested from the palate should determine and form a keratinized mucosa after healing. The mobility of this healed graft however is affected by the presence or not, of submucosa and loose lamina propria at the recipient site. In order to achieve a stable band of keratinized mucosa after a free gingival graft procedure, and create a mucoperiosteum, the partial thickness incision on the recipient bed in a free gingival graft procedure should be a deep one, at the level between the submucosa and the underlying periosteum. Not doing so will leave the palatal graft positioned on a bed of loose connective tissue, which risks remaining mobile even

if the epithelium is keratinized (figures 3 to 6). Because the partial thickness incision is made at the level close to the periosteum, an extreme thin tissue phenotype is not a contra-indication for free gingival grafts (figures 7 to 9).

Coronally advanced flap with CTG

The histology of the gingiva and the lining mucosa is different, therefore the considerations for the depth of the partial thickness incisions are different. The partial thickness incisions made at the anatomical papilla where the surgical papilla will lie on at flap closure is a de-epithelialization incision, while the incision at the surgical papilla should be one that leaves enough connective tissue for the survival of this portion of the flap. The partial thickness incision over an area where a CTG may be



Figure 3. Pre-op appearance of tooth 43.



Figure 4. A deep partial thickness incision is made beyond the lamina propria and submucosa layer, in order that the graft can lie on stable immobile periosteum bed.



Figure 5. The palatal graft is securely sutured down to the underlying periosteum.



Figure 6. Healing at 3 months. A stable band of thick keratinized mucosa is noted.



Figure 7. Extreme thin tissue phenotype is not a contra-indication for free gingival graft.



Figure 8. Free gingival graft was done.



Figure 9. Healing at 12 months.



Figure 10. The partial thickness incisions made at the anatomical papilla where the surgical papilla will lie on at flap closure is a de-epithelialization incision, while the incision at the surgical papilla should be one that leaves enough connective tissue for the survival of this portion of the flap.

sutured on needs to be thick enough for this purpose (Zuchelli and De Sanctis 2000, Zucchelli *et al* 2009) (figure 10).

Zuchelli and De Sanctis (2000) described a sharp dissection into the vestibular lining mucosa to release muscle tension (figure 11) and Greenwell *et al* (2004) described a superficial incision to separate the epithelium and connective tissue from the deeper muscle and periosteum (figure 12) to allow extreme flap release and prevent the muscles from retracting the flap during healing.

Harvesting the palatal connective tissue

The superficial part of the palate consists of the lamina propria which contains more fibrous connective tissue and less fatty and glandular tissues. Bertl *et al* (2015) found that it is not the location of the palate where the graft is harvested from, but the method by which

the harvesting was done, that determines whether the graft contains more fibrous connective tissue or fatty/glandular tissues. The de-epithelialized palatal graft contains more fibrous connective tissue than sub-epithelial connective tissue graft. The de-epithelialized palatal graft is therefore the harvesting method of choice if the quality of the fibrous connective tissue is parameter of measure.

There is concern that a de-epithelialized graft harvesting method leads to increased post-operative pain for patients. In a randomised controlled clinical trial, Zucchelli *et al* (2010) compared post-op pain reported by patients after a de-epithelialized graft and a sub-epithelial connective tissue harvested via a trap door access method and reported no statistical difference in post-op painkiller consumption, bleeding or reported discomfort. Painkiller consumption increased in cases of primary flap dehiscence/necrosis (28% of the sub-epithelial connective tissue patients).

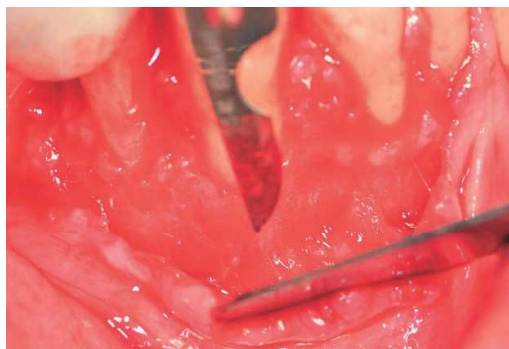


Figure 11. A deep incision is made with blade parallel to bone to separate the muscles from the periosteum.

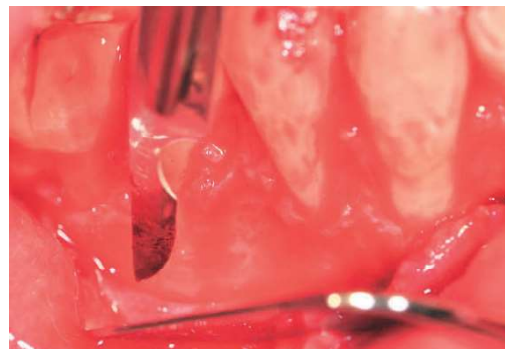


Figure 11. The blade is now angled parallel to the mucosa surface and a superficial incision is made to separate the lamina propria and epithelium from the muscle layer.

This could be because post-operative pain after palatal graft harvesting is related to the thickness and not the size of the graft (Burkhardt *et al* 2015). The de-epithelialized grafts Zucchelli *et al* (2010) harvested in their protocol were thin grafts of average 1.32mm in thickness. Zucchelli *et al* (2015) also found that while no statistical difference was noted in root coverage outcomes, a statistically greater increase in buccal thickness was observed in the de-epithelialized graft group. Ouhayoun *et al* (1988) harvested palatal grafts and then further separated them into two thinner grafts, a superficial epithelial-CTG and a deeper CTG. These were transplanted into contralateral recipient mucosal beds in the lower canine/premolar area that lacked attached gingiva. Analysis of punch biopsies three months postoperatively showed that sites receiving the epithelial-CTG displayed histologic and biochemical characteristics of keratinized mucosa. However, sites receiving the deep CTG predominantly showed features of non-keratinized mucosa.

Conclusion

The partial thickness flap may be split at different depths for different purposes. The careful attention to detail, based on understanding the histology and biology of oral tissues improves the outcomes of periodontal mucogingival surgery. Failure to do so will inevitably lead to sub-optimal outcomes.

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