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# Soft tissue management at implant sites

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***Abstract***

**Background:** Dental implants are widely used to replace lost teeth. It was suggested that surgical manipulation/augmentation of peri-implant soft tissue may be beneficial to increase the width/thickness of keratinized tissue (KT) and to enhance aesthetic outcomes of implant therapy. The aim of this paper was to provide a narrative review of the literature concerning soft tissue management at implant sites.

**Material and Methods:** Clinical studies were identified with both *medline* and hand searches. Three topics were considered in this review: (i) the significance of KT at implant sites, (ii) the surgical techniques to increase KT and (iii) soft tissue stability around implants.

**Results:** Several papers concerning soft tissue management at implant sites were identified, mainly expert opinions, case reports and case series. In addition, a systematic review was selected. Generally, the level of evidence was weak. So far, literature analysis showed that (i) the width of KT did not influence the survival rate of dental implants; (ii) there is no evidence to recommend a specific technique to preserve/augment KT; and (iii) factors including bone level, KT and implant features have not been shown to be associated with future mucosal recession around dental implants.

**Conclusion:** Although scientific evidence in most part is lacking, soft tissue augmentation at implant sites may need to be considered in some clinical situations.

Key words: aesthetics; dental implants; keratinized tissue; soft tissue management

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Tooth replacement by means of dental implants is considered to be a predictable procedure in modern dentistry (Lekholm et al. 1999). Peri-implant tissues significantly differ from periodontal tissues in terms of lack of cementum and periodontal ligament, less blood vessels and fibroblasts in the connective tissue and absence of an attached supra-crestal connective tissue (Berglundh et al. 1991, Abrahamsson et al. 1998). In the presence of plaque accumulation, these features may condition the development of inflammation and the rate of bone loss around implants (Lindhe et al. 1992). Notwithstanding, long-term clinical studies showed the efficacy of supportive therapy in preventing inflammation and bone destruction (Lekholm et al. 1999, Leonhardt et al. 2002), although periodontally susceptible individuals may have a greater risk for peri-implantitis (Hardt et al. 2002, Karoussis et al. 2003).

It was suggested that expected aesthetic outcomes of implant therapy may be enhanced by manipulating or augmenting peri-implant soft tissues using periodontal plastic surgery (Pini Prato et al. 1995). In addition, several factors such as presence of pre-existing ridge deformities (Pini Prato et al. 2004), quality and quantity of soft tissue over the ridge (Pini Prato et al. 2004) and surgical strategies in implant placement/uncovering (Ono et al. 1998) were considered to be related to the final aesthetic outcomes of implant therapy.

The aim of this paper was to provide a narrative review of the literature concerning the significance of keratinized tissue (KT) at implant sites, the surgical techniques to increase KT and soft tissue stability at implants.

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## Significance of KT at Implant Sites

The significance of KT in maintenance of dental implants is a controversial issue. Long-term retrospective studies (Adell et al. 1981, Albrektsson et al. 1986) suggested that dental implants may have a high survival rate irrespective of KT conditions. In a clinical study, Wennström et al. (1994) evaluated peri-implant conditions around 171 Brånemark implants with at least 5 years

of follow-up. The results showed that 24% of the sites were lacking KT and 13% of the implants had a KT width $<2$ mm. In addition, 61% of all implants showed mobility of the buccal soft tissue margin. No clinical difference between sites with and without an ''adequate'' width of KT and no association between the width of KT and the presence of bleeding on probing were found. These observations failed to support the concept that the lack of KT may jeopardize the maintenance of soft tissue health around dental implants. Bengazi et al. (1996) analysed 41 patients with partial or full-arch implant-supported fixed prostheses on 163 standard Brånemark implants in a 2-year longitudinal prospective study. Peri-implant conditions were re-assessed 6 months, 1 and 2 years after the prosthetic rehabilitation. The authors described a progressive recession in the first 6 months and a slight decrease in mean probing depth (0.2 mm) and mean KT (0.3 mm) during the follow-up period. Statistical analysis showed that the width of KT was a poor predictor of soft tissue recession occurring during the 2 years of follow-up. The authors suggested that the recession of the peri-implant soft tissue margin was mainly the result of a remodelling of the soft tissue for establishing ''appropriate biological dimensions'' around implants. More recently, Chung et al. (2006) investigated the significance of keratinized mucosa in the maintenance of 339 dental implants in 69 patients with at least 3 years of follow-up. Implants had rough or smooth surfaces of different configurations. The results of the study revealed no association between KT and bone loss, irrespective of the surface configuration, even though an association between reduced KT, higher levels of plaque accumulation and gingival inflammation was reported for posterior implants. On the other hand, an association between the presence of keratinized mucosa, plaque level and incidence of mucositis was suggested (Roos-Jansåker et al. 2006). The authors hypothesized that this finding was probably related to the fact that less pocket formation may be more common in areas with minimal KT (Roos-Jansåker et al. 2006). Notwithstanding, these evidences do not address the possible relationship between the width of KT and aesthetic outcomes of the implant-supported restoration. A clinical study on the aesthetic outcome of implant-supported single teeth revealed that the surrounding soft tissue appearance and the form of the crown had the strongest influence on the clinician's overall satisfaction (Chang et al. 1999).

### Surgical Techniques for Increasing KT

Despite the observation that the lack of KT does not influence long-term implant survival, the preservation and/or the reconstruction of keratinized mucosa around dental implants may be advocated to facilitate restorative procedures, to improve aesthetics and plaque control during oral hygiene (Block & Kent 1990, Buser et al. 1990). Expert opinions (Langer & Sullivan 1989, Langer & Langer 1990) suggested techniques to obtain adequate amounts of KT around two-stage implants, mainly based on the preservation of KT over the edentulous ridge. At the time of implant exposure, apically positioned flaps (using a mid-crestal or a lingual-positioned incision) or lateral-positioned flaps were proposed to reconstruct an adequate width of KT around implants. When the amount of KT over the edentulous ridge was minimal, a free gingival graft (FGG) was suggested (Langer & Sullivan 1989, Langer & Langer 1990).

Barone et al. (1998) proposed a surgical protocol for soft tissue reconstruction around implants. An FGG was placed before fixture installation when the baseline width of KT was minimal ($<2$ mm). At the time of fixture installation, the distance between the bone crest and the mucogingival junction was measured and the type of second surgical procedure was scheduled. When this distance was $\leqslant 3$ mm, the use of an apically positioned flap for implant exposure was planned. When this distance was $>3$ mm, a circular gingivectomy was scheduled. This protocol was effective in mucogingival management of 53 implants; at the 1-year follow-up, all sites showed an area of KT $\geqslant 2$ mm.

Landi & Sabatucci (2001) proposed a combination of apically positioned flap and FGG at the time of membrane removal following a guided bone regeneration (GBR) procedure in mandibular areas with a shallow vestibule and minimal amounts of KT. A mid-crestal incision preserving KT available on the lingual side was suggested in order to elevate a double-layer flap: the inner layer of the flap was then sutured back, thus protecting the regenerated bone after the membrane removal and allowing a recipient bed for a free gingival graft, while the external layer was apically sutured, thus deepening the vestibule.

The increasing aesthetic demand in implant dentistry has led to the development of several surgical techniques, mainly using the connective tissue graft (CTG) or connective tissue pedicle flap (CTPF) approach, in order to improve soft tissue integration and potentially reduce patient discomfort associated with the FGG procedure. Scharf & Tarnow (1992) proposed a modification of the roll technique (Abrams 1980) for managing soft tissues around implants in the aesthetic area. At the time of the second surgical procedure, a ''trap-door approach'' on the alveolar ridge over the palatal connective tissue was recommended to preserve the epithelium. This allowed the mobilization of a pedicle connective tissue flap that was buccally rotated to increase soft tissue thickness. A subsequent modification of this technique by Barone et al. (1999) avoided buccal releasing incisions, suggesting the use of an intrasulcular incision on the adjacent teeth to improve the aesthetic outcomes. The use of a rotated split-thickness palatal flap was proposed to obtain primary soft tissue closure over implants placed into fresh extraction sockets (Nemcovsky et al. 1999) and to increase the width of KT around implants at the time of implant exposure using a simultaneous apically positioned flap (Nemcovsky & Artzi 1999).

In the last decade, the CTG procedure has been suggested to cover implants placed immediately after extraction (Edel 1995) and to improve soft tissue thickness and peri-implant marginal sealing (Grunder et al. 1996, Price & Price 1999, Khoury & Happe 2000, Evian et al. 2003). Combined techniques to obtain soft tissue augmentation and inter-implant papilla reconstruction were also suggested. Nemcovsky (2001) proposed an advanced papillary flap combined with a CTG to augment the soft tissue in the inter-dental area. Tinti & Parma-Benfenati (2002) proposed an apically positioned flap from the palatal to the vestibular side at the time of second-stage surgery. This flap was stabilized with a ramp mattress suture technique in a more coronal position at the buccal site; CTG was used to cover inter-implant bone tissue.

A few weeks following the first surgical procedure, a buccal-scalloped gingivectomy was performed around the buccal surface of the abutments to create a scalloped gingival margin and interproximal papillae only in the vestibular area.

Bianchi & Sanfilippo (2004) analysed the clinical results (1–9-year follow-up) of immediate implant placement and CTG for single-tooth replacement in a retrospective study. These authors evaluated 116 patients with a total of 116 solid screw ITI implants: 96 patients underwent the combined treatment (immediate implant+CTG), while 20 received only single immediate implants. The survival rate was 100% for both the test and the control group at the last follow-up. Comparative statistical analysis showed better outcomes for the test group when compared with controls for bone levels, KT width and patient satisfaction. Similar results were reported recently by Covani et al. (2007), who suggested this procedure in replacing hopeless teeth with severe gingival recession and lack of KT. The authors reported a mean width of KT > 3 mm at the 1-year follow-up (Covani et al. 2007).

Despite the large number of papers, studies dealing with soft tissue management around dental implants are mainly expert opinions, case reports and case series. In a recent systematic review (including five RCTs), Esposito et al. (2007) analysed the possible influence of flap design, soft tissue correction/augmentation and suturing on the success of implant therapy. The authors reported that the flapless or minimally invasive approach resulted in less post-surgical discomfort than the conventional flap approach, even if further investigation on potential complication of this approach was needed. Moreover, the authors reported that there was no evidence to recommend increase in KT or to indicate specific techniques for peri-implant soft tissue management.

### Soft Tissue Stability at Implants

It is currently believed that the achievement of aesthetic success in implant dentistry requires a careful treatment that places an implant with the correct diameter in an ideal position in relation to the bone, soft tissue and adjacent tissue. Grunder et al. (2005) focused on the biological limits of the soft tissues around implants in achieving good aesthetics. These authors described a so-called ''3D Bone to Implant'' relationship for an ideal soft tissue morphology, based on the observations that connective tissue thickness overlying bone around implants ranged from 2.8 to 3.8 mm (Berglundh et al. 1991, Cochran et al. 1997) and its height ranged from 3.5 to 5 mm (Kan et al. 2003). The authors hypothesized that the soft tissue coronal levels after healing were influenced by the original volume of bone and by the possible bone resorption occurring in both vertical and horizontal directions for at least 1 mm following implant installation (Tarnow et al. 2000). Therefore, Grunder et al. (2005) suggested that at least 2 mm of bone thickness around implants is advisable to obtain stable soft tissue margins; bone regeneration should be scheduled in sites with less bone volume (Grunder et al. 2005). Improvements in implant design such as the platform-switching concept seem to be promising in preserving stable marginal bone levels around the implant neck (Lazzara & Porter 2006, Becker et al. 2007).

Another key factor in obtaining aesthetics may be the correct 3D position of the implant; the optimal location is considered in the centre of the tooth to be replaced, $\sim$ 2 mm more palatal than the expected buccal emergence profile at the gingival margin of the crown (Grunder et al. 2005). Moreover, proper implant diameter should be carefully evaluated in relation to the surgical site. Small et al. (2001) compared soft tissue levels in wide- and standard-diameter implants in a 3–5-year prospective study. Wide-diameter implants showed higher mean recession and a higher number of sites with recession at the time of prosthesis installation when compared with standard-diameter implants. Soft tissue recessions at wide-diameter implants increased at the 5-year follow-up. Based on these observations, the use of wide-diameter implants in the aesthetic zone may be questionable (Small et al. 2000).

The stability of peri-implant soft tissues is a keystone in selecting the timing for placement of the final restoration. Small & Tarnow (2000) evaluated soft tissue remodelling from abutment connection surgery to the 1-year follow-up, reporting that a gingival recession of approximately 1 mm occurred especially within the first 3 months. Grunder (2000) evaluated soft tissue stability in 10 single-tooth implants in the maxillary incisor area. All sites were treated with implant fixture positioning and a non-resorbable membrane on the buccal side. At the second-stage surgery, the barrier was removed and a CTG was positioned buccally. Clinical measurements of soft tissue levels were recorded following crown installation and at 1-year follow-up. This author described a mean soft tissue shrinkage of 0.6 mm with a relative increase in visible length of the implant crown. In addition, a small increase of papilla volume was reported. Because of this soft tissue rearrangement, a temporary restoration for at least 6 months in the management of aesthetically demanding cases was suggested. Similar clinical consideration may be made for one-stage implants: Cochran et al. (2002) reported soft tissue recession of $\sim$ 1 mm at the 1-year follow-up for ITI implants; this shrinkage may be increased at the 2-year follow-up (Oates et al. 2002). On the other hand, a long-term study (at least 15 years) analysed the changes on casts of clinical crown height on 48 single implants in the anterior maxilla compared with crown height variations in natural dentition (Jemt et al. 2006). The results of the study showed, in some cases, an increase in clinical crown height on implants, irrespective of the patients' age at the first surgical procedure, while measurements at the controlateral teeth were basically stable (Jemt et al. 2006).

### Discussion

Despite the observation that the lack of KT may not influence implant survival (Wennström et al. 1994, Bengazi et al. 1996), the careful management of soft tissue around implants is considered essential by clinicians. Several expert opinions/case series proposed different techniques to augment peri-implant-keratinized mucosa. Current approaches frequently suggest CTG or CTPF (Grunder et al. 1996, Nemcovsky et al. 1999, Bianchi & Sanfilippo 2004). Moreover, the achievement of aesthetic success in implant dentistry requires a careful management between soft tissue/bone and proper implant position/diameter (Grunder 2000). Post-operative soft tissue shrinkage ( $\sim$ 1 mm) is described for both two-stage (Grunder 2000) and one-stage implant procedures (Cochran et al. 2002) at 1-year follow-up, suggesting a long-term provisional restoration in the aesthetic zone. However, Esposito

et al. (2007) reported that there is no sufficient evidence to recommend increase in KT or to indicate specific techniques for peri-implant soft tissue management. Therefore, RCTs are needed to evaluate the potential benefit of peri-implant soft tissue management and its influence on the aesthetic outcome of implant therapy.

## Conclusion

Although scientific evidence in most part is lacking, soft tissue augmentation at implant sites may need to be considered in some clinical situations.

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**Clinical Relevance**

*Scientific rationale for the study:* To provide a narrative review of the literature concerning soft tissue management at implant sites.

*Principal findings:* There is no evidence to suggest indications or specific techniques to augment KT around implants.

*Practical implications:* Soft tissue augmentation can be considered in order to enhance the width/thickness of KT around implants and in an attempt to improve aesthetics.