Developing Keratinized Mucosa Around Nonsubmerged Dental Implants. Part II: The Use of Non-Vascularized Soft-Tissue Grafts

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As with natural teeth, controversy exists with regards to the need for keratinized mucosa around dental implants. Most clinicians find that a healthy zone of keratinized mucosa circumventing dental implants facilitates restorative procedures and improves patient comfort relative to plaque control and professional maintenance. It has been found that the quantity of keratinized mucosa in a planned implant site may vary significantly, due to local anatomy and/or local procedures. This is especially true in edentulous posterior regions where significant bone resorption has occurred. Keratinized mucosa may also be reduced or eliminated during the surgical phase of implant dentistry due to the incisions needed for flap elevation during first or second stage procedures. Concerns related to the absence of keratinized mucosa around dental implants are most often observed during the maintenance phase of treatment. These considerations include mucosal pouching, gingival hyperplasia, gingival fistulas and gingivitis. Schroeder et al (1981) postulated that the establishment of a circumferential sealing effect by a dense connective tissue collar at the site of implant penetration into the contaminated environment of the oral cavity was a prerequisite for long-term implant success. It is critical that the implant surgeon remain knowledgeable regarding the treatment of peri-implant tissues as it relates to the development of keratinized mucosa. By reconstructing keratinized mucosa at the time of implant placement the surgeon can reduce treatment time and patient expense, minimize marginal tissue recession and improve esthetics. Part I of this series focused on the development of keratinized mucosa around non-submerged dental implants with vascularized flaps. This installment focuses on techniques involving non-vascularized soft tissue grafts, specifically the sub-epithelial connective tissue graft and the free gingival graft.

Key words: dental implants, peri-implant keratinized mucosa, connective tissue graft, free gingival graft

The original protocol for the placement of endosseous dental implants required a fully submerged positioning beneath the oral soft tissues. This method necessitated a second surgical procedure to facilitate abutment connection and subsequent restoration (Branemark, 1985). It has been observed that the second surgical procedure could reduce or eliminate the amount of keratinized mucosa in the peri-implant region (Han, 1995; Tinti, 1995). This finding is important to note as it has been postulated that the establishment of a circumferential sealing effect by a dense connective tissue collar at the site of implant penetration into a contaminated environment of the oral cavity was a prerequisite for long-term success of dental implants (Schroeder, 1981; McKinney, 1988). Warrer et al (1995) found that the absence of keratinized mucosa around dental implants increases the susceptibility of the peri-implant region to plaque-induced destruction. An endosseous dental implant utilizing

Fig 1 Pre-operative view of retained deciduous tooth 'K'.

Fig 2 Pre-operative occlusal view of tooth area 15. Note broad zone of keratinized mucosa.

Fig 3 Occlusal view of implant site following the extraction of deciduous tooth 'K'.

Fig 4 Occlusal view of the immediate implant placement using a regular neck Straumann Dental Implant.

a one-stage surgical approach was developed in 1974 by Sutter et al (1983). This treatment method has been embraced as it reduces treatment time and procedures for the patient and potentially preserves keratinized mucosa. Situations exist in which a minimal or lack of keratinized mucosa is present at a planned implant site. This is frequently evident in the maxillary and mandibular posterior edentulous sextants. Based on the findings in the literature, it would follow that the preservation and possible development of keratinized mucosa would be beneficial (Alpert, 1994). A previously published paper described the use of vascularized flaps to develop keratinized mucosa around non-submerged dental implants (Beagle, 2005). This paper will focus on the use of non-vascularized (free) soft-tissue grafting techniques for the same purpose.

Two of the most versatile non-vascularized techniques for increasing the zone of keratinized tissue around both teeth and dental implants are the free gingival graft and the sub-epithelial connective tissue graft. Both techniques rely upon obtaining tissue from a donor site and transplanting it as a non-vascularized graft to a prepared recipient bed.

The free gingival graft, also known as the free masticatory mucosa graft, was first reported in the dental literature by Bjorn in 1963 and subsequently by Sullivan and Atkins in 1968. Since its first report, the technique for the free gingival graft has been modified extensively, particularly in regards to the treatment of the exposed root surface (Ochsenbein, 1974; Miller, 1982). Donor tissue for this technique is generally a full-thickness graft obtained from the hard palate, but recently accellular dermal tissue has been reported as being efficacious in increasing the zone of attached gingiva as well as obtaining root coverage (Harris, 2000). Primary indications for the use of the free gingival graft for nat-

Fig 5 Suturing of the flaps and suspension of the free gingival grafts along the mesial and distal of the implant.

Fig 6 Ten day post-operative photo of the surgical site following suture removal.

Fig 7 Buccal view of the four month healing of the soft tissues following implant placement.

Fig 8 Occlusal view of the four month healing of the soft tissues following implant placement.

ural teeth as well as dental implants would include the lack of attached gingival, persistent inflammation and arresting progressive recession (Maynard, 1979).

Case one illustrates the use of a free gingival graft at the time of dental implant placement, and involves the utilization of a regular neck Straumann dental implant to replace deciduous tooth 'k'. The implant procedure was performed immediately following the extraction of the deciduous molar which had ≤3 mm of attached gingival present, prior to treatment, along the buccal surface (Figs 1–3). At the time of flap suturing, it was determined that primary closure could not be achieved interproximally without sacrificing keratinized mucosa along the buccal flap (Fig 4). To avoid the undesirable gingivectomy procedure, a free gingival graft was obtained from the maxillary left hard palate and used as donor tissue to close the exposed interproximal areas. The graft was divided into two equal halves and was passively placed interproximally adjacent to the transmucosal polished collar of the implant. Vertical mattress sutures (5.0 vicryl) were utilized to approximate the buccal and lingual flaps as well as to stabilize the soft tissue grafts (Fig 5). Sutures were removed at 10 days and healing progressed uneventfully (Figs 6–8).

Case two involves one of the most versatile techniques found in the periodontal plastic surgical literature: the subepithelial connective tissue graft. The use of the connective tissue graft to increase the width of the keratinized gingiva around teeth was first introduced by Edel (1977). It was found that the palatal connective tissue could function as an indicator of keratinization of proliferating epithelial cells. The use of the connective tissue graft was further developed by Langer and Calanga (1980) to correct edentulous ridge concavities. In

Fig 9 A deciduous tooth is present in the position of tooth 4.

Fig 10 An occlusal view of the deciduous tooth in the position of tooth 4.

Fig 11 Radiographic evidence of significant root resorption of the deciduous tooth is noted.

Fig 12 The deciduous tooth is extracted.

1985, Langer and Langer published a technique using the subepithelial connective tissue graft for the purposes of obtaining root coverage over a denuded root surface. Modifications of this technique have been described in the literature, deeming it one of the most favorable methods for predictable root coverage (Raetzke, 1985; Allen, 2004).

Block recently published indications for use of the connective tissue graft in dental implant sites (Block, 1999). These indications include:

1. thickening of the gingiva to eliminate metal showing from an underlying dental implant
2. improving the quality of crestal gingiva
3. increasing the convexity of the labial contours of soft tissues in esthetic sites
4. increasing the thickness of gingiva available for sculpting
5. correcting minor vertical height discrepancies.

Sub-epithelial connective tissue grafts can be placed at the time of implant surgery or at a separate surgical procedure prior to restoration. The primary advantages of the single surgical approach are to reduce healing time and eliminate additional surgical procedures for the patient. The principal disadvantage of such an approach is the possibility of a decreased vascular supply to the graft when placed over the implant surface or denuded bone.

In case two, a 29-year-old female presented for implant surgery to replace tooth 4 (Figs 9 and 10). Noteworthy was that tooth 4 was congenitally missing, and deciduous tooth 'a' was retained but exhibited significant root resorption (Fig 11). The treatment plan recommended to the patient involved the extraction of deciduous tooth 'a' and immediate placement of a Straumann dental implant to replace tooth 4.

Fig 13 Prosthetically driven implant placement.

Fig 14 A connective tissue graft has been harvested.

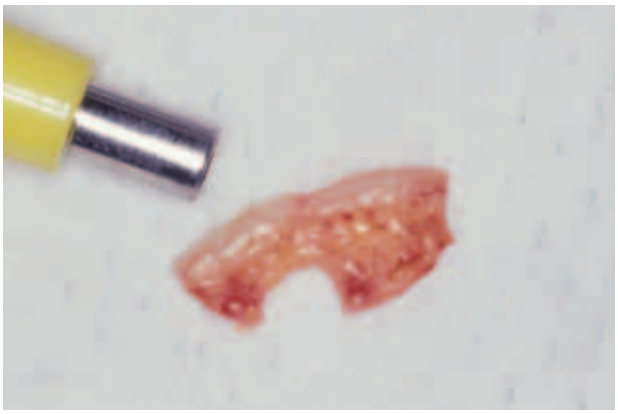

Fig 15 A biopsy punch is used to sculpt the graft tissue.

Fig 16 A connective tissue graft is placed beneath the palatal flap around the implant.

The surgical protocol followed the method described by Buser el al (2000), with a sulcular incision extending from tooth 2 to tooth 5 both bucally and palatally. Full-thickness mucoperiosteal flaps were elevated, and deciduous tooth 'a' was extracted using forceps (Fig 12). The site was thoroughly degranulated and an osteotomy was performed to allow ideal implant positioning relative to the planned prosthetic outcome (Fig 13).

Following implant placement, a 4mm gap was noted from the margin of the palatal flap to the palatal aspect of the implant. A subepithelial connective tissue graft was harvested from the maxillary left palatal area to cover the denuded bone noted along the palatal aspect of the implant (Fig 14). A 4 mm disposable biopsy punch was used to sculpt the donor tissue (Fig 15), allowing it to lie passively around the non-submerged Straumann dental implant. Prior to suturing, the epithelial border of the graft was excised. The lateral and apical borders of the connective tissue graft were tucked beneath the palatal flap (Fig 16), and were sutured interproximally to the buccal flap using 5/0 vicryl suture. The palatal flap was then sutured interproximally to the buccal flap with an interrupted technique followed by a horizontal mattress technique around the implant site (Fig 17) Closure of the palatal donor site was accomplished using 5/0 vicryl with a horizontal mattress technique (Fig 18). Healing proceeded uneventfully, with sutures removed at one week (Figs 19 and 20). Following eight weeks of healing, excellent peri-implant soft tissue health was observed circumferential to the implant (Figs 21 and 22) and the patient was released to complete definitive restoration of the implant.

Fig 17 The buccal and palatal flaps, and the connective tissue graft are sutured into place.

Fig 18 The graft donor is sutured.

Fig 19 The sutures are removed one week postoperatively.

Fig 20 The donor site is healing uneventfully one week postoperatively.

Fig 21 Following healing, abundant keratinized tissue is noted on the buccal aspect of the implant.

Fig 22 An occlusal view demonstrating the healed soft tissue around the implant.

DISCUSSION

Peri-implant problems are all too often observed at the maintenance phase of treatment following dental implant restoration. These concerns may include an inadequate zone of keratinized tissue, mobility of the soft tissues, mucosal 'pouching', gingival hyperplasia, gingival fistulas and gingivitis (Rapley, 1992). Despite the on-going debate regarding the need for keratinized mucosa around dental implants, it is generally accepted that such tissue is clinically desirable. Improvements with regard to esthetics, reduction of marginal tissue recession, ease of restorative procedures, and comfort of the patient relative to plaque control have been noted when keratinized mucosa is present (Alpert, 1994). Schroeder (1991) has postulated that the establishment of a circumferential sealing effect by a dense connective tissue collar at the site of implant penetration into the contaminated environment of the oral cavity is a pre-requisite for long-term implant success. This concept was experimentally tested in animals by Warrer and Buser (1995), noting that the absence of keratinized mucosa around dental implants increased the susceptibility of the peri-implant region to plaque induced tissue destruction. Lindhe (1998) stated that connective tissue integration is important for the longevity of the implant, while osseointegration is important for the function of the implant. The initial and secondary surgical procedures often reduce or eliminate the available keratinized mucosa. Therefore, a variety of surgical techniques have been devised to develop peri-implant keratinized mucosa around two stage implant systems. When appropriate, periodontal plastic surgical procedures can be performed on one-stage implant systems thereby reducing treatment time and costs for the patient, and improving the peri-implant soft and hard tissue health. The free gingival graft and the subepithelial connective tissue graft are two such techniques.

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