Developing Keratinized Mucosa Around Nonsubmerged Dental Implants. Part I: The Use of Vascularized Flaps

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Despite the continued debate regarding the need for keratinized mucosa around dental implants, most clinicians are in agreement that keratinized peri-implant soft tissues are clinically desirable. The quantity of available keratinized mucosa in a proposed implant site can vary significantly due to local anatomy and/or previous surgical procedures. In many instances a minimal zone of keratinized tissue is noted prior to implant placement in the posterior regions, and in other instances, surgical incisions necessary for implant placement may reduce or eliminate what keratinized mucosa exists. Peri-implant concerns related to an absence of keratinized tissue, and often observed throughout the maintenance phase of treatment, can include tissue mobility, mucosal 'pouching', gingival hyperplasia, gingival fistulas, and gingivitis. Schroeder 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 was a pre-requisite for long-term implant success (Schroeder et al, 1981). Knowledge and treatment of the peri-implant tissues will continue to be an area in which the unique expertise of the periodontist is sought and valued in the partnership with restorative dentists. Surgically reconstructing keratinized tissue at the time of implant placement minimizes treatment time and reduces total expense for the patient, improves patient comfort relative to plaque control and professional maintenance, reduces marginal tissue recession, improves esthetics, and facilitates restorative procedures. This two-part article series will focus on a variety of periodontal plastic surgical techniques designed to increase the zone of keratinized mucosa around non-submerged dental implants at the time of implant placement. Specifically, this installment will elaborate on vascularized versus non-vascularized flaps.

Key words: dental implants, peri-implant keratinized mucosa, vascularized flaps, mucoplasty, sliding pedicle flap, rotated papilla flap, internal pedicle flap

Since the recognition more than 30 years ago by Branemark et al (1977) that titanium endosseous dental implants could be used to predictably rehabilitate fully edentulous patients, the application of osseointegration has evolved into the treatment of partially edentulous patients, with equal or better success (Buser et al, 1997). One of Branemark's initial treatment protocols required a two-stage surgical approach, with the implant placed submucosally for six to nine months before a second surgical procedure was performed to insert a transmucosal abutment cylinder (Branemark et al, 1985). It has been recognized that this second surgical procedure could reduce or eliminate the amount of keratinized mucosa in the peri-implant region (Han et al, 1995; Tinti and Parma-Benfenati, 1995).

In 1974, Sutter et al developed the ITI dental implant system. Among its many biologically designed differences from other currently available endosseous implant systems was the advent of a one-stage surgical approach in placing the implant transmucosally. This aspect, as well as the titanium plasma sprayed (TPS) surface, contributed to a healing time of three to four months before insertion of the prosthetic abutment and initiation of the final restorative treatment. Current research by Cochran et al (1993), examining a sand-blasted large-grit acid-etched (SLA) implant surface, indicates that abutment placement can be initiated at

Fig 1 Pre-operative buccal view of tooth area 15.

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

Fig 3 Buccal view of non-submerged implant #15 following gingivectomy and suturing.

Fig 4 Occlusal view of non-submerged implant #15 following gingivectomy and suturing.

Fig 5 Three-month post-operative buccal view showing non-submerged implant #15.

six weeks in type I, II, or III bone utilizing the single stage transmucosal approach described in 1974. With the paradigm shift of implant treatment toward the partially edentulous patient from the fully edentulous patient, clinicians have begun to recognize the reduction or lack of peri-implant keratinized mucosa at the time of implant surgery. It has been repeatedly 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 the long-term success of dental implants (Schroeder et al, 1981; McKinney et al, 1988). Warrer et al (1995) have shown that the absence of keratinized mucosa around dental implants increases the susceptibility of the peri-implant region to plaque-induced tissue destruction. It has also been noted that a more shallow peri-implant sulcus is present at implants surrounded by keratinized mucosa as opposed to those circumscribed by non-keratinized mucosa (Zarb and Symington, 1983).

Fig 6 Three-month post-operative occlusal view showing non-submerged implant #15.

Fig 7 Pre-operative buccal view of tooth area 15.

Fig 8 Final restoration of implant #15 showing excellent peri-implant keratinized mucosa.

Various methods have been developed to provide precise inter-proximal flap closure around non-submerged dental implants. These techniques have been designed to either maintain an existing zone of keratinized mucosa or reconstruct a non-existent zone of keratinized mucosa. As with soft-tissue grafting around natural teeth, these surgical procedures can be categorized as either vascularized or non-vascularized (free) grafts.

This article, part one of a two-article series, will focus on vascularized flaps to maintain or increase the zone of keratinized mucosa around non-submerged dental implants.

Gingivectomy (mucoplasty) (Figs 1-8)

When an adequate zone (≥ 3 mm) of keratinized mucosa is present on both buccal and lingual aspects of a non-submerged dental implant, primary interproximal tissue closure can be achieved with a standard gingivectomy procedure. Buser et al (2000) have described this in regard to basic surgical procedures for Straumann dental implants. This technique is primarily intended for posteriorly placed implants and can be achieved by scalloping the flap margins using either a scalpel blade, surgical scissors, or disposable 4 mm biopsy punch. An extended healing cap should be chosen of sufficient height to prevent migration of the soft tissue in a coronal direction. Suturing is accomplished using 5.0 vicryl to properly adapt the interproximal tissues.

Sliding pedacle flap (Figs 9-20)

The sliding pedicle flap is designed to preserve keratinized mucosa along the buccal aspect of posteriorly placed, non-submerged dental implants. It has been illustrated in the literature by Buser

Fig 9 Pre-operative buccal view of area 37 and 36.

Fig 10 Pre-operative lingual view of area 37 and 36.

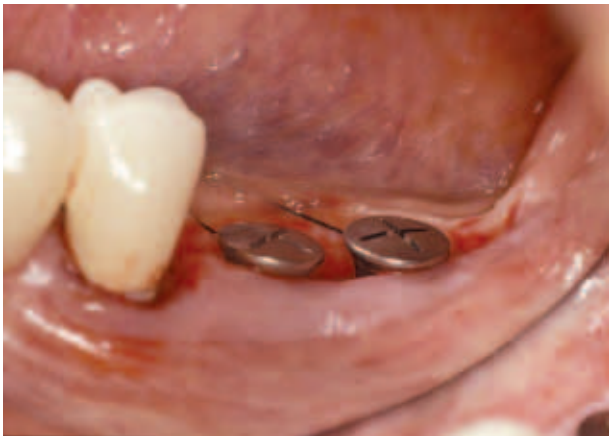

Fig 11 Buccal view of placement of non-submerged implants 37 and 36.

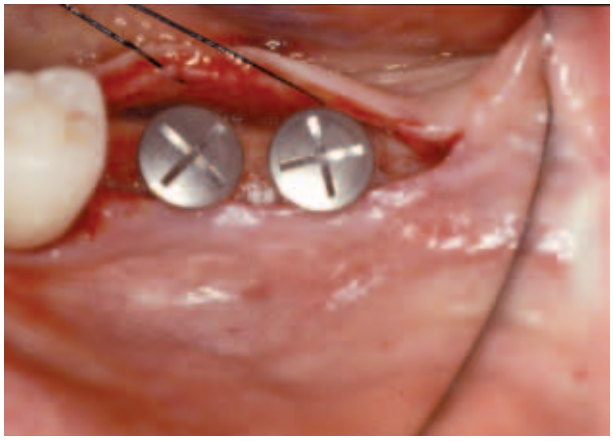

Fig 12 Occlusal view of non-submerged implants 37 and 36.

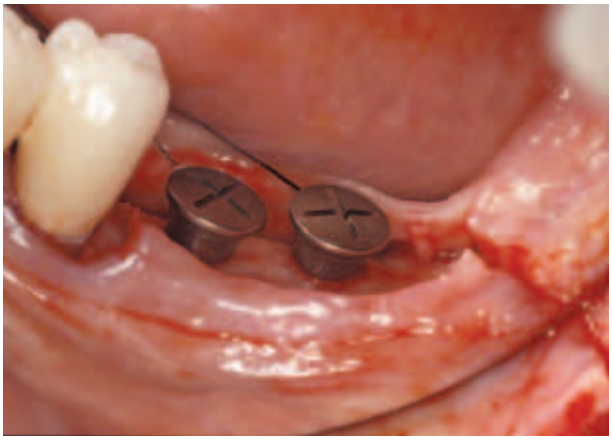

Fig 13 Distal vertical release of buccal flap. Note release extending into buccal vestibule.

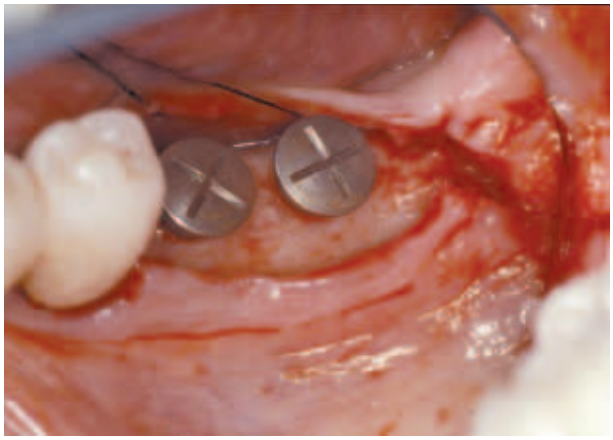

Fig 14 Distal vertical release of buccal flap (occlusal view).

and von Arx (2000). The surgical technique can be adapted for both single and multiple implant placement when a minimal zone (≤ 2 mm) of keratinized mucosa is present. Unlike the gingivectomy procedure, no scalloping of the buccal tissues is performed. Instead, a vertical releasing incision is made

Fig 15 Buccal view of non-submerged implants 37 and 36 following suturing.

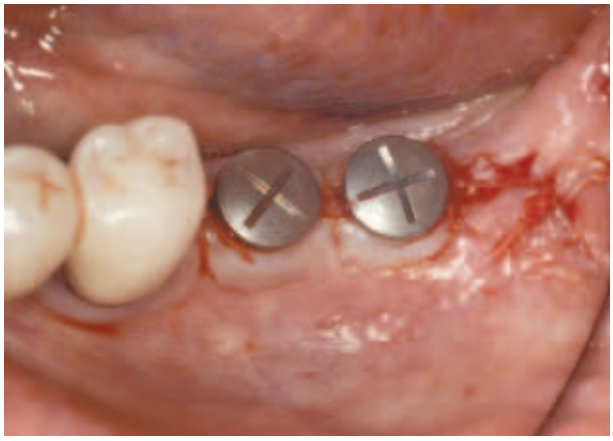

Fig 16 Occlusal view of non-submerged implants 37 and 36 following suturing (note achievement of primary closure interproximally).

Fig 17 One week post-op following suture removal (buccal view).

Fig 18 One week post-op following suture removal (occlusal view).

Fig 19 Three-month post-op (buccal view) of non-submerged implants 37 and 36.

Fig 20 Three-month post-op (occlusal view) of non-submerged implants 37 and 36. Note extended peri-implant keratinized mucosa.

approximately 10 mm distal to the most distal implant, with a periostial release undermining the buccal flap. This permits the flap to rotate freely and slide both mesially and coronally. Suturing is initiated at the interproximal zone beginning at the most mesial implant, with 5.0 vicryl closure of the inter-

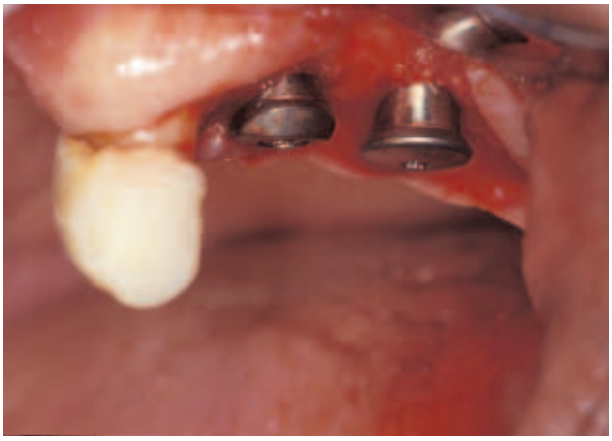

Fig 21 Buccal view of non-submerged implants 24 and 25.

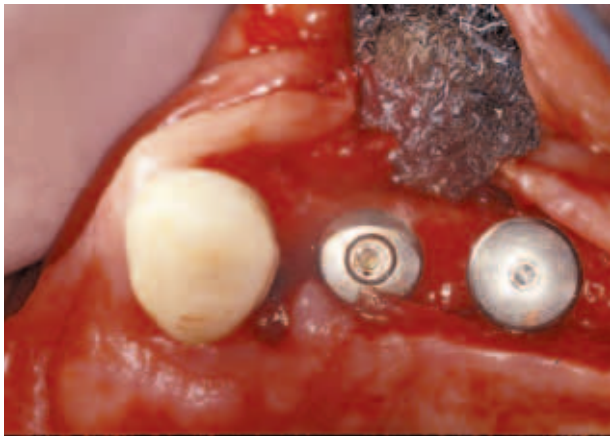

Fig 22 Occlusal view of non-submerged implants 24 and 25.

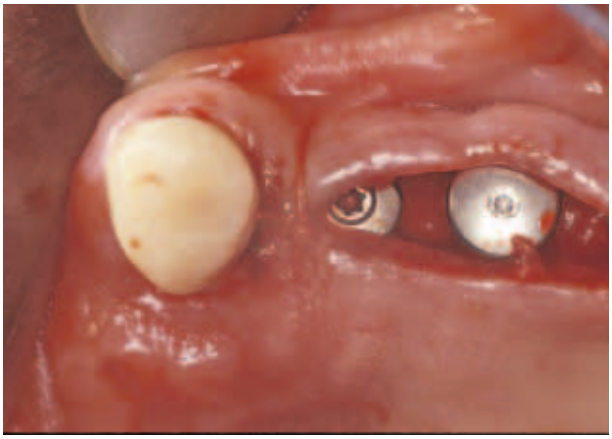

Fig 23 Occlusal view of non-submerged implants 24 and 25 with initial interrupted suture placed mesial of 24. Note lack of primary closure between the implants.

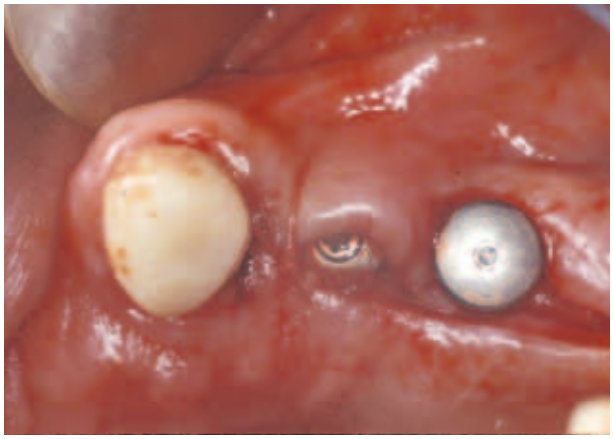

Fig 24 Rotational papilla flap placed inter-proximally between implants 24 and 25.

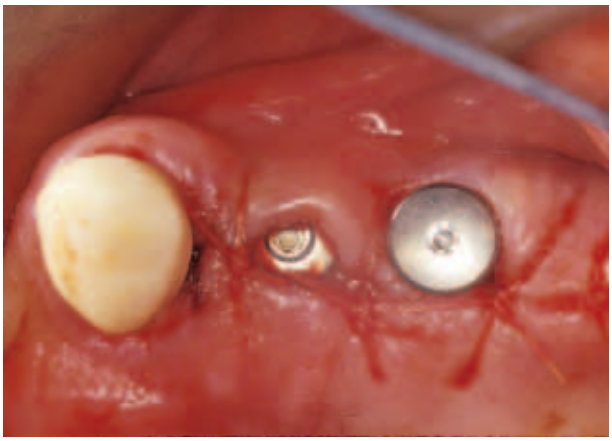

Fig 25 Completion of suturing. Note semi-submerged closure for 24 and non-submerged closure for 25.

Fig 26 One week post-op of implants 24 and 25 (buccal view).

Fig 27 One week post-op of implants 24 and 25 (occlusal view).

Fig 28 One month post-op of implants 24 and 25 (occlusal view).

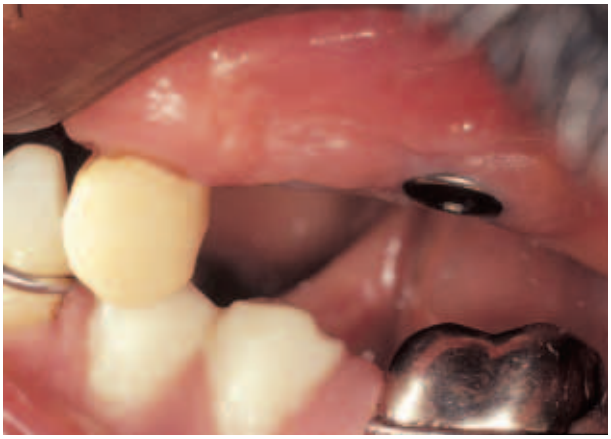

Fig 29 One month post-op of implants 24 and 25 (buccal view).

Fig 30 Three-month post-op of implants 24 and 25 with semi-submerged healing cap for 24 (occlusal view).

proximal spaces accomplished by allowing the flap to migrate coronally and curve around the transmucosal aspect of the implants. Again, it is important to select an appropriate extended healing cap to prevent unwanted migration of the flap margin over the non-submerged implant.

Rotated papilla flap (Figs 21-30)

Palacci (1995) has described the rotated papilla flap in the literature for use during second stage surgery in treating submerged dental implants. When applied to non-submerged sites, this technique permits not only reconstruction of the interdental papilla, but also primary closure of the interproximal zone. This method is accomplished by creating a small pedicle via an incomplete scalloping incision using a 15c scalpel blade along either the buccal or lingual flap margins adjacent to the non-submerged implant. A prerequisite for this technique is the availability of at least 3mm of keratinized mucosa at the site. With appropriate release, the small papilla pedicle can be freely rotated interproximally and then sutured using 7.0 vicryl. It is advisable to also place a mattress suture through this site for added stability.

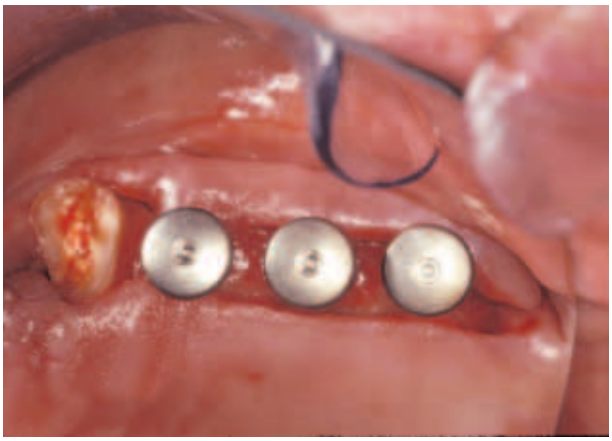

Fig 31 Occlusal view of non-submerged implants 24, 25, and 26. Note lack of primary closure and narrow zone of buccal keratinized mucosa.

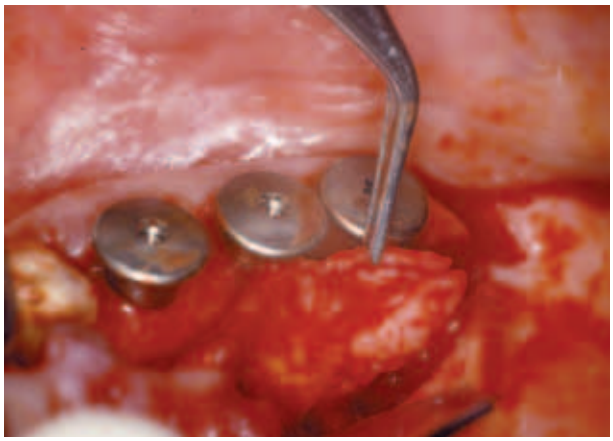

Fig 32 Release of vascularized connective tissue graft. Blood supply is maintained along mesial.

Fig 33 Suturing of vascularized connective tissue graft to buccal flap, following scalloping incision.

Fig 34 Completed suturing of non-submerged implants 24, 25, and 26.

Fig 35 One month post-op of non-submerged implants 24, 25 and 26. Note excellent peri-implant keratinized mucosa.

Internal pedicle flap (Figs 31-35)

The internal pedicle flap is designated for maxillary posterior sites having a minimal (≤ 2 mm) zone of keratinized mucosa along the buccal flap margin. This technique requires that a full-thickness palatal flap be elevated, permitting a dissection of the underlying connective tissue into a vascularized pedicle. The blood supply to the pedicle can be maintained at either the mesial or distal segment. The pedicle flap should be extended in length to permit free rotation in a coronal direction to fill the interproximal spaces, without tension. It is helpful to scallop the pedicle adjacent to the non-submerged dental implant using a 15c scalpel blade or 4 mm disposable biopsy punch. Suturing

is accomplished by approximating the pedicle interproximities to the buccal flap using 5.0 vicryl. A mattress suture is then placed interproximally to secure the buccal flap to the primary palatal flap, providing stability to the underlying connective tissue pedicle.

DISCUSSION

Controversy still remains with regard to the need for keratinized mucosa around dental implants, not unlike discussions raised regarding the need for attached gingiva around natural teeth (Lang and Loe, 1972; Ochsenbein and Maynard, 1974; Miyasato et al, 1977; Hall, 1981; Dorfman et al, 1982; Wennstrom, 1987; Karring et al, 1975; Kennedy et al, 1985). In contrast to Miyasato et al (1977), who demonstrated that gingivitis did not develop more rapidly around natural teeth in sites with a minimal zone of attached gingiva, Warrer et al (1995) showed a clear difference in the progression of plaque- induced peri-implant lesions around implants with non-keratinized mucosa. This study concluded that the difference could be explained by the lack of a tight tissue adaptation providing the necessary seal for a functional optimal epithelial attachment. In retrospective studies, Adell et al (1986) and Albrektsson et al (1986) failed to show any significant differences in the progression of lesions around implants, with or without keratinized mucosa. It should be noted the data assessed considered only implant survival rates, not histology.

Despite the debate, it is generally accepted that keratinized mucosa around dental implants is desirable, as it provides improved esthetics, provides greater ease with restorative procedures, reduces marginal tissue recession, and offers greater comfort for the patient with home care and professional plaque removal (Alpert, 1994).

A variety of surgical techniques, both vascularized and non-vascularized, have been devised to develop peri-implant keratinized mucosa around two-stage dental implant systems, as the initial and secondary surgeries often reduce or eliminate the available keratinized mucosa. When appropriate, these methods can be successfully applied to one-stage non-submerged implant placement at the time of the initial surgery to provide optimal peri-implant tissue health.

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