Immediate Implant Placement and Provisionalization With and Without a Connective Tissue Graft: An Analysis of Facial Gingival Tissue Thickness

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Facial gingival tissue thickness (FGTT) is important for an esthetically pleasing anterior restoration since it determines the soft tissue’s ability to conceal the underlying restorative material. The purpose of this study was to investigate the change in FGTT after immediate implant placement and provisionalization with and without a connective tissue graft. Patients with a failing maxillary anterior tooth planned for immediate implant placement and provisionalization with (CT group) or without (NCT group) a subepithelial connective tissue graft were included in this study. After tooth extraction, direct measurement of the FGTT was performed; subsequent measurements were performed at the time of definitive prosthesis placement. Data were analyzed using independent and paired t tests at a significance level of α = .05. There was no statistically significant difference in the mean FGTT at tooth extraction between the CT and NCT groups. At prosthesis delivery, the mean FGTT for the CT group was significantly greater than that of the NCT group. The mean FGTT of both groups at prosthesis delivery was significantly higher than that at tooth extraction. The mean change in FGTT in the CT group was also significantly greater than that in the NCT group. Immediate implant placement and provisionalization in conjunction with a connective tissue graft is more likely to result in sufficient peri-implant tissue thickness to conceal underlying implant restorative materials than when performed without a connective tissue graft. (Int J Periodontics Restorative Dent 2012;32:657–663.)

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Gingival biotype, as assessed visually or by using a periodontal probe, is indicative of the propensity for facial gingival tissue recession after surgical and restorative procedures. Gingival tissue thickness, which can only be obtained by direct measurement, determines the soft tissue's ability to conceal the underlying restorative material. Accurate diagnosis is necessary for a precise treatment plan and clear communication among clinicians as well as with the patient.

The purpose of this study was to investigate the change in facial gingival tissue thickness (FGTT) after IIPP with and without a subepithelial connective tissue graft (SCTG).

Method and materials

This study was approved by the Institutional Review Board of Loma Linda University and was conducted in the Center for Prosthodontics and Implant Dentistry, Loma Linda University School of Dentistry, Loma Linda, California. Patients were selected according to the following inclusion criteria: 18 years of age or older with good overall oral hygiene; a single failing maxillary anterior tooth (canine to canine) without prior guided tissue regeneration, root coverage, crown lengthening, or gingival tissue graft procedures; presence of adequate and harmonious gingival architecture with the surrounding dentition; and presence of a free gingival margin to underlying bone dimension of approximately 3 mm on the facial aspect of the failing tooth ascertained by the bone sounding technique. Presence of infection or inflammation around the free gingival margin of the failing tooth or a medical or dental history that would compromise the outcome of the study, such as alcohol or drug dependency, history of smoking, mouth breathing, poor overall health, or any other medical, physical, or psychologic reason warranted exclusion from the study.

Clinical procedures

All patients involved in this study received comprehensive treatment planning and a diagnostic work-up and consented to the treatment, which was either IIPP with SCTG (CT group; Figs 1a to 1c) or IIPP without SCTG (NCT group; Figs 2a to 2c). Immediately after minimally traumatic extraction of the failing tooth, direct measurements of the FGTT at approximately 2 mm apical to the free gingival margin were made using a modified caliper (Wax Caliper) to the nearest 0.1 mm (Fig 3). The measurement was recorded when two duplicate values were registered. IIPP was then performed, followed by guided bone regeneration with a mixture of allograft and xenograft to fill the extraction socket. The SCTG harvested from the palate was only incorporated on the labial aspect of the labial bony plate of patients in the CT group. Implant position was recorded as facial, centered, or palatal according to the position of the center of the implant platform in relation to the extraction socket at the time of implant placement. The subsequent measurements of the FGTT were performed at the time of definitive prosthesis delivery.
Data collection and analysis

The following data were recorded: patient demographics, position of the failing tooth, mode of failure, implant position in relation to the extraction socket, and FGTT before implant placement (T1) and at the time of definitive prosthesis delivery (T2). Means and standard deviations of the FGTT were calculated and compared between and within the CT and NCT groups using independent and paired t tests, respectively. Pearson correlation was used to seek associations between FGTT at T1 and T2 as well as between the change in FGTT and the length of follow-up (time elapsed between T1 and T2). All statistical analyses were performed at a significance level of $\alpha = .05$.

Results

Twenty-four patients (13 men, 11 women) with a mean age of 45.4 years (range, 23 to 87 years) underwent IIPP without an SCTG (NCT group). Nine of the failing teeth were central incisors, 12 were lateral incisors, and 3 were canines. The modes of failure included caries ($n = 1$), failed restoration ($n = 4$), endodontic failure ($n = 4$), root resorption ($n = 4$), periodontal failure ($n = 4$), and tooth/root fracture ($n = 7$). The implant systems used were NobelActive (Nobel Biocare; $n = 6$) and NobelReplace (Nobel Biocare; $n = 18$). One implant was placed in the center of the extraction socket, while 2 and 21 implants were placed facial and palatal to the center of the extraction socket, respectively. At T1, the
mean FGTT was 1.10 ± 0.25 mm (range, 0.7 to 1.6 mm). After a mean follow-up of 8.6 months (range, 6 to 17 months) (T2), the mean FGTT was 1.42 ± 0.36 mm (range, 0.8 to 2.1 mm). The mean change in FGTT was 0.32 ± 0.36 mm (range, –0.4 to 1.3 mm). The frequency distribution of FGTT before and after IIPP without an SCTG is presented in Fig 4.

Thirty-one patients (8 men, 23 women) with a mean age of 43.9 years (range, 19 to 74 years) underwent IIPP with an SCTG (CT group). Twenty-three of the failing teeth were central incisors, 6 were lateral incisors, and 2 were canines. The modes of failure included caries (n = 2), failed restoration (n = 2), endodontic failure (n = 13), root resorption (n = 5), and tooth/root fracture (n = 9). The implant systems used were Osseospeed (Astra Tech; n = 1), Straumann (Straumann; n = 8), NobelActive (n = 11), NobelPerfect (Nobel Biocare; n = 5), and NobelReplace (n = 6). Seven implants were placed at the center of the extraction socket, while 24 implants were placed palatal to the center of the extraction socket. At T1, the mean FGTT was 1.18 ± 0.23 mm (range, 0.7 to 1.6 mm). After a mean follow-up of 10.2 months (range, 6 to 24 months) (T2), the mean FGTT was 2.61 ± 0.57 mm (range, 1.5 to 4.1 mm). The mean change in FGTT was 1.43 ± 0.59 mm (range, 0.4 to 2.7 mm). The frequency distribution of FGTT before and after immediate tooth replacement with an SCTG is presented in Fig 5.

Independent t tests showed no statistically significant difference in the mean FGTT at T1 between the CT (1.18 mm) and NCT groups (1.10 mm) (P = .25). The mean FGTT in both groups at T2 (CT, 2.61 mm; NCT, 1.42 mm) was significantly higher than that at T1 (paired t test, P < .01). At T2, the mean FGTT of the CT group was significantly greater than that of the NCT group (independent t test, P < .01). The mean change in FGTT for the CT group (1.43 mm) was also significantly greater than that of the NCT group (0.32 mm) (independent t test, P < .01).

Mild positive correlation was observed regarding the FGTT at T1 and T2 (the higher the T1 thickness, the higher the T2 thickness) for the NCT group (r = 0.35), but it was not statistically significant (P = .09). Similarly, there was no significant correlation observed between the FGTT at T1 and T2 for the CT group (r = 0.11, P = .55). In addition, no significant correlations were observed between the change in FGTT and the length of follow-up in both groups (CT: r = 0.19, P = .32; NCT: r = –0.01, P = .72).

Fig 4 Frequency distribution of FGTT at T1 and T2 for the NCT group (n = 24).
Discussion

FGTT often dictates the soft tissue’s ability to conceal the underlying implant and restorative material. In this study, the overall mean FGTT of maxillary anterior teeth at T1 (1.15 ± 0.24 mm; range, 0.7 to 1.6 mm) was comparable to that obtained in studies similar in nature (mean, 1.0 to 1.1 mm; range, 0.6 to 1.5 mm). In fact, only 11% (6 of 55) of subjects in this study had ≥ 1.5 mm FGTT at T1 (see Figs 4 and 5). In a spectrophotometric study evaluating the ability of gingival tissue of various thicknesses to mask different types of underlying restorative material (titanium, titanium-ceramic, zirconia-ceramic, and zirconia), it has been shown that with 1.5 mm of gingival tissue thickness, all test materials caused visible tissue color change. In fact, 3 mm of gingival tissue thickness was required to sufficiently mask all test materials, while with 2-mm-thick gingival tissue, only zirconia did not induce any visible color change. In other words, the average human maxillary anterior FGTT is not sufficient to mask most underlying restorative materials.

It is interesting to note that the mean FGTT at T2 (1.42 mm) for the NCT group was significantly greater than that at T1 (1.10 mm, P < .01). These results are similar to those reported in studies where the mean FGTT (1.8 to 2.0 mm) of the implant restoration without gingival tissue grafts was greater than that of the contralateral natural tooth (1.1 to 1.5 mm). Most implants placed in this study were positioned palatally, thereby increasing the space between the implant restoration and gingival tissue, which might have contributed to the slight thickening of the facial gingival tissue. In addition, the inevitable soft tissue level change after an immediate tooth replacement procedure made it virtually impossible to repeat the T1 and T2 tissue measurements at the exact same apico-coronal location. Nevertheless, even with the slight increase in dimension, the FGTT at T2 (mean, 1.42 mm) seems inadequate for masking any type of underlying restorative material.

In this study, the FGTT values at T2 of ≥ 1.5 mm and ≥ 2 mm were observed in only 46% (11 of 24) and 8% (2 of 24) of subjects, respectively (see Fig 4). The fact that no significant correlation was observed between the change in FGTT and the length of follow-up suggests that the peri-implant gingival tissue thickness is stable 6 months after IIPP and that no further improvement in tissue thickness should be expected. In addition, the mild but
statistically insignificant positive correlation between FGTT at T1 and T2 in the NCT group ($r = 0.35, P = .09$) indicates that while there is a tendency of gingival thickness to increase, the change is not predictably (range, –0.4 to 1.3 mm).

As anticipated, the mean FGTT at T2 (2.61 mm) for the CT group was significantly greater than that at T1 (1.18 mm, $P < .01$) as well as at T2 in the NCT group (1.42 mm, $P < .01$). The FGTT at T2 for all subjects in the CT group ($n = 31$) was ≥ 1.5 mm, while 84% ($n = 26$) of patients had ≥ 2 mm, 68% ($n = 21$) had ≥ 2.5 mm, and 29% ($n = 9$) had ≥ 3 mm (see Fig 5). Most values observed at T2 were adequate in concealing one or more types of implant restorative materials.18 The lack of a significant positive correlation between values at T1 and T2 ($r = 0.11, P = .55$) can be attributed to the nonstandardized thickness of the connective tissue graft. The effect of thickness of the SCTG on the change in the peri-implant gingival tissue thickness, while not in the scope of this study, would provide valuable insight into this issue. Nevertheless, all subjects in the CT group experienced a gain in FGTT (range, 0.4 to 2.7 mm). The fact that no significant correlation was observed between the change in FGTT and the length of follow-up suggests that the peri-implant gingival tissue thickness is stable and maintainable 6 months after an immediate tooth replacement procedure. The results of this study demonstrate that connective tissue grafting is beneficial and can predictably and sufficiently improve gingival tissue thickness when performed in conjunction with IIPP.

Conclusions

Within the confines of this study, the following conclusions can be made:

- At T2, a significant increase in FGTT was observed in both groups. However, the mean FGTT in the CT group was significantly greater than that in the NCT group.
- Peri-implant gingival tissue thickness is stable and maintainable 6 months after IIPP.
- IIPP in conjunction with a connective tissue graft is more likely to result in sufficient peri-implant tissue thickness to conceal underlying restorative materials than when performed without a connective tissue graft.

References
