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CLINICAL CASE

Tissue Stability following Soft-tissue Augmentation and Zirconia Prosthesis: A 6 Years Follow-up

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ABSTRACT

Background: 'Reconstructive esthetic implant therapy' is a term evolved in the ever-demanding age of oral implantology today. Maintaining the critical factor in this delicate balance of the gingival/pink esthetics is the periimplant papilla. Its presence being a major esthetic achievement and its loss leads to tremendous esthetic handicap known as 'black hole disease'. This case report addresses this fascinating yet challenging aspect of reconstruction of periimplant papilla through a novel technique.

Methods: A 38-year-old patient presented for replacement of missing tooth. Complete oral and periodontal examination, orthodontic intervention to prepare the implant site was undertaken. Preoperative soft-tissue assessments were done. A modified palatal roll technique was performed for reconstruction of the papillary architecture. Zirconia prosthesis was fabricated and the pink esthetic score (PES) around the prosthesis was calculated.

Results: An appreciable PES score around the prosthesis complete fill of the interproximal papilla and buccal soft tissue augmentation resulted from this technique.

Keywords: Papilla reconstruction, Palatal roll technique, Maxillary anterior esthetics.

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INTRODUCTION

Optimal esthetics for implant-supported restorations in the anterior maxilla may be more difficult to obtain than implant osseointegration.

The ability to predictably preserve or reproduce inter-implant papilla is extremely important in the replacement of maxillary anterior teeth. The presence of interproximal papilla around implant-supported restorations allows symmetrical soft tissues margins and a state of harmony between natural teeth and dental implant components.[1] This harmony and tissue symmetry leads to natural looking restoration that does not obscure vision. On the contrary, slightest change in the level of the interproximal papilla can lead to major esthetic and phonetic complications. This is what makes the periimplant supported tissues a delicate clinical issue to handle.

Ideal esthetic outcomes demands an optimal position and inclination of the implant. Periimplant soft tissue is the crucial element that decides and influences the tooth length, color, texture to impart a natural appearance to the implant-supported restoration.[2]

Biologic Truths

The sequence of losing the interproximal papilla starts immediately after tooth extraction. The thin adjacent alveolar bone (interradicular bone) starts rapid resorption due to thin alveolar nature of alveolar bone, reduced blood supply to the crest of interradicular bone, possible direct contamination of the crest of interradicular bone by oral bacteria as a result of tooth extraction, absence of sharpeys fibers that stimulate continuous bone remodeling.

Engquist et al 1995[3] stated that consequence of tooth extraction leads to the interdental papilla remodeling in a sloping fashion from the palatal to the more apical facial osseous plate and becomes depressed in comparison with the healthy adjacent marginal tissue. Unfortunately, the lost interdental papilla cannot regenerate to regain its original dimensions.[4]

Biology of the Periimplant Mucosa

There is a significant difference between the tissues surrounding the natural teeth and implants. In implants due to lack of cement-like structures, connective tissue fibers of the periimplant mucosa are stretched parallel to the implant surface rather than perpendicularly attached to the root surface as seen in natural teeth. Most groups of surpracestal fibers (gingivodental and transeptal fibers) do not exist surrounding the implant abutment.

Important vital differences also is the restricted blood supply, which is due to the absence of periodontal ligament and associated blood vessel branch. The branches from the bone and oral soft tissues only provide the blood supply to the periimplant mucosa. In natural teeth, the gingival vascularization is derived from the branches originating from the interdental septa, periodontal ligament and oral mucosa. Further, the periimplant mucosa contains a high amount of collagen and low number of fibroblasts, therefore, the periimplant mucosa can also be defined as 'scar-like tissues'.

Biologic Width around Natural Teeth and Implant

The biologic width around an implant differs from the natural tooth. Average being about 3 mm compared with that present around natural teeth about 2 mm. The junctional epithelium is also the double the size of that in healthy gingival.[5] Between an implant and abutment, a space or microgap always exists and biologic width forms apical to the microgap leading to crestal bone loss of about 2 mm irrespective of whether the microgap is located at or below the alveolar crest.[6] This indicates that crestal bone changes are not dependant on the surgical technique[7] (submerged/nonsubmerged) neither on the older thought of 'saucerization'[8] (owing to mechanical stress generated by implant body) but on the location of the interface microgap[9] and lack of viable biologic width around the implant.[5]

FACTORS INFLUENCING THE OUTCOME OF PAPILLA RECONSTRUCTION

Blood Supply

It's the key factor in predicting the treatment outcome, as sufficient blood supply should be maintained in any flap design.

Implant Positioning

Well-placed implants lead to an esthetically successful implant restoration.[10] Three different directions govern the positioning of the implant: Apicoincisal, mesiodistal, labiopalatal.

Periodontal Biotype

Periodontal biotype thick or thin affects the dimension of the periodontal tissue and should be carefully evaluated during presurgical planning. Thick biotype more prone to pocket formation but reconstruction procedures seem to be more predictable due to sturdy nature of the soft-tissues and osseous structure. Thin biotype more prone to gingival recession following mechanical and surgical manipulation.

Bone Quality and Quantity

The bony support between a tooth and an implant or between two implants has been shown to be an important criterion in creating or preserving the papilla.[11,12] Tarnow et al reported a mean papillary height between two adjacent implants as 3.4 mm. One difficulty in maintaining or reforming a papilla between two implants is that the biologic width around an implant usually is located apically to the implant abutment junction. In the esthetic zone, the distance from the alveolar crest to the adjacent tooth CEJ should be 3 to 5 mm to achieve ideal implant localization and appropriate space for the periimplant sulcus to form.[13]

Soft-tissue Quantity and Quality

The documented literature unanimously states that sufficiently broad cuff of keratinized mucosa is necessary to allow for predictable manipulation of the soft-tissue surrounding the implant gingival tissues and also leads to long-term success of oral endosseous implants and maintenance of the integrity of the interproximal papilla.[14-16] Of all the methods used for soft-tissue augmentation and the flap designs used, the underlying concept is to preserve the blood supply to the adjacent papilla and to minimize recession.

Implant Size Selection

Selection of an implant for an esthetic zone depends on the dimensions of the edentulous crest and proximity of adjacent roots. Implants with larger diameter are of limited use as they compromise the interimplant distance of 3 mm leading to increased crestal bone loss.[17] Hence, implants 3.75 to 4 mm in diameter are preferred for the anterior restoration.[18] Platform switching to a smaller diameter at the interface level favors the biologic width development in the horizontal direction to compensate for vertical one hence forth minimizing the postoperative bone resorption and maintaining soft-tissue margins.[19]

Emergence Profile

A proper emergence profile is important for hygiene, gingival health and appearance. Implant restorations in the esthetic zone should mimic the emergence profile (flat) of the natural tooth. The vertical length of the subgingival portion of the restoration is extremely important as the guided gingival growth is indirectly proportional to the submergence depth of the implant.[20] The emergence profile of the final prosthesis should be carefully created. If the profile is too narrow, no contralateral pressure or support for the gingival will exist and the interdental papilla will diminish. If the profile is too wide papilla will be vertically compressed, oral hygiene will be difficult or impossible to perform and papilla will collapse.

Classification for Interdental Papilla

Nordland had classified according to marginal level of papilla in relation to the CEJ[21]:

Class 1: Tip of the interdental papilla lies between the interdental contact point and most coronal extent of the interproximal CEJ.

Class 2: Tip of the interdental papilla lies at or apical to the CEJ (interproximal CEJ visible)

Class 3: Tip of the interdental papilla lies level with the or apical to the facial CEJ.

Tarnow's classification had its basis on the predictability of the presence of interdental papilla:[22]

Class 1: When the distance between the contact point of the natural tooth and crest of the bone was 5 mm or less papilla is present almost 100% time

Class 2: When the distance was 6 mm, the papilla was present 56% times

Class 3: When the distance was 7 mm the papilla was present 27% times. Several other classifications have described this clinical entity.[23-25]

The choice of restoration for the esthetic rehabilitation in implant dentistry primarily focuses on the position, inclination, shape and color of the restoration.[26] The soft tissue around the implant-supported restorations play a significant role in defining its close imitation in their appearance to the natural teeth.[27] Restorations can cause discoloration of the mucosa.[28] Metal-free restorations/all ceramic restorations allow to preserve soft tissue color more similar to the natural tooth than the PFM restorations.[29] Zirconia with its mechanical properties similar to metal and color similar to tooth color.[30] Periimplant soft-tissue reaction to zirconium dioxide is minimal as compared to other restorative materials.[31] Biologic response of titanium *vs* the zirconia healing caps was studied. Results revealed increased inflammatory infiltrate, microvessel density and vascular endothelial growth factor expression around the titanium caps than around ZrO_2 ones.[32]

The PES Scoring Criteria[33]

This criteria is based on the seven variables: Mesial papilla, distal papilla, soft-tissue level, soft-tissue contour, alveolar process deficiency, soft-tissue color and texture. Each variable is assessed with a score of 0-1-2, with 2 being the best and 0 being the poorest score (Table 1).

Fig. 1: Orthodontic treatment done to prepare the site for implant

CASE REPORT

A 30-year-old female patient presented for routine examination with a desire of replacement of missing anterior tooth that was extracted some years ago. Patient was healthy with no significant medical history. Intraoral examination revealed congenitally missing lateral incisor in relation to left maxillary quadrant (Fig. 1). Long-standing edentulism had resulted in mesial migration of canine. Patient's oral hygiene status was adequate. Thorough treatment planning for the mouth was charted that included recording of the oral hygiene scores (plaque index, gingival bleeding index) was done. No significant periodontal findings were evident. Radiographic findings of the mouth revealed normal bone levels.

Orthodontic treatment was started with the aim of preparing the edentulous site for receiving the implant-supported prosthesis (see Fig. 1).

PREOPERATIVE ASSESSMENTS

Soft-tissue Characteristics

Under anesthesia, the surgical site was sounded for the soft-tissue thickness and to record the papilla height. Mucosal thickness 4.8 mm (midbuccal), 1.75 mm (crestal) was recorded. Papilla height index 5.5 mm (Tarnow's index) was scored. Patient had a thin flat biotype in the area.

Table 1: PES score criteria[33]

Variables	*Details*	*0*	*1*	*2*
Mesial papilla	Shape *vs* reference tooth	Absent	Incomplete	Complete
Distal papilla	Shape *vs* reference tooth	Absent	Incomplete	Complete
Marginal tissue level	Level *vs* reference tooth	Major discrepancy >2 mm	Minor discrepancy 1 to 2 mm	No discrepancy <1 mm
Soft-tissue contour	Natural matching with reference tooth	Unnatural	Fairly natural	Natural
Alveolar process	Alveolar process deficiency	Obvious	Slight	None
Soft-tissue color	Color *vs* reference tooth	Obvious difference	Moderate difference	No difference
Soft-tissue texture	Texture *vs* reference tooth	Obvious difference	Moderate difference	No difference

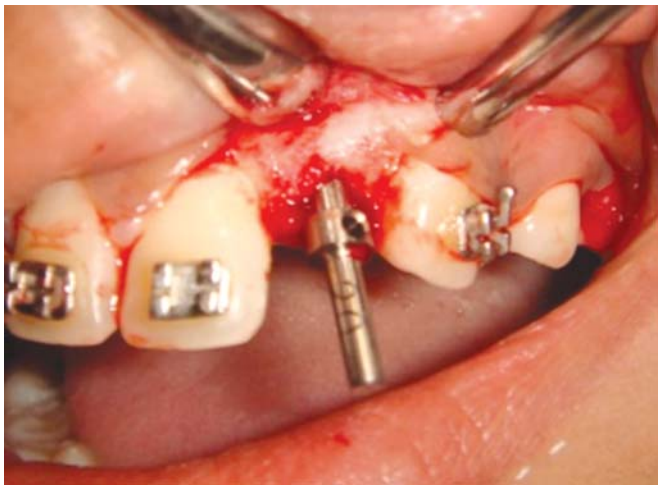

Fig. 2: Stage 1 implant surgery force direction indicator (FDI) in position

Fig. 4: Flat gingival architecture at 4 months

Fig. 3: Implant in position

Fig. 5: Stage 2 implant surgery—palatal site deepithelized

The Technique

Stage 1 surgery was performed and 3.8/10.5 mm (tapered internal, Biohorizon, AL, USA) implant was placed following manufacturer's protocol (Figs 2 and 3).

After 4 months Stage 2 surgery of uncovering the implant was performed along with the desired soft-tissue augmentation (Fig. 4). After securing anesthesia, esthetic flap design was planned preserving the interdental papilla along the adjacent teeth (Fig. 5). A 15–c scalpel (HU-FRIEDY, CH, USA) is used to mark the vertical incision extending from the buccal aspect toward the palatal side. The palatal extent is marked about 5 to 7 mm from the crestal tissue. Palatal site is marked and deepithelized with scalpel/diamond bur (Fig. 6). Full thickness flap is elevated from the palatal side. This elevation extends toward the buccal side as pouch dissection. Once the buccal dissection has been completed, the palatal tissue of the pedicle graft is then rolled and positioned into the buccal pouch and under the buccal flap (Fig. 7). Narrow diameter healing abutment

Fig. 6: Papilla preserving flap incision, flap reflected buccally

was screwed in. The pedicle graft is meticulously sutured around the emerging healing abutment using 4-0 eptfe cytoplast sutures (Osteogenics Biomedical, TX-USA). Simple interrupted sutures were placed at the mesial and

Fig. 7: Palatal flap rolled under the buccal flap

Fig. 9: Composite crown 18 months postoperative buccal view

Fig. 8: Temporary crown—at insertion

Fig. 10: Soft tissue profile after removal of composite crown

distal interproximal part of the pedicle graft that forms the future papilla and maintaining the buccal fullness simultaneously. Impression was recorded at the same visit for the fabrication of the temporary crown (Fig. 8). Two weeks postoperatively sutures were removed and temporary crown was cemented (see Fig. 8). After 8 months, with soft-tissue attaining the early stability, composite crown was placed in (Fig. 9). Two years later, impression was done to replace the composite crown with zirconia prosthesis (Figs 10 to 12). The PES of the periimplant area in relation to 22 was 5 months later, an impression was taken and a composite crown was fabricated.

Fig. 11: Final abutment

RESULTS

At 2 years, the composite crown was replaced with the zirconia crown. Complete fill of the interproximal papilla (mesial and distal) was observed. Gingival tissue thickness as measured on the buccal aspect was 4 mm at the crestal region and 6 mm at the mid buccal aspect.

CONCLUSION

Ideal outcome of the practice of implantology depends on the functional and esthetic success. Reconstruction of the gingival esthetics is an important issue in modern esthetic implant dentistry. Ideal treatment planning and sound

Fig. 12: Zirconia crown in place

preoperative assessment of soft and hard tissues form the baseline for successful predictability of the reconstructed papilla. The PES scoring criteria with its advantage of reproducibility helps in assessing the success of the surgical and prosthetic protocols especially around the single tooth implant restorations.

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