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An immediate implant with connective tissue graft as a biological barrier was evaluated for replacing a single tooth: A clinico-radiographic study.

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ABSTRACT

Background and Objectives: This study aimed to assess the one-year survival rate of Screw-Vent® instant implants with sub-epithelial connective tissue graft for single-tooth replacement.

Materials and Methods: With an average age of 27.6 years, ten patients five men and five women were treated one after the other as outpatients. They received Screw-Vent® dental implants in their newly extracted sockets along with augmentation using a sub-epithelial connective tissue graft taken from the palate to support single crowns. At baseline and every three months for a year, the clinical and radiographic data were documented to assess each patient's marginal bone loss and peri-implant soft tissue health, respectively.

Results: Screw Vent® dental implants had a 100% cumulative 1-year survival rate among all ten patients. In terms of peri-implant aesthetic qualities, such as the breadth of the keratinized

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mucosa, statistical analysis indicated highly significant findings, indicating an improvement in peri-implant soft tissue parameters. Non-significant marginal bone increase or loss indicated that hard tissue properties remained stable.

Interpretation and Conclusion: The 100% implant survival rates and noticeable increase in the width of the keratinized mucosa at the 1-year follow-up characteristics showed that Screw Vent® dental implants, when used in conjunction with guided bone regeneration using autologous connective tissue graft, are a predictable treatment for replacing a single tooth in a fresh extraction socket.

Key words: Peri-implant aesthetics, immediate implant, guided bone regeneration, and sub-epithelial connective tissue graft

INTRODUCTION

The most cutting-edge option for treating patients in need of oral rehabilitation is osseointegrated implants.

Based on more recent evidence, immediate implant placement into fresh extraction sites has been considered a predictable procedure. The Brånemark protocol, however, recommends a healing period after tooth extraction before implant placement, [1] extending the treatment period for several months.[2]

Schulte and Heimke initially reported immediate implantation in a clinical report in 1976[3], and further histologic investigations verified the process as successful.[4,5] The purpose of the immediate implant is to stop bone resorption after extraction. This technique shortens the healing period by maintaining the ridge's height and dimension[6] and avoiding several surgical treatments.There is still an issue with this technique, though, in that there is typically a gap left in the vicinity of the coronal region of the implant known as "jumping distance" because of the size and shape difference between the extraction socket and the implant.[7] The extraction socket's surrounding mucogingival state could not be conducive to primary closure over the implant.

To accomplish primary soft tissue closure and directed bone regeneration surrounding the implants inserted into extraction sites, a number of surgical techniques[8] have been proposed.

Edel[9] was the first to describe the use of a connective tissue graft for immediate implants, which allows for the undisturbed healing of peri-implant deep tissues by achieving primary closure over implants positioned in extraction sockets in conjunction with guided bone regeneration surrounding immediate implants. In order to achieve optimal tissue conditioning and a natural-looking prosthetic crown, connective tissue maintains the amount of keratinized tissue and enhances the local metabolic environment of the superficial soft tissues. This results in a satisfactory peri-implant marginal sealing.[10]

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This study aimed to ascertain the survival rate of Screw-Vent® implants inserted straight into extraction sockets supplemented with sub epithelial connective graft by using clinical parameters to assess the soft tissue health surrounding the implants and by using Image J analysis to assess the height of the peri-implant bone mesially and distally to the Screw-Vent® implants one year after implant placement.

MATERIALS AND METHODS

A human ethics committee approved this study, which was planned as a case series investigation. Ten patients, five of whom were male and five of whom were female, were chosen from the Rama Dental College's outpatient department of periodontology and implantology, hospital and research center in Kanpur, Uttar Pradesh, India. The patients' mean age was 27.6 years. The research was carried out for a year. Patients must be in good overall health, not smoke, have at least one maxillary and/or mandibular anterior or premolar tooth that is recommended for extraction (due to a root fracture, endodontic failure, or a severely decayed tooth without an active infection) [Figure 1]. Prior to the trial starting, all patients gave their verbal and written informed permission.

Diagnostic casts were used to examine each case's intra-arch connection. Long cone parallelling technique was used to get intraoral periapical radiographs (IOPA) of specified sites. Pre-operative panoramic radiographs were collected to assess the link between anatomical land markings and the tooth to be extracted. Pre-operative computed tomography images were collected in coronal and transverse sections to determine implant size. All selected clinical cases required tooth extractions in the frontal and premolar areas (Table 1). No bone dehiscences or alveolar fenestrations were detected.

Table 1: Tooth number that had to be extracted and implant size

Position	#11	#25	#24	#11	#44	#22	#24	#25	#34	#21
Implant size (width & length in mm)	3.7×13	4.7×13	4.7×13	3.7×16	3.7×13	3.7×13	3.7×13	4.7×13	3.7×13	3.7×13

Materials used in the study

Implant system

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This study utilized the Screw-Vent® implant system (Zimmer Dental, Carlsbad, CA, [USA]), designed by Dr. Gerald A. Niznick. The implant set includes osteotomy drills with diameters ranging from 2.3 to 4.5 mm and lengths of 9 mm, 11 mm, 14 mm, and 17 mm. Implants were offered in lengths of 8 mm, 10 mm, 13 mm, and 16 mm, with diameters of 3.3 mm, 3.7 mm, and 4.7 mm.

Sub epithelial connective tissue graft

In all ten patients, an autologous subepithelial connective tissue transplant was extracted from the palate using Bruno's approach [11].

Pre-surgical procedure

Following an initial evaluation and treatment plan, all patients in the research received phase I therapy, which included education, motivation, oral hygiene instructions, scaling, and polishing. Following 4 weeks of maintenance medication, chosen patients were advised to have an urgent implant surgical surgery.

Surgical procedure

The implant-surgical protocol was consistent across all patients. Implant surgeries were performed on an outpatient basis using aseptic precautions. To produce adequate local anesthesia, 2% lignocaine hydrochloride with a 1:80,000 adrenaline concentration was injected into the appropriate nerve. To extract a tooth, make a crevicular incision around it with B.P. blade no. 12, then make vertical incisions along the tooth's line angles with B.P. blade no. 15 (see Figure 2). A full thickness mucoperiosteal flap is raised to the muco-gingival junction, followed by a partial thickness flap beyond the junction to allow for coronal advancement of the flap.

Periotome was used for minimally invasive extraction, preserving alveolar bone integrity. The socket was curetted to eliminate infection, inflammation, and periodontal ligament remains (see Figure 3).
To determine implant dimensions, the extracted tooth's root length and width were measured with a caliper. To shape and deepen the socket, osteotomy was performed sequentially with saline irrigation and suitable drill size. Using aseptic procedures, the Screw-Vent® dental implant was inserted into the socket as per the manufacturer's instructions [Figure 4]. After removing the abutment, the implant platform was cleansed with metronidazole gel and secured with a cover screw. The recipient site was kept clean of saliva and blood.

An autogenous connective tissue graft measuring approximately 1.5 mm in thickness was taken from the palate. The donor site was located between the maxillary first premolar and first molar, 2 mm apical to the gingival crestal edge. Bruno's technique [11] was used to remove the graft, as shown in Figures 5 and 6. Horizontal suspension sutures with black braided (3-0) silk were used

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to close the donor site. The connective tissue graft was placed over the implant cover screw and inserted under the facial and palatal flaps. It was stabilized by a 5-0 polyglactin (Vicryl, Ethicon, Johnson and Johnson, Somerville, NJ) resorbable suture material [Figure 7]. The facial flap was then advanced coronally and secured by interrupted sutures using black braided (3-0) silk to achieve primary wound closure [Figure 8]. The recipient and donor surgical regions were treated with non-eugenol dressing (Coe-Pack®, G C America Inc, USA). Patients were given systemic Amoxycilline 500 mg thrice daily for 5 days, Diclofenac sodium + Serratiopeptidase (Divon S) thrice daily for 3 days, and chlorhexidine mouthwash during the post-operative period. The periodontal dressing and sutures were removed 10 days after surgery, and the area was carefully rinsed with saline. Oral hygiene instructions were reiterated. The second stage operation was conducted 6 months following the initial procedure to put a healing abutment for 4 weeks [Figure 9]. The final implant prostheses were then cemented on the abutments using zinc polycarboxylate luting cement [Figure 10]. Follow-up was conducted at 9 and 12 months (see Figure 11).

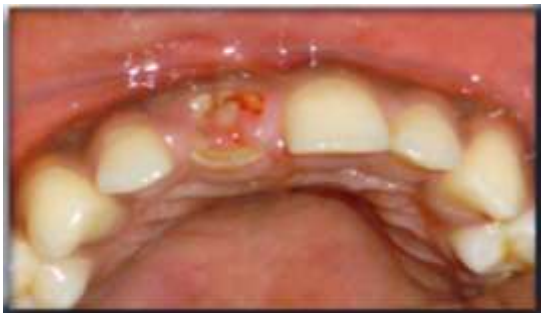

Fig 1: Tooth #11 indicated for extraction due to subgingival fracture

Fig 2: Vertical and sulcular incisions placed

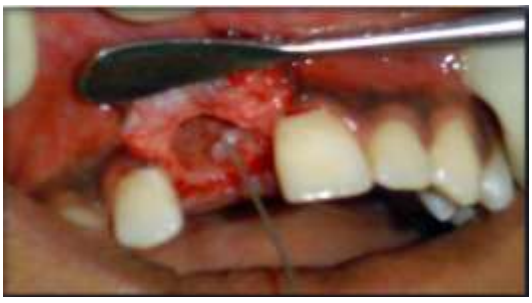

Fig 3: Socket debridement done.

Fig 4: Implant (3.7x16 mm) placed in to the socket

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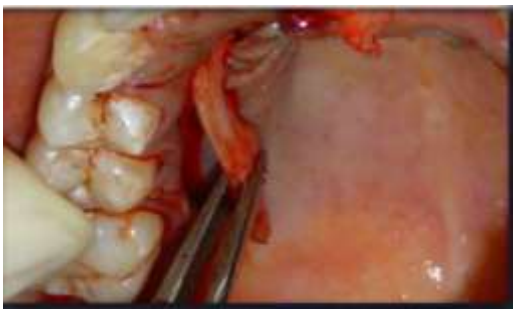

Fig 5: subepithelial connective tissue graft Harvested from the palate

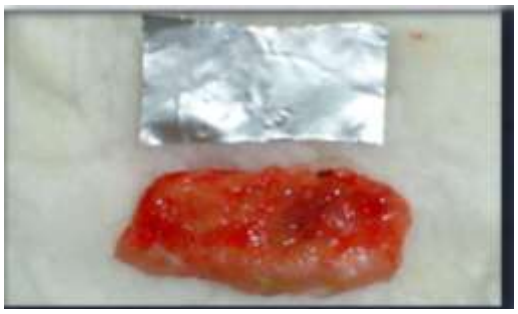

Fig 6: Havested connective tissue graft.

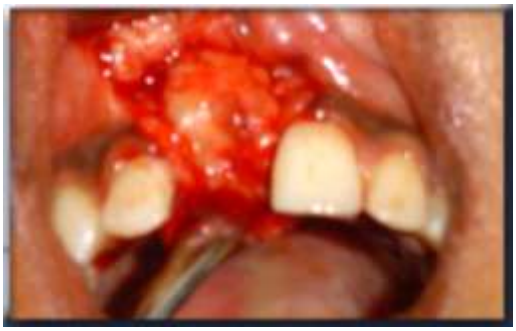

Fig 7: Connective tissue graft placed over the implant

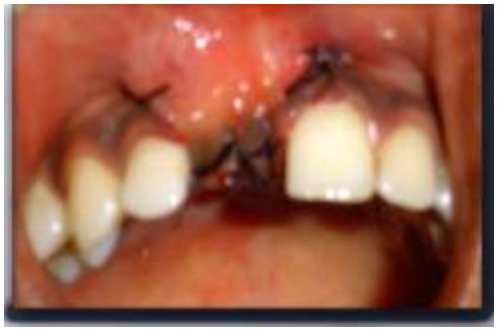

Fig 8: Buccal flap coronally repositioned &sutured

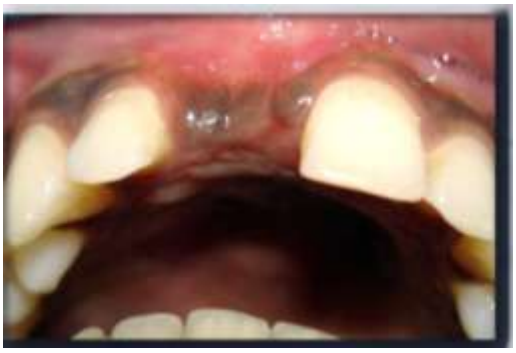

Fig 9: Healing phase at stage 2 surgery

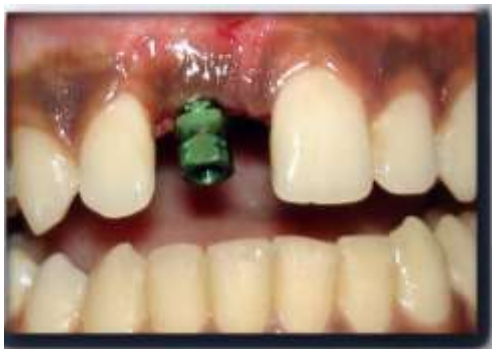

Fig 10: Final abutment placed.

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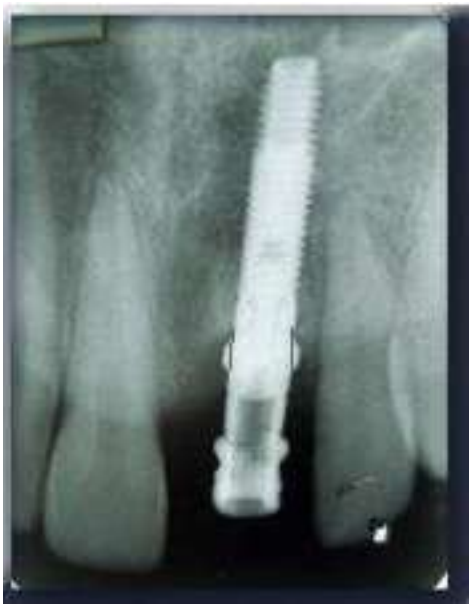

Fig12: Immediate post operative radiograph with Image J analysis(Black line indicates distance from implant shoulder to first implant-bone contact)

The stability and health of the peri-implant soft tissue was clinically examined at 6 months, 9 months, and 12 months after implant placement using the following indices. Presence or absence of mobility,[12] probing. The depth (PD) and probing attachment level (PAL) of each implant were assessed using a Vivacare true pressure-sensitive® probe at four sites (mesial, facial, distal, and palatal/lingual) from the implant shoulder to the base of the peri-implant sulcus [13, 10].

The following radiographic parameters were evaluated for each patient at baseline, 3 months, 6 months, 9 months and 12 months after surgery: IOPA were taken to evaluate the presence of peri-implant radiolucencies, and to evaluate the marginal bone loss by measuring the linear distance between implant shoulder and first implant-bone contact (DIB) using Image J analysis software[15,16] at baseline (immediate post-operative) [Figure 12] and at every 3 months interval up to 1 year after implant placement [Figure 13].

STATISTICAL ANALYSIS

Descriptive data that included mean ± SD and percentages were calculated for each clinical and radiographic parameter, at baseline and at different time intervals. Paired t-test was used to compare the post-operative changes with baseline. A level of significance was set at the probability value of $P < 0.05$.

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RESULTS

The surgical procedure, which included rapid implant implantation and subepithelial connective tissue transplant, went nicely. All patients in this trial were closely monitored for a year. All patients experienced an uneventful post-surgical healing phase. Four out of ten patients experienced pain and discomfort after their initial implant insertion. At 3 months, 6 months, 9 months, and 12 months after surgery, no patients experienced any symptoms or problems. At the second stage of surgery, the implants were asymptomatic, immobile, and osseointegrated. Probing the areas revealed no bone abnormalities around the implants.

No signs of infection or bleeding were detected on probing sites. There was a reduction in plaque index, gingival index and sulcular bleeding index from baseline to 12 month-time period, which was statistically significant. All sites that showed a PD value 3 mm at the end of the follow-up period, was statistically highly significant [Table 4].

A slight increase in DIB values from 2.66 mm at baseline to 2.97 mm at 6 months with a difference of 0.31 mm (indicating bone loss) and a slight decrease in DIB values from 2.97 mm at 6 months to 1.63 mm at 12 months with a difference of 1.34 mm (indicating bone gain) were found in the radiographic evaluation of the implant's intraoral periapical radiograph using Image J Analysis at the mesial and distal sites [Table 5 and Graph 1]. These findings demonstrated both bone remodeling and the advantageous effect of guided bone regeneration surrounding the implant. However, the values were not statistically significant, indicating that the hard tissues surrounding the implant were in a stable state.Six months following prosthetic rehabilitation, the implants were judged effective based on the clinical standards proposed by Albrektsson et al. [17]

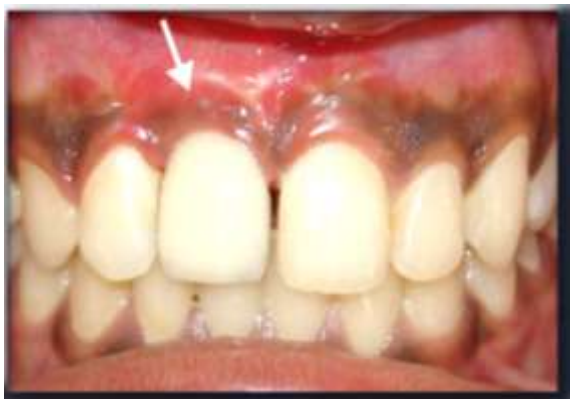

Fig 11: 12 months after implant placement

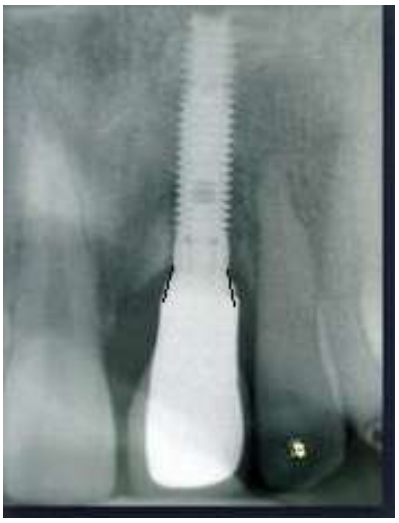

Fig13: 12 months post operative radiograph with Image J analysis (Black line indicates distance indicates distance from implant shoulder to first implant-bone contact)

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Table 2: Mean probing depth values in mm

Measurements	6 months	9 months	12 months
Mean±SD	3.24±0.82	3.21±0.82	3.20±0.75
Difference from 6 months	-	0.05±0.87	0.05±0.65
t*	-	1.93	2.96
P	-	>0.05	<0.05

*Paired t test. P>0.05 not significant; P

Table 3: Mean probing attachment level in mm

Measurements	6 months	9 months	12 months
Mean±SD	2.36±0.84	2.31±0.97	2.31±0.93
Difference from 6 months	-	0.06±0.93	0.04±0.76
t*	-	1.91	2.94
P	-	>0.05	<0.05

*Paired t test. P>0.05 not significant; P

Table 4: Mean width of keratinized mucosa

Measurements	Baseline	3 months	6 months	9 months	12 months
Mean±SD	2.62±0.43	4.05±0.44	4.12±0.36	4.11±0.39	4.15±0.36
Difference from 6 months	-	1.43±0.5	1.50±0.46	1.47±0.47	1.53±0.44
t*	-	9.10	10.49	9.70	10.76
P	-	<0.001	<0.001	<0.001	<0.001

*Paired t test. P>0.05 not significant; P

Measurements	Baseline	3 months	6 months	9 months	12 months
Mean±SD	2.66±1.65	2.94±1.63	2.97±0.95	2.49±1.02	2.17±0.92
Difference from 6 months	-	0.28±0.43	0.31±1.04 (−)	0.17±1.1 (−)	0.49±0.96
t*	-	2.06	0.97	0.50	1.59
P	-	0.07	0.36	0.63	0.15

Table 5: Mean changes in radiographic DIB values in mm

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DIB – Distance between implant shoulder and first implant-bone contact; (−) — Reduction compared to baseline.

*Paired t test. P>0.05 not significant

Graph 1: Mean changes in radiographic distance between implant shoulder and first implant-bone contact values in mm

DISCUSSION

Providing an attractive and healthy smile along with a pleasant and functional dentition is a major objective of modern dentistry. For the replacement of lost teeth, there are several treatment options available. The most cutting-edge treatment approach among them is dental implant placement, particularly immediate implant placement, which has shown itself to be a reliable treatment plan with a very high success rate. There are a lot of benefits to immediate implant installation, including fewer surgical procedures, shorter recovery times between tooth extractions, and the placement of the final prosthesis.[18]

It can be difficult to achieve peri-implant aesthetics and bone regeneration in the "jumping distance" around an immediate implant in the oral cavity's aesthetic zone, and it can be just as difficult to maintain over time. It has been suggested that barrier membranes be used at the bone-implant interface when the "jumping distance" is more than 2 mm in order to promote bone regeneration and inhibit the formation of soft tissue. Nevertheless, a number of clinical issues, membrane exposure, bacterial colonization, and infection might result in implant failure [19,20]. As a result, the necessity of barrier membranes needs to be carefully considered. An undisturbed peri-implant healing process may result from guided bone healing techniques that use a connective tissue graft to cover the remaining alveolar defect linked to an immediate implant.[9, 10]

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Conversely, as the peri-osteum layer lines the underlying surface of the connective tissue graft, there may be a very slim possibility of fibroblasts from the graft infiltrating the jumping distance. Such findings lack recorded, documented, and published evidence in the literature. Therefore, there is no concrete evidence that fibro-osseous integration happens following connective tissue grafting; yet, if primary closure over the implant has not been achieved precisely, fibroblast migration into the leaping distance may be possible.

This study used a one-step procedure that involved coronal advancement of the face flap, immediate implant implantation, subepithelial connective tissue graft placement, and tooth extraction. For aesthetic reasons, this one-step method is preferred. In addition to improving the local metabolic environment of the superficial tissues and preventing the complications caused by the use of synthetic barrier membrane, the connective tissue graft appears to preserve the keratinized tissues grafted. However, if primary closure over the implant has not been achieved perfectly, there may be a chance of fibroblast migration into the jumping distance. Six months following implant implantation, the second stage of surgery was carried out. Six months following the initial surgery, the final prosthetic repair was performed, and it was crucial to reconstruct the peri-implant soft tissues' aesthetic profile.

The patients performed well in terms of oral hygiene. In comparison to baseline values, the peri-implant indices indicated a declining tendency of PD values at the conclusion of the follow-up period. Analyzing the PAL values revealed that the scores behaved similarly. Since the digitizing unit provides the exact result, the radiographic assessment was completed by evaluating linear DIB using Image J analysis software. A normal process of bone remodeling for the first six months and the beneficial effect of guided bone regeneration procedure in the next six months of follow-up were indicated by the analysis of DIB values, which showed an increasing tendency from baseline to six months and a decreasing tendency from six months to twelve months. This led to good stabilization of peri-implant hard tissues at twelve months post-operatively. These outcomes are similar to those that Bianchi and Sanfilippo reported.[10]

The morphology of the soft tissues was essential to achieving excellent outcomes in the aesthetic zone. All patients treated with an instantaneous implant in addition to subepithelial connective tissue grafts had KMW values >3mm at the conclusion of the follow-up, according to the evaluation of the cosmetic outcome using KMW criteria. The lowest result deemed appropriate for both an aesthetically pleasing and functional output was an AKMW value of 3mm. At the conclusion of the follow-up period, the mean KMW value was 4.16 ± 0.36 mm. Additionally, these outcomes are analogous to the findings published by Bianchi and Sanfilippo.[10]

Our findings demonstrate that sub epithelial connective tissue grafting combined with coronal advancement of the facial flap surrounding the immediate implant can increase the height and thickness of the peri-implant soft tissue, improving peri-implant health and aesthetics in both normal and deficient soft tissue configuration cases.

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CONCLUSION

It has been demonstrated that implant insertion at new extraction sites combined with coronal advancement of the face flap and immediate sub epithelial connective tissue grafting is a legitimate therapeutic approach that yields predictable outcomes for the non-salvageable teeth. At the conclusion of the 12-month follow-up, it was demonstrated that the single-step approach used in this study improved the quality of the hard and soft tissues around the implant. However, before this method is regularly used in implant treatments, longer-term research is required.

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