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The effect of connective tissue graft and platelet rich fibrin around immediately placed dental implants in the esthetic zone: a randomized clinical trial

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ABSTRACT

Aim Restoring of normal function after tooth extraction using immediate dental implants results in more patient satisfaction compared to delayed dental implants. Unfortunately following healing of the implant site, soft tissue profile could not be naturally restored. Therefore, soft tissue augmentation was introduced around immediate dental implants to achieve better esthetics. The aim of the current study was to evaluate the clinical efficacy of immediate augmentation of the implant site using CTG and L-PRF.

Materials and methods Twelve patients with single non-restorable teeth in the anterior/ premolar area were randomly assigned to either receiving immediate implant alone or immediate implant with CTG and L- PRF. The width of keratinized tissue (WKT), tissue biotype (TB), pink esthetic score (PES) and crestal bone level (CBL) were assessed before extraction (baseline), at 3 and 6 months after restoration.

Results Immediate implant with CTG and L- PRF showed a non-statistically significant difference on PES (p-value = 0.310) and a statistically significant difference on WKT (p-value = 0.162) and TB (p-value = 0.012).

Conclusion Augmenting the soft tissue profile with CTG and L=PRF showed: (1) Enhanced TB. 2) Increased WKT, 3) No effect was reported on the CBL.

KEYWORDS Immediate implant; Connective tissue graft; Platelet-rich fibrin; Keratinized tissue; Tissue biotype.

INTRODUCTION

Natural looking restorations and unaltered stable peri-implant tissue architecture are the main domain behind implant dentistry. Unfortunately, papilla loss, black triangles and gingival recession are problems of a higher rate of occurrence especially when restoring the anterior esthetic zone (1).

Following extraction, loss of the bundle bone relationship is the main concept behind the changes that usually occurs leading to resorption of the alveolar ridge in both horizontal and vertical dimensions (2). Therefore, the concept of tissue preservation was conceived to enhance the esthetic outcome (1). This concept aims mainly to preserve and maintain bone architecture as well as the soft tissue profile by placing of dental implant immediately after extraction (3).

Immediate implant placement has several advantages, such as reducing the number of surgical steps, and preservation of the bone and gingival tissues. The highest rate of bone resorption occurs during the first 6 months after tooth extraction, unless an implant is placed or a socket augmentation procedure is performed. The early maintenance of the gingival architecture helps a lot the peri-implant gingival tissue esthetics by preserving support for the interdental papillae (4).

Connective tissue graft was introduced in periodontology by Edel (5) as "A tool to increase the width of keratinized tissue (WKT) as well as a treatment for root recession". Moreover, thickening of soft tissue by connective tissue graft (CTG) may lead to maintain the bone volume (or level) in the labial area (6). Koury and Happe (7) have shown that the use of CTG improves the local metabolic environment of the superficial soft tissues and preserves the keratinized tissue, thus obtaining a satisfactory peri-implant marginal seal.

L-PRF is a biologic adjunctive that is obtained by engineering of autologous blood. It was widely introduced

in dentistry for enhancement of peri-implant tissues. The angiogenic properties of L-PRF may be explained by the three-dimensional structure of the fibrin matrix with several growth factors and cytokines oriented in the matrix including Platelet-Derived Growth Factor (PDGF), transforming growth factor β-1 (TGF-β1), insulin growth factor (IGF), and vascular endothelial growth factor (VEGF) (8). The constructive power of these cytokines has been implicated in tissue wound healing and regeneration (9). Choukroun et al implied that the fibrin matrix accelerates the expression of integrin avb3 which starts the mechanism of cells binding to fibrin, fibronectin, and vitronectin. This event stimulates the process of angiogenesis and finally wound healing (10).
Based on the available data from the literature, the objective of our study was to investigate the effect of the simultaneous usage of L-PRF and CTG together on enhancement of the peri-implant soft tissue profile following immediate implant placement.

PATIENTS AND METHODS

This study is a prospective, randomized, and controlled two arm parallel-group double-blind clinical trial conducted in Cairo, Egypt. The study protocol was approved by the Research Ethics Committee of the Faculty of Dentistry, Cairo University (Approval number: 18 – 4 – 28) and the Centre for Evidence-Based Dentistry, Cairo University. The trial was registered in clinicaltrials.gov (registration number NCT03413553) and was prepared based on the CONSORT guidelines for reporting of randomized controlled trials (11). Twelve patients were enrolled among those attending outpatient postgraduate clinic at the Department of Oral Medicine, Diagnosis, and Periodontology of the Faculty of Dentistry at Cairo University (Cairo, Egypt) where the trial took place from January 2018 to January 2020.

Eligibility criteria

Patients aged between 18 and 60 years with single or multiple non restorable teeth in the anterior or premolar regions were selected for inclusion. Radiographic assessment was performed to ensure the integrity of the labial/buccal bone plate. Patients should be free from untreated periodontal disease the surgical steps started when the full mouth bleeding index (FMBS) and full mouth plaque index (FMPS) less than 15% with intact periodontium and periapical region. High patients' compliance and good oral hygiene were highly recommended. Smokers, pregnant and lactating mothers and patients with psychological or systemic conditions were excluded (Table 1).
Eligible patients were thoroughly informed of the study protocol (including procedures, follow-up assessments, potential risks, and possible therapeutic alternatives) and signed a written informed consent form in which all procedures of the study were detailed. Patients also approved the use of their data for research purposes.

Sample size calculation

Based on Wiesner et al., 2010, the Pink aesthetic score difference between control and augmented group was expected to be 2.87±1.55. Using power 80% and 5% significance level 6 patients in each group were needed to be able to reject the null hypothesis that the population means of the experimental and control groups are equal. This number was increased to 8 in each group to correct for non-parametric usage and again increased to 10 to compensate for possible losses during follow up. Sample size calculation was achieved using PS: Power and Sample Size Calculation Software Version 3.1.2 (Vanderbilt University, Nashville, Tennessee, USA). The operator could not be blinded, performing the surgeries, but the outcome assessor, data analysts, were blinded from the allocation. The outcome assessor was unaware of the group the participant belonged to during follow-up, and the data analyst was unaware of the study hypothesis.

Grouping

The patients were randomly assigned to both groups using coin toss by the operator; the control group received immediate dental implant alone while the test group received immediate dental implant with CTG and L-PRF.

Pre-surgical phase and treatment allocation

Patient preparation in terms of improving oral hygiene (tooth brushing twice daily and chlorhexidine HCL 0.12%

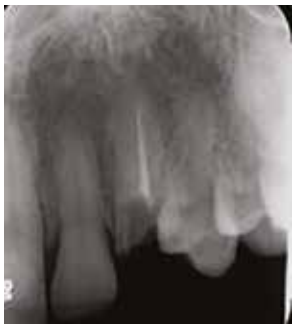
INCLUSION CRITERIA	EXCLUSION CRITERIA
Age: 18-60	Smokers
Patients with single or multiple non-restorable teeth in anterior or premolar area	Pathology at the site of interventions: apical lesions affect the process of osseointegration leading to implant failure
Patient consent approval and signing	Psychological problem
Intact labial/buccal bone plate	Systemic diseases
The recipient site of the implant is free from any pathological condition	Pregnancy, due to hormonal misbalance that may lead to peri-implant mucositis
Patients should be free from untreated periodontal disease.	

TABLE 1 Inclusion and exclusion criteria.

mouthwash twice daily). Quadrant ultrasonic supra and sub gingival scaling with sub gingival debridement with oral hygiene instructions was performed. After 1 month, the oral status was re-evaluated.

Clinical assessment

After enrollment, the following clinical parameters were evaluated at baseline and 6 months after implant placement. WKT was determined by measuring the distance between mucogingival junction (MGJ) and free gingiva using UNC graduated periodontal probe. The roll technique to identify the (MGJ) using a customized acrylic stent (Fig. 2D). TB was measured after anesthesia application and piercing the keratinized gingiva



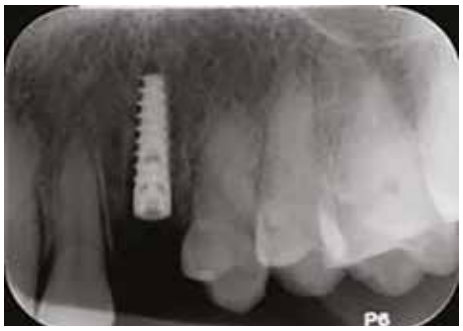
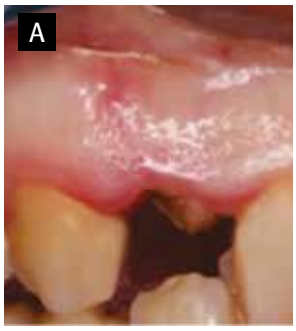
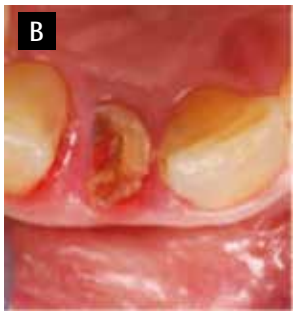


FIG. 1 Peri-apical x ray before root extraction and after immediate dental implant placement.





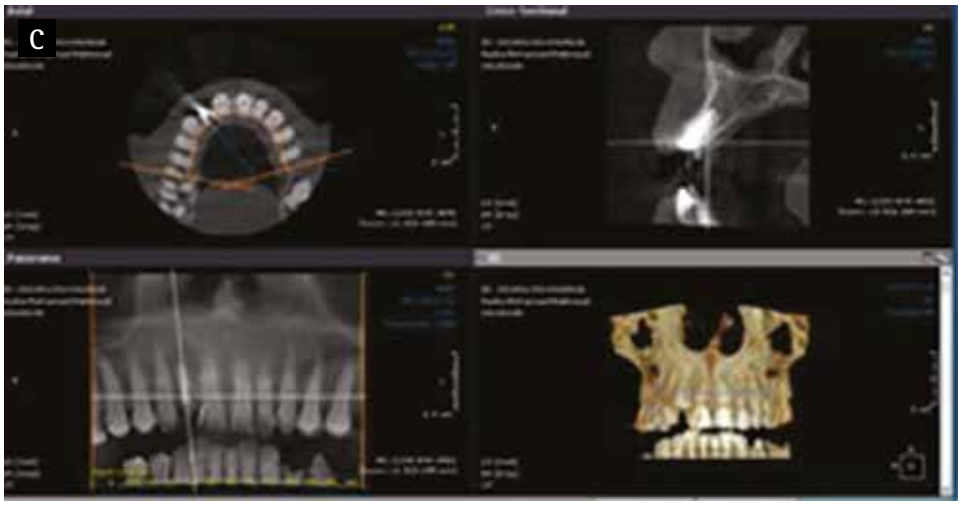
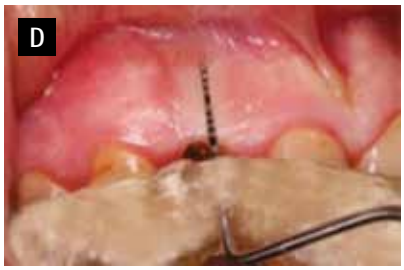
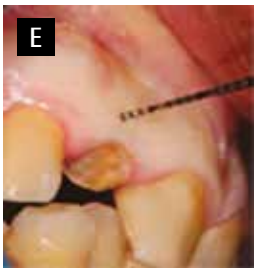
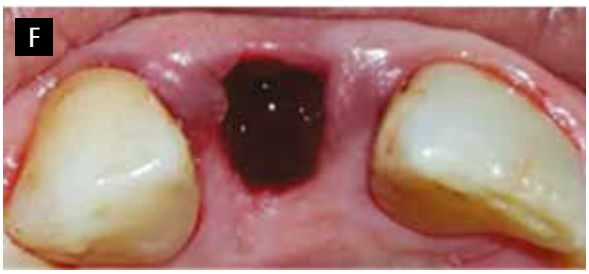
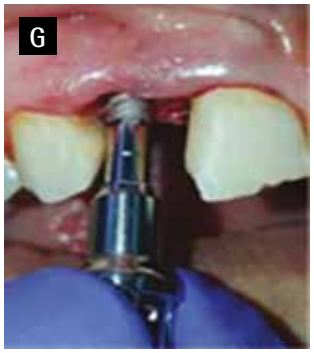


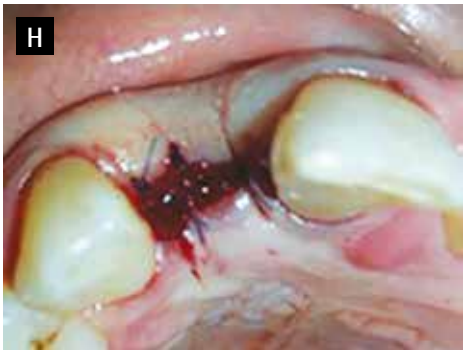
FIG. 2 Control case. A: Front view. B: Occlusal view of unrestorable maxillary right lateral incisor. C: CBCT for the maxillary right lateral incisor before surgical procedure.

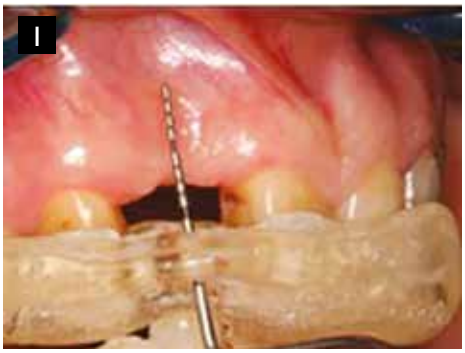




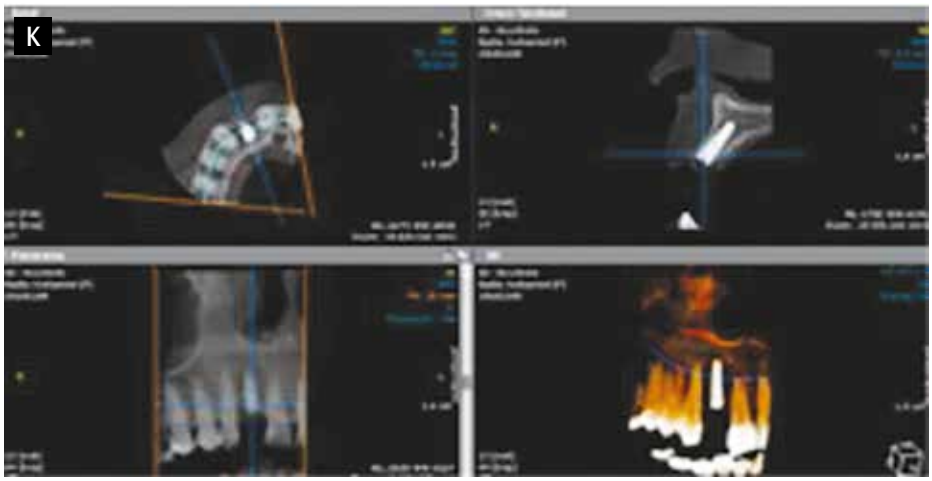








D: Acrylic stent for measuring the width of keratinized tissue showing 10 mm at the middle area of the right maxillary incisor. E: Measurement of soft tissue thickness by transgingival probing (0.5 mm). F: Atraumatic extraction. G: Implant insertion. H: Suturing of the socket. I: Measuring width of keratinized tissue.



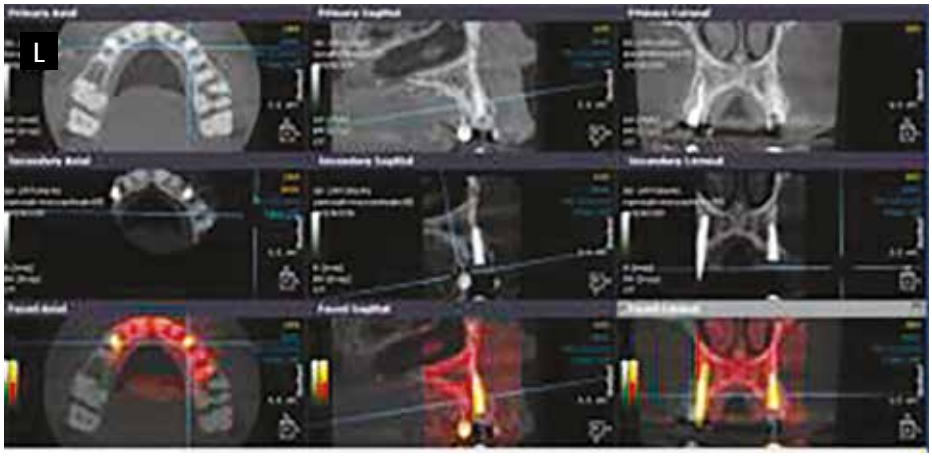
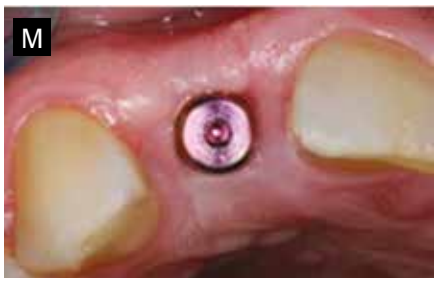
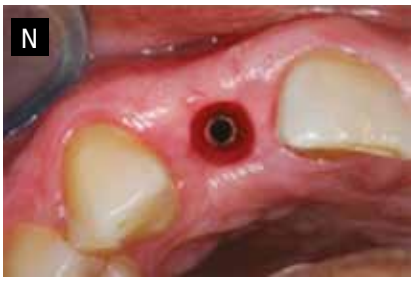
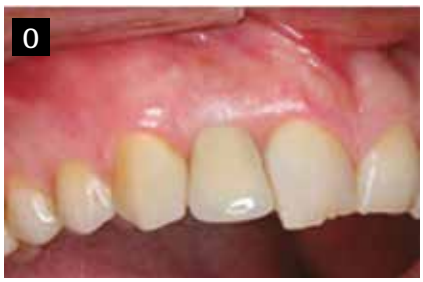
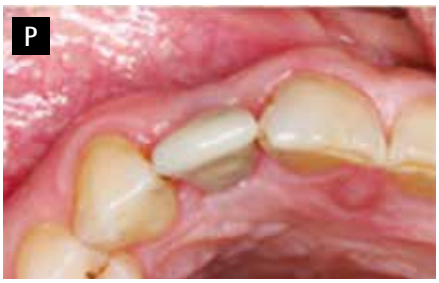


FIG. 2 Control case.
J: Transgingival probing showing soft tissue thickness three months after implant placement. K: CBCT 6 months after implant placement. L: Super imposition for pre and post surgical procedures six months revealing crestal bone resorption 0.3 mm.
M: Occlusal view of the healing abutment.
N: Socket after removing healing abutment.
O: Frontal view of the final restoration.
P: Occlusal view of the final restoration.









perpendicular to the tooth against the alveolar bone using UNC graduated periodontal probe 2 mm apical to the gingival margin (Fig. 2E) (12).
Pink esthetic score (PES) was also measured 6 months after the prosthetic phase where two clinical photographs (facial and occlusal). Seven variables were evaluated: mesial and distal papilla, soft tissue level, soft tissue contour, alveolar process deficiencies, soft tissue color, and texture. A scoring system was used, where 0 is the lowest, and 2 is the highest value, with a maximum score of 14 (1). Two independent and blinded dentists with different specialty scored the pictures on a computer screen for aesthetics (AA endodontist and NF periodontist).
Patient satisfaction was evaluated using a questionnaire answered by the patients 6 months after placement of the final restoration. It contains several questions related to the final restoration and peri-implant mucosa.

Radiographic assessment

Radiographic measurement for crestal bone level (CBL) changes was performed at baseline (before extraction) a periapical x ray to evaluate mesio distal dimensions and immediately after iplant placement (Fig. 1). Cone-beam computed tomography (CBCT) was used at baseline (before extraction) and after 6 months to

record pre-operative bone height. Bucco-lingual width measurements to detect the condition of the remaining root.
Super imposition technique for bone level measurement was recorded on facial aspects of the remaining root and dental implant between baseline and 6 months measurements. For standardization of measurements, incisal edges and/or cusp tips of neighboring teeth (13,

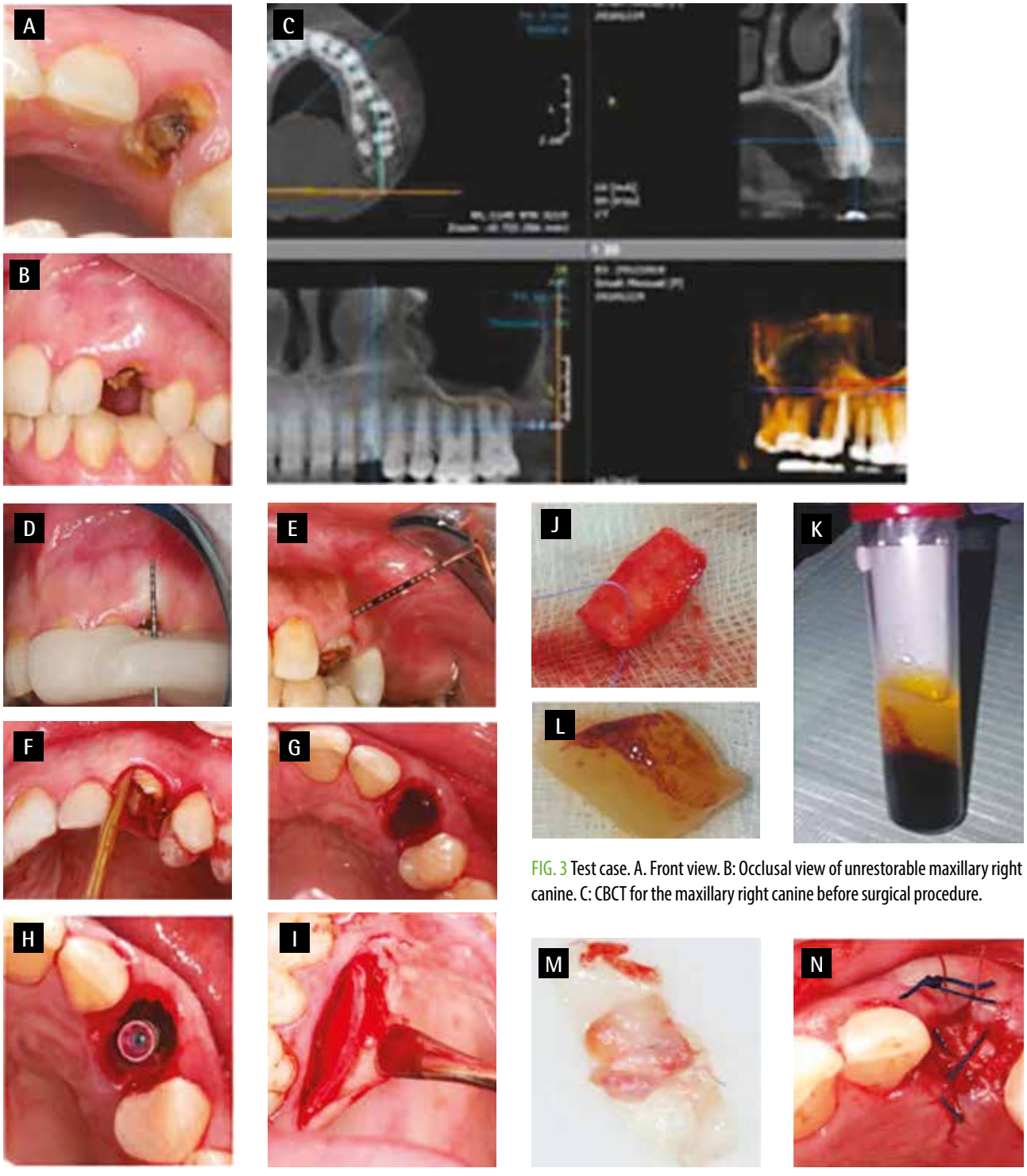
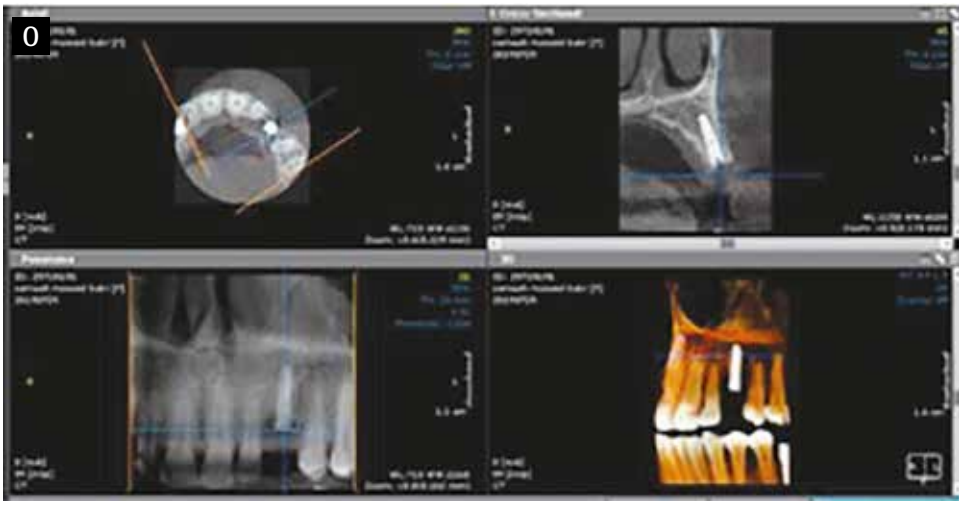
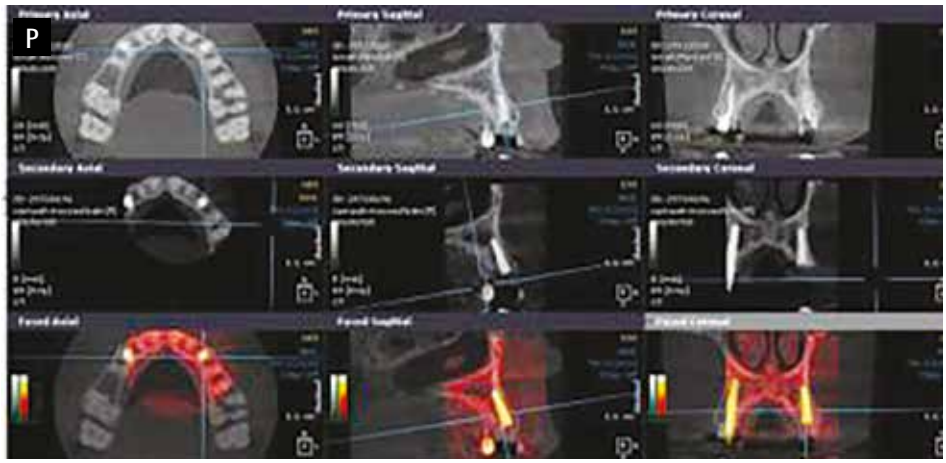
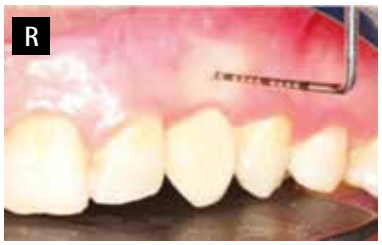


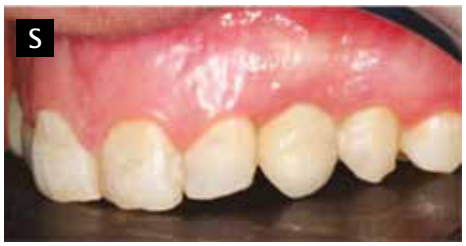
FIG. 3 Test case. A. Front view. B: Occlusal view of unrestorable maxillary right canine. C: CBCT for the maxillary right canine before surgical procedure.

FIG. 3 D: Occlusal acrylic stent for mid buccal position revealing 6 mm width of keratinized tissue. E: Measurement of soft tissue thickness by transgingival probing (0.5 mm). F: Atraumatic extraction of the upper right canine. G: Socket after atraumatic extraction of upper right canine. H: Immediate implant placement in the extraction socket. I: Single incision line from the mesial aspect of the upper left first premolar to the distal side of the upper left first molar.
J: Harvesting of connective tissue graft using single incision technique. K: L- Platelet rich fibrin membrane preparation. L: L-platelet rich fibrin. M: L-platelet rich fibrin+ connective tissue graft (sutured together). N: L-Platelet rich fibrin membrane and connective tissue graft inside the pouch covering the implant.









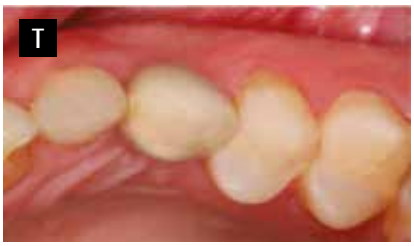


FIG. 3 Test case.
O: CBCT 6 months after immediate implant placement and CTG and L- PRF (P) Superimposition before and after surgical procedures revealing at six months a crestal bone resorption of 1.4 mm.
Q: Measuring width of keratinized tissue six months after immediate implant placement and CTG with L–PRF 7 mm.
R: Transgingival probing showing soft tissue thickness 6 months after immediate implant placement and CTG with L–PRF 3 mm.
S: Frontal view of the final restoration.
T: Occlusal view of the final restoration.

14) and the highest coronal area of the implant platform are used as static reference points (Fig. 2L, 3P).

Surgical procedure

- Control Group: The same operator performed all procedures under local anesthesia (4% articaine with 1/200 000 adrenaline solution). Atraumatic extraction was performed using periotome in order to preserve the socket walls intact (Fig. 2F, 3F, 3G). Tapered self-drilling self-tapping dental implants (JD Evolution® S, or JD Evolution® Plus+ or JD ICON® Ultra S, 2-piece implants) were placed till the implant's platform 2 mm apical to the alveolar crest (Fig. 2F, 3F, 3H). The jumping gap is measured after the implant placement.
- Test Group: After implant placement subepithelial connective tissue graft was harvested from the palate using a single incision technique (Fig. 3I, 3J). The L-PRF was prepared, where 10 ml of blood was obtained from the antecubital vein and transferred to the free anticoagulant test-tube (Fig. 3K). The blood sample was immediately centrifuged at 3000 rpm for 10-12 min (Fig. 3L). The resultant fibrin clot was compressed in the PRF box to obtain uniform thickness of L-PRF membrane. The latter was then adapted and applied over the CTG on top of the implant. The graft was stabilized by the horizontal mattress, after creating a buccal and lingual pouch with an absorbable suture (Vicryl 6-0). Flaps were approximated with a non-absorbable polyamide suture (Fig. 3N).

Postoperative care

All patients received Amoxicillin 1 g capsule/1 hour before the surgery for prophylaxis then every 12 hours after the surgery and continued for 5 days, Cataflam 50

mg was prescribed to reduce postoperative discomfort twice daily (15).
Mouthwash was used daily (chlorhexidine HCL 0.12% mouthwash twice daily) for reducing plaque retention. The patients were instructed not to use brush or floss at the gingival margin and not to chew hard food for 1 week. Sutures were removed after 7-14 days.

Second stage surgery

After 6 months, radiographic CBCT scans were performed. By using the superimposition program, manual registration was selected. For accurate evaluation, two-time points (T1 at baseline before extraction and T2 after 6 months of implant placement) were used, where the T2 image was placed as close as possible to T1 regarding the axial, coronal, and sagittal slices. Autoregistration was performed, where the T2 image was superimposed on that of T1 automatically. Orientation of T2 matches that of T1 with common coordinates. Both images are visualized using the fusion module of the software (13,14) (Fig. 2L, 3P). Implant exposure procedure was performed under local anesthesia. Healing collars were inserted for 1 week then replaced by permanent abutments (Fig. 2N, 2M). Impressions (3M ESPE, Maplewood, Minnesota) were taken and fixed prosthesis was fabricated accordingly. PES was measured by clinical evaluation 6 months after the prosthetic phase, where two clinical photographs (facial and occlusal) were taken. Seven variables were evaluated: mesial and distal papilla, soft tissue level, soft tissue contour, alveolar process deficiencies, soft tissue color, and texture. A scoring system was used, where 0 is the lowest, and 2 is the highest value, with a maximum score of 14 (1) (Fig. 2O, 2P, 3S, 3T).

Statistical analysis

Data was analyzed using IBM SPSS advanced statistics (Statistical Package for Social Sciences), version 21 (SPSS Inc., Chicago, IL). Numerical data were described as mean and standard deviation or median and range. Categorical data were described as numbers and percentages. Data were explored for normality using Kolmogorov-Smirnov test and Shapiro-Wilk test. Comparisons between the two groups for normally distributed numeric variables were done using the Student's t-test while for non-normally distributed numeric variables were performed by Mann-Whitney test. Comparisons between categorical variables were performed using the chi square test. P-value less than or equal to 0.05 was considered statistically significant. All tests were two tailed.

RESULTS

Width of keratinized tissues (WKT)

At 3 and 6 months, the intergroup comparison showed a higher mean value in the test group than the control group, however there was no statistically significant difference between them. While the intragroup comparison showed the highest mean value of the control group at baseline followed by 3 months and the lowest mean after 6 months. No statistically significant difference between the different follow-up intervals. At 3 and 6 months, the test group showed the lowest mean value at baseline. No statistically significant difference was recorded between different follow-up intervals (Fig. 4, Table 2). At 0-3 months, the test group had a significantly higher mean value than the control group, as shown by the independent t-test, while at 3-6 months the test group had a higher mean value (0) than the control group and the independent t-test showed no significant difference. The test group had a significantly higher mean value than the control group as shown by the independent t-test (Fig. 5, Table 3).

Tissue biotype (TB)

After 3 months, the intergroup comparison showed

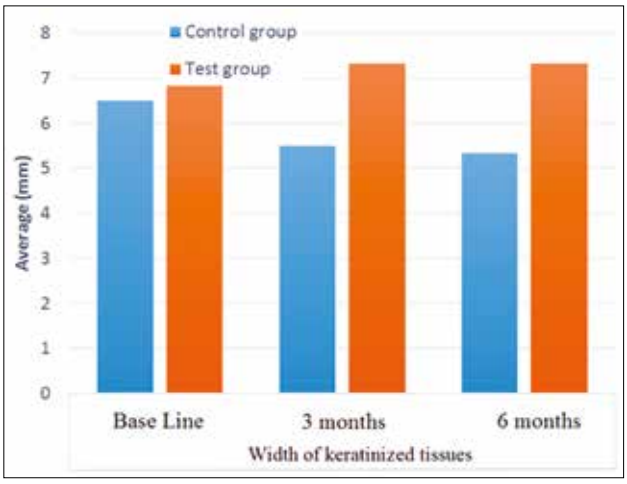


FIG. 4 Bar chart showing average width of keratinized tissue (mm) in both groups at baseline, 3 months and 6 months.

Follow-up	Means ±SD		Mean difference	CI (95%)	*p* value
	Control group	Test Group			
Base line	6.50±2.17^{A}	6.83±1.83^{A}	-0.33	-2.92 - 2.25	0.780
3 months	5.50±2.26^{A}	7.33±2.16^{A}	-1.83	-4.68 -1.01	0.181
6 months	5.33±2.42^{A}	7.33±2.16^{A}	-2.00	-4.95 - 0.95	0.162
p-value	0.056ns	0.168ns			
**: significant (p < 0.05) ; non-significant (p>0.05)*					

TABLE 2 Mean and standard deviation (SD) values for the width of keratinized tissue (mm) in both groups at base line, 3 months and 6 months.

no statistically significant difference between test and control groups. However, after 6 months, there was a statistically significant difference between both groups; where the test group showed higher mean values than the control group using the independent t-test (Fig. 6, Table 4). Comparing the results within each group revealed that at 3 and 6 months test group showed higher values than the control group. One-way repeated measures ANOVA showed no significant difference among different follow-up intervals (Fig. 7, Table 5).

Buccal crestal bone level

The test group had a higher mean value than the control group and independent t-test results showed no significant difference between the two groups (Table 6, Fig. 8).

Pink esthetic score (PES)

PES in the test group had a higher value than the control group and Mann-Whitney test results showed no significant difference between both groups. The Control group had a higher value of patient satisfaction scores than the test group, showing a statistically significant difference between both groups using the Mann-Whitney test (Table 7, Fig. 9).

Patient satisfaction

Patient satisfaction in the control group had a higher value of patient satisfaction scores than test group and Mann-Whitney test results showed a significant difference between both groups (P- value = 0.023) (Table 8, Fig. 10).

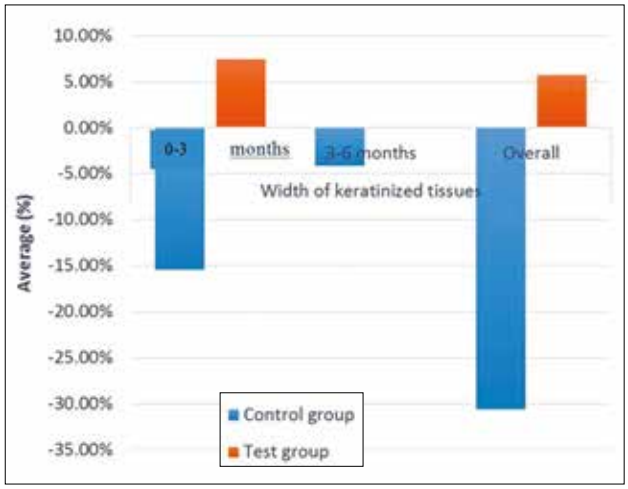


FIG. 5 Bar chart showing average percentage change of width of keratinized tissue (%) in both groups at base line, 3 months and 6 months.

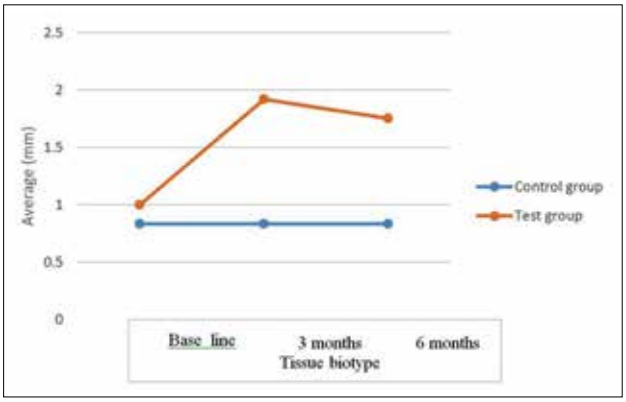


FIG. 6 Line chart showing average tissue biotype (mm) in both groups at base line, 3 months, 6 months.

Follow-up	Means±SD		Mean difference	CI(95%)	*p* value
	Control group	Test Group			
1-3 months	15.42±18.60	7.43±12.63	-22.85	-43.30 -2.40	0.032*
3-6 months	-4.17±10.21	0.00±0.00	-4.17	13.45 5.12	0.341ns
Overall	-30.62±35.88	5.71±12.36	-36.34	-70.86 -1.81	0.041*
**: significant (p < 0.05) ; non-significant (p>0.05)*					

TABLE 3 Mean and standard deviation (SD) values for the percentage change of width of keratinized tissue (%) in both groups at base line, 3 months and 6 months.

Follow-up	Means±SD		Mean difference	CI(95%)	*p* value
	Control group	Test Group			
Base line	0.83±0.26	1.00±0.00	-0.16	-0.40:0.07	0.145
3 months	0.83±0.26	1.92±1.07	-1.08	-2.08:-0.08	0.036*
6 months	0.83±0.26	1.75±0.69	-0.91	1.58:-0.25	0.012*
p-value		0.078			
**: significant (p < 0.05) ; non-significant (p>0.05)*					

TABLE 4 Mean and standard deviation (SD) values for the tissue biotype (mm) in both groups at base line, 3 months and 6 months.

Follow-up	Means±SD		Mean difference	CI(95%)	*p* value
	Control group	Test Group			
0-3 months	0.00±0.00	91.67±60.85	-91.66	-188.55 -5.52	0.013*
3-6 months	0.00±0.00	-4.17±10.21	-4.17	-5.12 13.45	0.341
Overall	0.00±0.00	75.00±69.82	-75.00	-137.70 -12.31	0.024*
**: significant (p < 0.05) ; non-significant (p>0.05)*					

TABLE 5 Mean and standard deviation (SD) values for the percentage change of tissue biotype (%) in both groups at base line, 3 months and 6 months.

Groups	Means±SD	Mean difference	CI(95%)	*p* value
Control group	0.48±1.49	0.84	-3.11 -1.43	0.425
Test group	0.36±1.78			
**: signifiant (p < 0.05) ; non-signifiant (p>0.05)*				

TABLE 6 Mean and standard deviatioAn (SD) values for change of buccal crestal bone level after 6 months (mm) in both groups

Groups	Means±SD	Mean difference	CI(95%)	*p* value
Control group	10.67±1.37	-1.50	-3.50 -0.50	0.310
Test group	12.17±1.72			
**: signifiant (p < 0.05) ; non-signifiant (p>0.05)*				

TABLE 7 Mean and standard deviation (SD) values for (PES) in both groups

Groups	Means±SD	Mean difference	CI(95%)	*p* value
Control group	4.72±0.70	0.833	0.15 -1.50	0.023*
Test group	3.89±1.23			
**: signifiant (p < 0.05) ; non-signifiant (p>0.05)*				

TABLE 8 Mean and standard deviation (SD) values for patient satisfaction scores in both groups

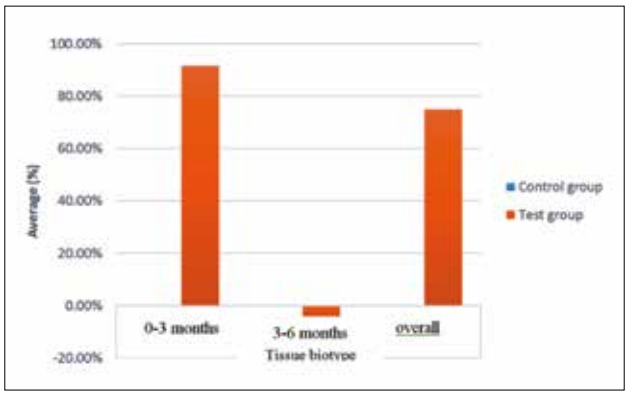


FIG. 7 Bar chart showing average and percentage change of tissue biotype (%) in both groups at baseline, 3 months and 6 months.

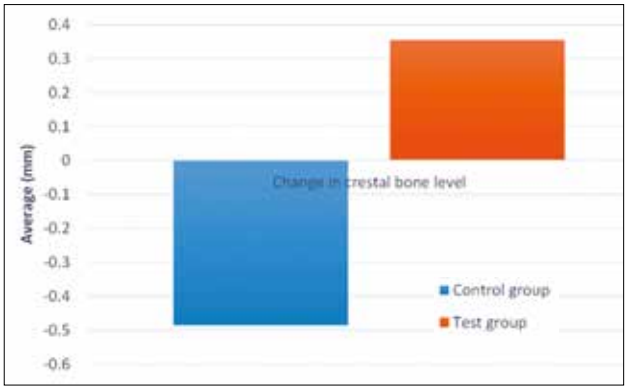


FIG. 8 Bar chart showing average change of buccal crestal bone level after 6 months in both groups.

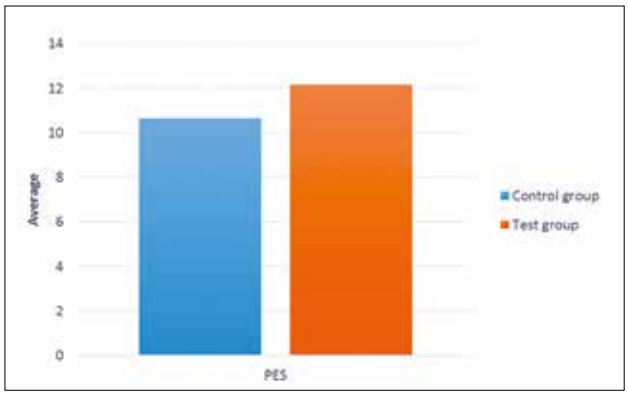


FIG. 9 Bar chart showing average (PES) in both groups after 6 months.

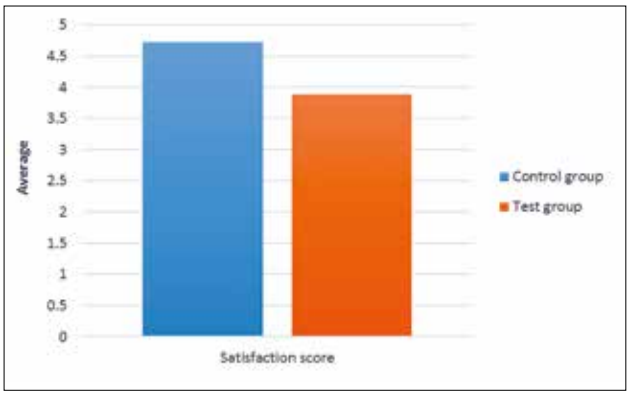


FIG. 10 Bar chart showing average patient satisfaction in both groups after 6 months.

DISCUSSION

The rationale of using immediate implant is to reduce the number of surgical procedures and treatment times. Immediate implant placement is also associated with less bone resorption (16). Bone resorption may occur between the implant and the socket walls that may lead to esthetic impairment that commonly occurs in the anterior region and in patients with high smile line (17).

CTG has a powerful effect to improve the facial contour

of the alveolar process with less invasive surgery and shorter healing periods (18,15).
Choukroun developed the second generation of platelet concentrations (PCs). It is lacking bovine thrombin which is detected in Platelet-rich plasma (PRP) preparation. The synergistic effect between leukocytic cytokines and fibrin complex plays an essential role in the regeneration (19).
L-PRF has a powerful effect on socket preservation, in accelerating the healing of local soft tissue and in reducing postoperative pain response. L-PRF has a rigid three-dimensional fibrin structure composed of platelets and leukocytes, making it thicker than other fibrin-rich concentrates and enhancing its biological kinetics (20).
Therefore, the current study was conducted to evaluate the clinical efficacy of immediate implant placement in fresh extraction sites with and without simultaneous CTG and L-PRF for enhancing soft tissue quality in the esthetic anterior region.
PES was assessed by a blind and independent outcome assessor therefore the findings should be considered reliable. In the present study, the test group had a higher value of PES (12.17±1.72) than the control group (10.67±1.37), with no statistically significant differences (P-value =0.310). These findings are in line with those of Frizzera et al. (21), who found that PES was higher in patients receiving immediate implant with CTG compared to immediate implant with collagen matrix and a third group that received immediate implant with bone graft, but there were no statistical differences between the groups. However, Migliorati et al. (22) found significantly better PES scores with a CTG inserted with tunnel technique. The possible explanation of the difference in findings may be related to the longer study duration where Migliorati et al. reported their findings 2 years after implant placement and final restoration
Regarding the results of WKT, the test group had a higher mean value (7.33±2.16) than the control group (5.33±2.42) and independent t-test results showed no significant difference between both groups (P-value =0.162).
Karring et al. (23) suggested that only connective tissue possesses the capacity to induce keratinization of the epithelium and the genetics of the connective tissue determines the characteristics of the epithelium that will be formed.
Several studies support the importance of keratinized tissue (KT) around the implant to improve esthetic outcome, soft tissue stability and prevent plaque accumulation, mucosal recession, and peri-implant inflammation (24,25).
Regarding results of TB in this study, the test group had a higher mean value (1.75±0.69) than the control group (0.83±0.26), with a statistically significant difference (P-value=0.012).
As for buccal crestal bone level after 6 months, the test group had a higher mean value (0.36±1.78) than the control group (-0.48±1.49). However, there was no statistically significant difference (P-value =0.425).
Our findings were in line with Wiesner et al. (15), who reported no difference in bone loss between the CTG group and the non-augmented group.
On the other hand, Puisys (25) was not in line with the current investigations: it was found that augmentation of thin soft tissues with allogenic membrane during implant placement could be an approach to reduce crestal bone loss. After 1-year follow-up implants in the thin tissue group had a significant reduction in bone level compared to implants in the augmented tissue group and control group (implants in natural thick biotype). The difference between implants in the augmented group and control group was not significant. In our study there were no implants placed in thin biotype, but it could be hypothesized that biological width around implants formed from thin mucosal tissues could be less stable than peri-implant seal from thick or thickened mucosa.
Gingival volume may play an important role in preventing bone resorption, revealing that less bone loss may occur at thick mucosal tissue compared with thin soft tissue These findings were similar to those of Wiesner et al. (15). The possible explanation for such gain is that CTG acts as a biological connector to protect the residual alveolar bone over the immediate implant, leading to a constant, sequential intensive healing of peri-implant deep tissues (26).
Within the limitations of the present study due to short term follow up period, the additional significant effect of L-PRF on alveolar bone level could not be detected and neither that of CTG. However, there was no alveolar bone loss in grafted sites (0.36±1.78) compared to the non-grafted sites (-0.48±1.49) as revealed by the superimposition technique.
Khan et al. (27) assumed that the utilization of L-PRF did not affect marginal bone loss after six months of functional loading. However, another study by Boora et al (28) considered L-PRF as a healing biomaterial with a powerful effect on peri-implant tissue that could be utilized as a therapeutic adjunctive.
To the best of the author's knowledge, this is the first clinical trial to assess the efficacy of using CTG combined with L-PRF at immediate implant sites. The grafted sites showed increased tissue thickness compared to non-grafted sites emphasizing its significant use in patients with thin biotypes especially when receiving implants at the esthetic zone.

CONCLUSION

Immediate dental implants in combination with CTG and PRF might enhance tissue biotype, WKT only, and did not add particular benefit to crestal bone level. Regarding patient satisfaction, they were satisfied more with immediate dental implant alone.

Ethics approval and consent to participate

Both the ethical approval as well as the consent were provided and approved by the ethical committee of faculty of Dentistry-Cairo University.

Availability of data and materials

The data that support the findings of this study are available from faulty of Dentistry-Cairo University but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of faculty of Dentistry-Cairo University.

Competing interests

None.

Conflict of interest

No conflict of interest.

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Authors' contributions

The manuscript has been read and approved by all authors. All authors contributed to prepare each step of the manuscript; experiment, writing and analysis. MA: samples collection, methodology, revision and editing of manuscript; NY: samples collection, corresponding author, writing and statistical analysis.

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