

Soft Tissue Graft Versus Acellular Dermal Matrix Allograft in Preservation of Buccal Cortical Plate of Bone After Immediate Implant Placement

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Abstract

Purpose: This study set out to detect the efficacy of using acellular dermal matrix (ADM) allograft versus free connective tissue graft in the preservation of the buccal plate of bone using cone beam computerized tomography before and after immediate implant placement. **Patients and methods:** A total of 12 patients having badly decayed, and nonrestorable teeth in the esthetic area were allocated. Subjects were randomly allocated into two groups; group A: In which immediate implants were inserted in conjunction with ADM allograft. Group B: In which immediate implant were inserted in conjunction with free connective tissue grafts. **Clinically,** Patients were evaluated early at 1 week, 3 weeks, and after 6 months. **Radiography,** cone beam computed tomography was used to evaluate the thickness of the buccal plate of bone preoperatively and postoperatively. **Results:** Both groups showed signs of success in attenuating the buccal hard and soft tissue collapse. There was no statistically significant difference in the percentage of change in the buccal bone thickness for both groups. The mean percentage of change of the buccal bone height for ADM matrix group was lower than that for Subepithelial connective tissue graft. That difference was statically significant. Regarding the marginal bone loss there were not statistically significant differences between mean percentage of change for both groups. **Conclusion:** Based upon findings, both subepithelial connective tissue and ADM demonstrated favorable outcomes in regard to the conservation of the buccal plate of bone concomitantly with immediately placed implant in the esthetic zone. However, higher values come in favor of the subepithelial connective tissue graft group, AMD can still be a faster and easier solution alternative to autologous graft in case the patient has a concern about second-site surgery or thin palatal soft tissue.

Keywords: Acellular dermal matrix allograft, Buccal plate of bone, Esthetic zone, Immediate dental implants, Subepithelial connective tissue graft

1. Introduction

After tooth loss, the impact of forces on the surrounding bone is reduced. In an attempt to preserve the natural proportions of the alveolar bone and soft tissue architecture following a tooth extraction, sections of the alveolar bone that are not fully utilized are resorbed, and immediate implants are inserted into newly created extraction sockets [1]. Immediate implant placement (IIP) in fresh extraction sockets shortens the overall duration of treatment time moreover it has been shown to yield comparable rates of survival to those implants that

are placed in healed bony sites [2]. With all the merits of IIP, some pitfalls, and complications, it does not counteract the anticipated bone loss following a tooth extraction, particularly at the expense of the facial plate [3]. The anterior maxilla is made up of thin buccal bone which is known to consist of bundle bone and as being part of the periodontium, making it the first to be reabsorbed after tooth extraction [4].

Good primary implant stability and minimal marginal bone loss (MBL) were regarded as the solid evidence of success, Whilst the influence of the peri-implant soft tissues was out of concern. Recent

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emerging studies corroborate the evidence that peri-implant soft tissues are critical to peri-implant health [5]. Several researchers emphasized the significance of having a soft tissue seal with plenty of connective tissue around the dental implant for durability, stability, and esthetics. The existence of that band of tissue is essential as well for the provision of adequate cuff of bone surrounding the dental implant buccally [6].

Hitherto subepithelial connective tissue graft (SCTG) has a paramount importance basis to achieve an appropriate augmentation of soft tissue around natural teeth and dental implants [7]. Nevertheless, harvesting an autologous soft tissue graft necessitates a second-site surgery, increased operation time, and higher morbidity at the donor site [8].

Acellular dermal matrix (ADM) allografts was indicated as an alternative for autogenous grafts lately [9]. ADM allograft is prepared from human or mammal skin that has been surgically prepared by removing the epidermis and cellular components while leaving the bioactive dermal matrix intact [10]. ADM materials have proven successful in many surgical procedures as increasing the thickness of the attached gingiva perimeter implant as well as teeth [11]. Maintaining the integral proper characteristics of the acellular matrix ultrastructural often avoids induction of inflammatory response [12]. This ADM as a predictable grafting tissue provides a lot of advantages for both surgeons and patients. ADM might be a substitute for an autologous graft for soft tissue augmentation [13].

The study-relevant area of interest is to find out the efficacy of using soft tissue graft as compared to ADM allograft in the preservation of the width and breadth of the facial or buccal alveolar bone wall when immediate implant is addressed in the esthetic zone.

2. Patients and methods

2.1. Selection of patients

The present study was conducted by 12 patients with nonrestorable, and badly destructed teeth in the esthetic zone. (six in each of the two groups) will be sufficient to detect the difference. When the predicted count in any cell was found to be less than 5, the χ^2 test and/or Fisher exact test were used to compare two independent groups' qualitative data. All patients were blindly recruited from the outpatient clinic of Oral and maxillofacial surgery Department, Faculty of Dental Medicine for Girls, Al-Azhar University. Before any procedure, each participant in this study signed a written informed

consent (in the Arabic language). After being given all the information about the potential Merits and difficulties of participating in this investigation. The preoperative evaluation of each patient included a full case history as well as a radiographic examination. All Patients were carefully recruited according to the undermentioned inclusion criteria, none of the selected patients showed any metabolic or systemic diseases that may affect bone healing process or the dental implant integration. Each patient had to extract the compromised tooth that was going to be restored by implant limited to the esthetic area, nonsmoking, good Oral care, and good general health. Patients' mean age ranged from 22 to 45; all patients that may have an acute inflammation at the implant area, chemotherapeutic or radiotherapeutic offenders and subjects with bony diseases were excluded. The Research Ethical Committee of the Faculty of Dental Medicine for Girls at Al-Azhar University approved with approval number REC-SU-23-04. The study complies with the Declaration of Helsinki; written informed consent was obtained and signed in Arabic, and all patients were told about the procedure's steps.

2.2. Surgical procedures

Each patient underwent two-stage surgery. The first one was atraumatic tooth extraction under local anesthesia with successive immediately placed dental implants with simultaneous grafting of soft tissue. The second one was after 6 months that routinely involved the prosthetic phase.

2.3. Implant insertion and grafting surgical procedures

The operative procedure was conducted under local anesthesia using Bupivacaine HCL 0.5 % with 1 : 200 000 Adrenaline acid tartrate as a vasoconstrictor. For both groups, the aseptic surgical field was used all the time. Atraumatic extraction was done by the help of periotomes focusing on the conservation of the intervening bony structure in a healthy intact state. After probing the integrity of postextractive socket osseous walls, patients proceed immediate dental implants procedure.

The implant placement surgery was made by following the surgical sequence protocol claimed by the developer of the implant surgical set. It was utilized under 1200 rpm low speed, and vigorous saline irrigation. It was situated 2 mm in the palatal direction.

Group A, ADM was inserted and sutured into the split-thickness flap created on the facial aspect by a

tunneling technique Fig. 1a. This membrane was prepared for use according to manufacturer instructions. The membrane has two physical sides for correct orientation, a reticular side, and a papillary side. The papillary side is faced up while the reticular side is placed against the surgical wound. The material was placed in a sterile dish and soaked by sterile saline before using rinsing was not necessary but was for easy application. The rehydrated dermal graft was then transferred with sterile gloves or forceps to the bilaminar envelope. This was performed at a position between the buccal plate of the bone and the implant itself.

The same procedure of soft tissue augmentation was carried out in group B. A free SCTG was harvested from the safety zone of the hard palate based on anatomical findings. Then the harvested SCTG was tucked into the prepared split-thickness on the facial aspect of the buccal bone. This was performed by utilizing surgical sutures apically and proximally by a 3/0 resorbable strands, Fig. 1b.

Taking into consideration to extend the soft tissue graft to be situated in a position that is 3 mm apically from the buccal bone boundary as well as inserting it inside the palatal pouch. Eventually, interrupted multiple 3/0 Vicryl surgical sutures were utilized to seal the palatal donor site.

For both groups, Gentle pressure was applied for a few minutes with saline-moistened gauze over the inserted graft to prevent dead space and blood clot formation between the underlying bone and the inserted graft.

The Graft was then secured with 3e0 Vicryl sutures without tension.

2.4. Recall follow-up visits

Patients had follow-up recall appointments arranged and documented, and the stitches were taken out after 2 weeks. Following surgery, all patients were scheduled for a follow-up appointment 3 and 6 months later.

2.5. Cone beam radiographic evaluation

Cone beam computed tomography (CBCT) scanning done by using the CBCT machine: (Scanora 3D, Soredex, Helsinki, 8 mA, and 90 KV, Finland). It was carried out Preoperative, Immediate as well as 6 months following implant placement, for assessment. Superimposition over each other was done between every two scans and the average values were taken on greyscale.

2.6. Prosthetic phase

The patients were recalled 6 months post-operatively for loading. Implants were uncovered, Minimal crystal incisions were utilized and a healing cap for 2 weeks was inserted into each patient to help the surrounding Gum to heal. The abutment was tightened, and final cement-retained Ceramic metal crowns were done.

3. Results

All the outcomes of the installed implants revealed success signs clinically and radiographically six months postoperatively. Quit recovery has been shown at all surgical areas. Mild tolerated discomfort only has been reported by patients, within the initial three days following the surgery.

Table 1 summarizes the comparison between post 6 months and immediately after implant placement regards buccal bone thickness and height among ADM. There were no statistically significant differences; between IIP and post 6 months follow-up for Buccal bone thickness. While the mean of post 6 months for buccal bone height was lower than that for immediate after implant placement. That difference was statically significant.

Table 2 summarizes the comparison between post 6 months and immediately after implant placement regards buccal bone thickness and height among SCTG. There were no statistically significant



Fig. 1. Intraoperative photographs showing (A) A partial-thickness envelope was created on the facial bony plate for ADM graft placement (B) Subepithelial Connective Tissue Graft harvested from the palate and was imitatively placed in the facial aspect of the implant.

Table 1. Comparison between post 6 months and immediate after implant placement regards buccal bone thickness and height among Acellular dermal matrix (ADM).

Buccal bone thickness	Acellular dermal matrix (ADM)	N	Mean	SD	Median	Range		T	P Value	Significance
						Min.	Max.			
Crestal	Immediate	6	1.08	0.28	0.98	0.85	1.58	0.67	0.532	NS
	Post	6	0.97	0.23	0.96	0.68	1.32			
Middle	Immediate	6	0.83	0.17	0.80	0.67	1.03	1.12	0.314	NS
	Post	6	0.98	0.30	0.95	0.57	1.51			
Apical	Immediate	6	1.38	0.42	1.25	0.85	1.91	1.0	0.363	NS
	Post	6	1.33	0.37	1.25	0.85	1.91			
Buccal bone height	Immediate	6	15.61	0.52	15.70	15.0	16.26	3.56	0.016	S
	Post	6	14.37	0.53	14.32	13.71	15.22			

Paired-Samples T Test P greater than 0.05 = NS, P less than 0.05 = S, P less than 0.01 = HS.

Table 2. Comparison between post 6 months and immediate after implant placement regards buccal bone thickness and height among Subepithelial connective tissue graft (SCTG).

Buccal bone thickness	Subepithelial connective tissue graft (SCTG)	N	Mean	SD	Median	Range		T	P Value	Significance
						Min.	Max.			
Crestal	Immediate	6	1.27	0.51	1.14	0.72	1.95	1.62	0.167	NS
	Post	6	0.94	0.18	0.94	0.74	1.21			
Middle	Immediate	6	0.81	0.10	0.80	0.70	0.92	0.20	0.849	NS
	Post	6	0.83	0.35	0.70	0.64	1.55			
Apical	Immediate	6	1.14	0.38	1.09	0.72	1.81	1.0	0.363	NS
	Post	6	0.94	0.25	0.96	0.60	1.22			
Buccal bone height	Immediate	6	14.57	0.80	14.54	13.44	15.45	0.55	0.605	NS
	Post	6	14.73	0.88	14.61	13.50	15.99			

Paired-Samples T Test P greater than 0.05 = NS, P less than 0.05 = S, P less than 0.01 = HS.

differences; between immediately after implant placement and post 6 months follow-up for Buccal bone thickness and height among connective tissue graft.

Table 3 Summarizes the comparison between the two studied groups according to the buccal bone thickness and height. There were not statistically significant differences, between percentage of change in both groups, for Buccal bone thickness. While the mean percentage of change for ADM

matrix was lower than that for SCTG graft for buccal bone height. That difference was statically significant.

Table 4 Summarizes the differences between the two groups under study based on MBL. Neither SCTG nor ADM in the initial implant insertion followed by a 6-month follow-up showed any statistically significant differences.

Table 5 provides an overview of the differences between the two groups under study in terms of the

Table 3. Comparison between Acellular dermal matrix (ADM) and subepithelial connective tissue graft regards percentage of change in buccal bone thickness and height.

Percentage of change in Buccal bone thickness	N	Mean%	SD	Median	Range		Z	P Value	Significance
					Min.	Max.			
<i>Crestal</i>									
ADM matrix	6	-5.3	32.8	-5.1	-43.7	41.9	0.48	0.350	NS
SCTG graft	6	-15.9	35.0	-19.0	-56.9	45.8			
<i>Middle</i>									
ADM matrix	6	21.7	37.0	35.4	-44.1	53.7	1.12	0.155	NS
SCTG graft	6	1.8	33.5	-8.1	-26.1	68.5			
<i>Apical</i>									
ADM matrix	6	-2.6	6.3	0.0	-15.5	0.0	0.12	0.500	NS
SCTG graft	6	-11.1	27.3	0.0	-66.9	0.0			
<i>Buccal bone height</i>									
ADM matrix	6	-7.9	5.2	-8.1	-15.7	-2.1	1.92	0.032	S
SCTG graft	6	1.2	5.1	0.5	-3.6	6.9			

ManneWhitney Test, P greater than 0.05 = NS, P less than 0.05 = S, P less than 0.01 = HS.

ADM, acellular dermal matrix; SCTG, subepithelial connective tissue graft.

Table 4. Comparison between post 6 months and immediate implant placement regards marginal bone loss (MBL).

MBL	Subepithelial connective tissue graft (SCTG)	N	Mean	SD	Median	Range		T	P Value	Significance
						Min.	Max.			
Acellular dermal matrix (ADM)	Immediate	6	2.06	0.66	1.90	1.24	2.99	0.66	0.539	NS
	Post	6	1.93	0.62	1.89	0.97	2.78			
Subepithelial connective tissue graft (SCTG)	Immediate	6	2.81	0.93	3.03	1.33	3.67	1.06	0.336	NS
	Post	6	2.66	0.80	2.95	1.57	3.52			

Paired-Samples T Test P greater than 0.05 = NS, P less than 0.05 = S, P less than 0.01 = HS.

Table 5. Comparison between ADM and SCTG regards percentage of change in MBL.

Percentage of change	N	Mean%	SD	Median	Range		P Value	Z	Significance
					Min.	Max.			
MBL									
ADM matrix	6	-4.5	24.3	-12.7	-28.8	34.9	0.64	0.294	NS
SCTG graft	6	-3.2	14.5	-4.4	-19.1	18.0			

ManneWhitney Test, P greater than 0.05 = NS, P less than 0.05 = S, P less than 0.01 = HS.

ADM, Acellular dermal matrix; MBL, marginal bone loss; SCTG, subepithelial connective tissue graft.

percentage change in MBL. Between ADM and SCTG grafts, there was no statistically significant difference in the mean percentage of change in MBL.

4. Discussion

Regarding implant therapy, the salient merit of IIP in fresh extraction sockets is maintaining the alveolar bone dimensions and soft tissue architecture after tooth loss [14]. Concerning that fact, some authors declared that IIP has been at its zenith and it is widely accepted by both dentists and patients as the treatment of choice for missing tooth replacement but is not likely to completely conserve the hard and soft tissue volumes, while anticipated bony loss occur during healing, which is demonstrated on the Buccal plate of bone. This process is subsequently accompanied by soft tissue alteration which may jeopardize long-term esthetic stability in the near vicinity to the immediately placed dental implant [15].

To confront the unavoidable amount of bone loss occurring in Buccal hard and soft tissue contours, grafting the marginal discrepancy in-between the implant surface and the surrounding bone (jumping distance) and the external aspect of the Buccal plate may create more favorable peri-implant health [16]. Clinicians prefer grafting broader per-implant gap exceeding 2 mm. Although, controversially reports revealed that no need for gap grafting procedure irrespective of gap size [17]. this study was done by taking into consideration the palatal positioning of the implant while leaving a horizontal jumping distance that doesn't exceed the critical threshold of 2 mm so, grafting the jumping gap is not addressed in this study the scope was grafting the external aspect of facial plat of bone.

We can see a trend where the suggestion is that the essential requisite of augmenting hard tissue in close proximity to dental implant and surrounding it, might be diminished or even substituted by soft tissue augmentation procedures. Modish quote: 'Bone stands hard, but soft tissue is the guard' in Here and Now [18]. A previous study affirmed that soft tissue augmentation has positive effect on MBL when SCTG as being the gold standard for soft tissue augmentation was used [19]. In the line with the study which conclude that immediate implant concomitantly with connective tissue grafting push for more preservation of buccal plate of bone [20]. On the contrary some authors Noted that Buccal bone loss for immediately placed implant were more with connective tissue grafting than without and attributed this loss to the surgical intervention used during the application of the connective tissue graft (CTG) [21].

As 'all that glitters is not gold' recently ADM is introduced as substitute for autogenous CTG as an effort towards avoiding the palatal morbidity following harvesting of CTG. Based on the systematic review and meta-analysis that found ADM can be safely and effectively used as alternative to CTG, and it has proven its success in increasing the thickness of keratinized tissue and for recession coverage perimeter natural teeth and implants [22]. Some authors found that By using soft tissue substitute for augmentation around immediate dental implants put more success on view regarding MBL stability [23].

The line of inquiry in this study was to shed light on the feasibility of using SCTG versus using acellular dermal matrix for preservation of buccal plate of bone thickness.

All participants in the current study belonged to socket Type I with thin intact bony buccal wall [24]. The findings from this study matched trends that

implants placed in type I fresh extraction sockets can safely provide a successful therapy. The palatal donor sites in the second group takes 2 weeks to heal normally that was a perfectly normal part of the recovery.

Many studies showed that CBCT image can be reliable and reproducible way to measure changes in a buccal plate of bone thickness [25]. In this study CBCT scan were done preoperative, immediately after the surgery, and 6 months later to assess the changes in buccal bone thickness, height, and the MBL. Both groups showed signs of success in attenuating the hard and the soft tissue collapse. SCTG clearly help to minimize Buccal bone loss slightly more than ADM. The tenable explanation might back that the ADM was not that easy to handle however it overcame the limitation of autologous graft, so it is still considered a viable option for soft tissue grafting. This result came in accordance with the study that compared CTG with Xenogeneic collagen matrix and observed Although the collagen matrix material showed good results there was a lower increase in comparison to CTG, in terms of maintaining the alveolar bone level and the thickness of the keratinized gingiva was observed with the CTG being superior [26].

MBL: The study that demonstrated the strong correlation between top mucosal thickness and a reduction in MBL may help to explain why there was a decrease in MBL within both groups, even if the difference was not statistically significant.

Finally, The presence of thick soft tissue around dental implant could play an essential role in preventing both hard tissue resorption and soft tissue recession over time.

4.1. Conclusion

Based upon findings, Both Subepithelial connective tissue and Acellular dermal matrix demonstrated favorable outcomes in terms of conservation of buccal plate of bone concomitantly with immediately placed implant in the esthetic zone.

Although higher values came in Favor of the SCTG group, AMD can still be a faster and easier solution alternative to autologous graft in case the patient has a concern about second-site surgery or thin palatal soft tissue.

4.2. Recommendations

More clinical trials with large sample sizes are recommended.

Soft tissue thickness measurement is recommended.

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Ethics information

The Research Ethical Committee of the Faculty of Dental Medicine for Girls at Al-Azhar University approved with approval number RECSU-23-04.

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Conflicts of interest

There are no conflicts of interest.

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References

- [1] Lee S-J, Kim E-H, Lee D-K, Song I-S, Jun S-H. The effect of loading time on marginal bone change of implants immediately placed after extraction: a retrospective study. *Int J Implant Dent* 2022;8:236e41.
- [2] Lee W. Immediate implant placement in fresh extraction sockets. *J Korean Assoc Oral Maxillofacial Surg* 2021;47:57e61.
- [3] Reda A, El Baz M. Does the placement of a free connective tissue graft in conjunction with immediately placed dental implants in fresh extraction sockets preserve the labial marginal bone level? A randomized controlled clinical trial. *Egypt Dent J* 2019;65(2):1089e96. <https://doi.org/10.21608/edj.2019.72178>. April (Oral Surgery).
- [4] Heimes D, Schiegnitz E, Kuchen R, Kaemmerer PW, Al-nawas B. Buccal bone thickness in anterior and posterior teeth: a systematic review. *Healthc* 2021;9:1e33.
- [5] Thoma DS, Gil A, H€ammerle CHF, Jung RE. Management and prevention of soft tissue complications in implant dentistry. *Periodontol* 2000 2022;88:116e29.
- [6] Lin CY, Kuo PY, Chiu MY, Chen ZZ, Wang HL. Soft tissue phenotype modification impacts on peri-implant stability: a comparative cohort study. *Clin Oral Invest* 2023;27:1089e100.
- [7] Panwar M, Kosala M, Malik D, Sharma D. Comparison of acellular dermal matrix allografts and connective tissue autografts in soft-tissue augmentation around immediate implants: a pilot study. *Med J Armed Forces India* 2021;51e66.
- [8] Elbattawy W, kamal M, Eiid S, Shoeib M. Clinical Evaluation of platelet rich fibrin versus subepithelial connective tissue graft, for soft tissue augmentation around implant in the

- aesthetic zone: a randomized control clinical trial. *Egypt Dent J* 2020;66:2187e95.
- [9] Patel S, Ziai K, Lighthall JG, Walen SG. Biologics and acellular dermal matrices in head and neck reconstruction: a comprehensive review. *Am J Otolaryngol* 2022;43:103233.
- [10] Cigerim L, Tus,ba Yil YV. Treatment of exposed bone with acellular dermal matrix in a smoker patient after dental implant surgery: a case report. *J Oral Implantol* 2020;46:245e9.
- [11] Febriharta A, Murdiastuti K. The effect of acellular dermal matrix therapy on biphasic calcium sulfate bone graft. *Majalah Kedokteran Gigi Indonesia* 2020;6:48e53.
- [12] Pratiwi R, Setiawatie EM. Multiple gingival recession coverage treated with vista technique using acellular dermal matrix (Adm) combined with platelet rich fibrin (Prf): a case report. *ODONTO Dent J* 2019;6:56.
- [13] Zang J, Su L, Luan Q, Liu G, Li S. Clinical and histological evaluation of the use of acellular dermal matrix (ADM) membrane in peri-implant vertical soft tissue augmentation: a controlled clinical trial. *Clin Oral Implants Res* 2022;33:586e97.
- [14] El-Sayed A, Hashem S. Clinical and radiographic evaluation of the labial bone plate after using plasma rich fibrin in immediate implant in esthetic zone. *Egypt J Oral* 2021;12:35e45.
- [15] Seyssens L, Eeckhout C, Cosyn J. Immediate implant placement with or without socket grafting: a systematic review and meta-analysis. *Clin Implant Dent Relat Res* 2022;24:339e51.
- [16] Tatum CL, Saltz AE, Prihoda TJ, DeGroot BS, Mealey BL. Management of thick and thin periodontal phenotypes for immediate dental implants in the esthetic zone: a controlled clinical trial. *Int J Periodontics Restor Dent* 2020;40:51e9.
- [17] Deporter D, Khoshkhounejad A, Khoshkhounejad N, Ketabi M. A new classification of peri implant gaps based on gap location (A case series of 210 immediate implants). *Dent Res J (Isfahan)* 2021;18:29.
- [18] Thoma DS, Cosyn J, Fickl S, Jensen SS, Jung RE. Soft tissue management at implants: summary and consensus statements of group 2. The 6th EAO Consensus Conference 2021. *Clin Oral Implants Res* 2021;32:174e80.
- [19] Fickl S, Therese Kroeger A, Dietrich T, Kebschull M. Influence of soft tissue augmentation procedures around dental implants on marginal bone level changes: a systematic review. *Clin Oral Implants Res* 2021;32:108e37.
- [20] Reda A, El Baz M. Does the placement of a free connective tissue graft in conjunction with immediately placed dental implants in fresh extraction sockets preserve the labial marginal bone level? A randomized controlled clinical trial. *Egypt Dent J* 2019;65:1089e96.
- [21] Zuiderveld EG, van Nimwegen WG, Meijer HJ. Effect of connective tissue grafting on buccal bone changes based on cone beam computed tomography scans in the esthetic zone of single immediate implants: a 1-year randomized controlled trial. *J Periodontol* 2021;92:553e61.
- [22] Zhang M, Wang M, Zhang C. Efficacy and safety of acellular dermal matrix versus connective tissue graft for root coverage of Miller's Class I and II gingival recession: a systematic review and meta-analysis. *Ann Palliat Med* 2022;11:2478.
- [23] De Angelis P, Manicone PF, Gasparini G, De Angelis S, Liguori MG, De Filippis I, et al. Influence of immediate implant placement and provisionalization with or without soft tissue augmentation on hard and soft tissues in the esthetic zone: a one-year retrospective study. *BioMed Res Int* 2021;2021:1e9.
- [24] Kim JJ, Amara HB, Chung I, Koo KT. Compromised extraction sockets: a new classification and prevalence involving both soft and hard tissue loss. *J Periodontal Implant Sci* 2021;51:100.
- [25] Jain S, Choudhary K, Nagi R, Shukla S, Kaur N. New evolution of cone-beam computed tomography in dentistry: combining digital technologies. *Imaging Sci Dent* 2019;49:179e90.
- [26] Puzio M, Hadzik J, Błaszczyński A, Gedrange T, Dominiak M. Soft tissue augmentation around dental implants with connective tissue graft (CTG) and xenogenic collagen matrix (XCM). 1-year randomized control trial. *Anat Anzeiger* 2020;230:151484.