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Socket Preservation Using Calcium Phosphate Modified with silicon versus Autogenous Dentine chips as Pre-Implant Procedure

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Abstract: Objectives: This study was designed to compare clinically, radiographically, and histologically the effect of two different graft materials (calcium phosphate modified with silicon versus autogenous dentine chips**)** for socket preservation as pre-implant procedure. Patient and methods**:** Thirty patients with teeth indicated for extraction were randomly divided into three groups; group I: Patients received socket preservation with Calcium Phosphate modified with Silicon then implant placement after 4 months. Group II: Patients received socket preservation with autogenous dentin chips then implant placement after 4 months. Group III**:** patients did not receive socket preservation of extracted tooth flowed by implant placement after 4 months. All patients underwent clinical and radiographic evaluations at baseline, four months after socket preservation, three, six, and nine months after implant placement. Additionally, histological evaluations using bone core biopsy samples taken during reentry surgery were conducted prior to implant placement. Results: radiographic finding showing that the least amount of bone loss in ridge height after socket preservation in group 2 and histological evaluation showing statistical significant difference between group 1, 2, and 3. Conclusions Both the used grafted materials have been shown a successful socket preservation technique

Keywords: *clinical, radiographic, histological evaluation, dental socket healing, atraumatic extraction, autogenous dentin, dental implant*

Introduction

Given that the teeth are secured to the bone via the periodontal ligament, alveolar bone appears to be essential in supporting the teeth. Following tooth extraction, the surrounding bones immediately begin to shrivel and collapse due to a physiological bone resorption that was previously induced by the root [(1)]. Physiologically alveolar ridge atrophy happens quickly and is mostly noticeable in the first six months following extraction. [(2)]. The apical-coronal (vertical) and buccal-lingual (horizontal) dimensions of the extraction socket exhibit morphological alterations [(3)]. Additionally significant are the alterations in vascularization brought about by bone resorption, where intrabony

vascularization gives way to centripetal periosteal vascularization. Implant placement in the correct three-dimensional location may be challenging due to these dimensional alterations that take place in the alveolar process [4]. Furthermore, food particles and the quickly proliferating connective tissue may find their way into the deep open wound during the healing phase, potentially interfering with bone repair [5]. Moreover, following tooth extraction, the buccal bone wall's bundle bone, which is a component of the periodontium, begins to resorb and loses its function. Hence, loss of buccal bone is more noticeable than loss of lingual bone. A number of surgical strategies, such as socket preservation procedures, or the immediate post-extraction implant insertion with biomaterial grafts in the pre-implant gap, have been suggested as ways to preserve the volume of post-extraction sockets [6]. Following dental extraction, there is a surgical technique called socket preservation that has been demonstrated to dramatically reduce the collapse of the alveolar bone ridge. A biomaterial is inserted into the alveolus during socket preservation to help with implant-assisted rehabilitation later on [7, 8]. The hunt for novel synthetic biomaterials that could effectively replicate the benefits of autologous bone has expanded over the past few decades [9, 10]. Calcium phosphate-based synthetic materials are commonly utilized in scientific literature and have demonstrated encouraging outcomes in various bone regeneration investigations. They have proven effective in procedures like sinus lift, horizontal crest augmentation, and socket preservation [11, 12].

Increasing the osteogenic potential of calcium phosphate-based bone graft materials has been the subject of much research with the goal of producing the most amount of bone development in the least amount of time. The ultimate goals are to shorten treatment times and employ these biomaterials for implant-based rehabilitations. To enhance the osteoginic properties of biomaterials in this setting, a number of writers have suggested adding silicon (Si) to the material [13, 14]. A certain amount of silicon is thought to be required for healthy bone and cartilage growth, and it has been observed that artificial biomaterials based on calcium phosphate that have some silicon in their structure exhibit superior biological performance. Si is thought to enhance osteoblast activity and bone formation, which accounts for the improvement in performance [15].

Autogenous teeth, which are typically observed as dental waste following dental extractions, were a recently proposed material [16]. Due to its osteoconductive and osteoinductive matrix, dentin shares many chemical similarities with bone and is therefore a good option for bone grafting [17]. Autogenous teeth can be obtained using routine procedures with minimal morbidity and have a fair intraoral availability [18]. It is widely acknowledged that graft materials that are osteoinductive or osteoconductive are demineralized autogenous and allogenic teeth [19]. Three key requirements must be met in order to successfully implant osteointegrate and produce long-term results: an implant in the correct three dimensions, enough bone, and a volume of keratinized gingiva to support the establishment of an appropriate biological width and soft tissue sealing around the implant-crown interface [20–21].Thus, it is crucial to conserve as much hard and soft tissue as possible for proper implantation in order to minimize alveolar bone resorption and remodeling following tooth extraction. [21].

Patient and Methods: This study was designed as a randomized controlled clinical, histological, and radiographic study and was carried out on patients selected from those planed for extraction of one or more hopeless teeth at the Department of Oral Medicine, Periodontology, Oral Diagnosis and Dental Radiology,
Faculty of Dental Medicine, Al-Azhar University, (Assiut). Selected patients were classified randomly into three equal groups using online software (https://www.randomizer.org); numbers were concealed in closed envelopes. In Group I and II, Patients received socket preservation with Calcium Phosphate modified with Silicon and autogenous dentin chips respectively while in Group III, patients did not receive socket preservation then implants were placed after 4 months in all group. Patients Preparation**:** all patients received initial periodontal therapy, consisted of supra and subgingival scaling, subgingival debridement if needed, and polishing. They were instructed in proper plaque control measures. Preoperative assessment of all patients carried out including history taking, clinical and radiographic examination of jaw bone using cone beam computed Tomography (CBCT) carried out before tooth extraction. Tooth extraction: Tooth extraction was performed using a flapless approach and taking care of preserving the buccal bone plate as well as the

surrounding soft tissues by using manual periotomes. Alveolar curettage would be subsequently carried out then irrigated the socket well with saline.

Preparation and processing of the tooth graft: Immediately after extraction, carious lesions and discolored dentin or remnants of periodontal ligament (PDL) and calculus should be removed by high speed tungsten carbide burs. The cleaned tooth including crown and root were dried by air syringe and grind by newly designed Smart Dentin Grinder (Kometa Bio Smart Dentin Grinder United Kingdom; The REGEN STORE; Tel; +44 7800990131 Email; ask@regen-store.co.uk Main website for device; www.kometabio.com) **Fig (1) (a, b, c)**. Tooth graft particles between 300-1200 μm were collected. The particulate tooth from the drawer was immersed in basic alcohol for 10 minutes, in a small sterile glass container. After decanting the basic alcohol cleanser, the particulate was washed twice, in sterile phosphate buffered saline (PBS). After tooth extraction, socket was grafted or not according to group. Then we covered the socket with barrier membrane and sutured with silk sutures (Ethicon, USA) **Fig (1) (e, f, g)**. Implant placement: 4 months after tooth extraction, early implant placement was performed in all groups. Suitable antibiotic, analgesic, anti-inflammatory and antiseptic drugs shortly before and after implant placement were used. Local anesthesia infiltration using Mepevacine Hcl 2% with levonordefrine 1:20,000(Alex Company) was done. The implants had a diameter of 3.5– 4.1 mm and a length of 10–11 mm depending on the bone and space available. After raising a full thickness flap, implant bed preparation took place according to the manufacturer's guidelines and implants were placed. Tension- free flap closure was performed by means of single interrupted sutures. Trephine bur used to take bone tissue for histological evaluation. After surgical procedures all patients were instruct to defer from tooth brushing or any mechanical trauma in the area and return for a postoperative evaluation **Fig (1) (I, j, k, l, m, n).**

Evaluation was done in two stages: Frist stage after socket preservation included radiographic evaluation using cone beam computed Tomography (CBCT) carried out to evaluate bone density and measurement of buccolingual and vertical bone changes at 4 months after socket preservation.

Second stage (after implant placement): including clinical, radiographic and histological evaluations. **Clinical evaluation:** was done at 3, 6, 9 months after implant placement but implant primary stability were evaluated once after implant placement [22]. Modified plaque index (MPI) [23]: to asses' plaque accumulation around marginal area around implants. Modified sulcus bleeding index [23]: At 4 aspects around implants. Preimplant propping depth (PPD) [24]: distance from the crest of gingival margin to the bottom of gingival sulcus at four sites around dental implants.

Radiographic Evaluation: Radiographic evaluation was done using cone beam computed tomography (CBCT) carried out to evaluate bone density and measurement of marginal bone after 3, 6, 9 months post implant placement**. Fig (1) (o, p)**

Histological Evaluation: The sample collected during implant site drilling by trephine burs and histological evaluation using a light microscope was done.

I-Specimen staining procedure: Bone biopsy specimens were fixed in 10% formalin, decalcified in 17% nitric acid for 12 hours, embedded in paraffin, sectioned longitudinally into multiple 5mm thick sections and stained with hematoxylin and eosin (H&E) to provide general overview of tissue samples structure. Sections also stained with Masson's Trichrome (MTC) for qualitative and quantitative measurements of bone trabeculae and osteoid tissue**.**

II-Image analysis: For each MTC stained section, five microscopic fields showed the most abundant blue/purple staining (characteristic of the newly formed osteoid) were selected and photomicrographs were captured at variable magnifications. All images were captured using digital camera which was mounted on a light microscope (Leica DM500). Image analysis computer system was used to assess area percentage of MTC stained surface area. The image analysis was performed using Leica QWIN V3 image analyzer computer system (Switzerland), the image analyzer was first calibrated automatically to convert the measurement units (pixels) produced by the image analyzer program into actual micrometer units. This was done in the oral pathology departments, faculty of oral and dental medicine, Assiut and Cairo boys' branches, Al-Azhar University. The investigated parameters were assessed using area distribution of the blue/purple MTC-stained osteoid was

measured automatically. The area percentage represented the percentage of the newly formed osteoid to the total area of the microscopic field. It was measured in the form of area inside a standard measuring frame of area 59413.2 micrometer 2 per 10 fields using a magnification (x400) by light microscopy transferred to the monitor.

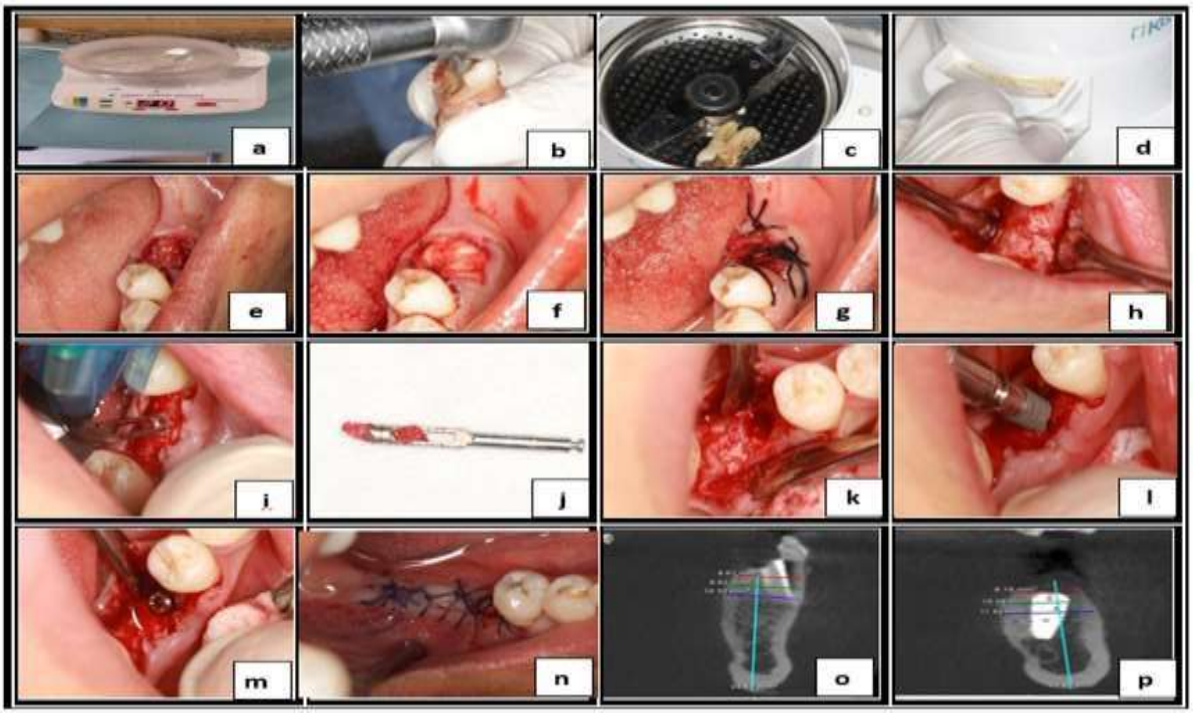

Fig. 1: Photographs showing; a- Smart dentin grinder, b- Removing of caries from extracted tooth, c- Cleaned extracted tooth in dentin grinder cup, d- Particulated dentine graft, e-Dental socket filled with tooth graft, f-Dental socket filled with tooth graft covered with collagen membrane, g- Sutured dental socket, h-Elevation of the flap. i-Taking bone tissue by trephine bur, j- trephine bur, k- Prepared site for implant placement, l-Screw of implant in prepared site. m**-** Cover screw, n-Suturing of site after implant placement**,** o- CMCT for measuring dental socket length and width befor extraction. p- CMCT for measuring dental socket length and width after 3m from implant placement.

Data management and analysis: data collected, tabulated, computed and statistically analyzed.

Results: The clinical results of the current study showed that: Paired t-test of plaque index, modified sulcus bleeding index, and pre-implant pocket depth of 3 groups after 6m and 9mthere showed no statistically significant difference between (Group 1), (Group 2) and (Group 3). The clinical results of stability showing there was a statistically significant difference between primary and secondary stability also between (Group 1), (Group 2) and (Group 3), **Table (1)**.

The radiographic results of the current study showed that: the coronal buccolingual width in the present study showed no statistically significant differences between (group 1), (group 2), and (group3) When we compered the height of the ridge of three groups showed no statistically significant differences, but in group 2 showed the least decrease in ridge height after 4m socket preservation then group1 and the most decrease in ridge height is in group3, as mean height of the ridge at base line at (group 1), (group 2), and (group3) are : 25.1, 25.8, 25.3 then the height after 4m of socket preservation are :24.1, 25.5, 23.5 respectively. Bone density showed there was a statistically significant difference between (Group 1), (Group 2) and (Group 3). A statistically significant difference was found between (Group 2) and each of (Group 1) and (Group 3) **Table (2, 3)**.

The histologic results Slides stained by H&E investigated by light microscope showed bone trabeculae contain osteocytes and surrounded by marrow spaces contains fibrous tissues and blood vessels. It was noticed that in

group 1 these trabeculae were larger in size in relation to other groups with more obvious interconnection between each other's and had nearly higher cellular content. Group 3 was the least in these entire characteristics **fig (2) (a, c, e).**

Slides stained by MTC stain showed areas of newly formed bone trabeculae appeared (blue) and areas of highly mineralized tissue appeared (red). It was noticed that in group 1 larger amount of newly formed bone trabeculae and larger areas of highly mineralized tissue in relation to other groups followed by group 2 and group 3 was the least also **fig (2) (b, d, f).** As regard to area percentage of Masson trichrome stain, there was a statistically significant difference (p-value = 0.042) between Group 1 and Group 2, statistically significant difference (p-value = 0.001) between Group 1 and Group 3 and no statistically significant difference (p-value = 0.1) between Group 2 and Group 3 **table (4).**

Table (1): representing Modified plaque index, Modified sulcus bleeding index, Pre-implant pocket depth, and Stability of dental implant of different groups:

		Group 1		Group 2		Group 3		p-value
Modified Plaque index	**Variables**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	
	After 6m	1.55	0.16	1.7	0.16	1.75	0.2	0.059ns
	After 9m	1.2	0.2	1.2	0.16	1.18	0.24	0.858ns
	p-value	**0.006***		**0.004***		**0.005***		
Modified sulcus bleeding index	**After 6m**	0.75	0.2	0.75	0.24	0.73	0.22	**0.955ns**
	After 9m	0.53	0.18	0.58	0.12	0.63	0.24	**0.418ns**
	p-value	**0.024***		**0.068ns**		**0.395ns**		
Preimplant pocket depth	**After 6m**	1.55	0.08	1.58	0.11	1.88	0.09	**0.058ns**
	After 9m	1.45	0.05	1.43	0.09	1.6	0.08	**0.245ns**
	p-value	**0.223ns**		**0.140ns**		**0.001***		
Stability of dental implant	**Primary**	68.5	4.74	74.5	5.5	62	4.83	**<0.001***
	Secondary	75.5	4.38	85	4.71	70.5	5.5	**<0.001***
	p-value	**<0.001***		**<0.001***		**0.001***		

Table (2): representing ridge length, and bone density:

	Variables	***Baseline***		***4mm after socket***		***3m after implant***		***6m after implant***		***9m after implant***		***p-value***
		Mean	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	
Length	***Group 1***	*25.1*	*2.66*	*24.13*	*2.67*	*23.88*	*1.93*	*23.95*	*2.19*	*23.75*	*2.2*	***0.001****
	Group 2	*25.85*	*1.92*	*25.58*	*1.83*	*25.41*	*1.85*	*25.07*	*1.87*	*24.92*	*1.88*	***<0.001****
	Group 3	*25.3*	*3.83*	*23.5*	*3.65*	*23.25*	*3.62*	*22.78*	*3.66*	*22.5*	*3.67*	***<0.001****
	p-value	***0.838ns***		***0.256ns***		***0.180ns***		***0.182ns***		***0.153ns***		
	Group 1	1390	150.55	1355	95.6	1340	107.5	1355	118.91	1350	117.85	**0.811ns**

Bone density	**Group 2**	1230	67.49	1210	51.64	1205	43.78	1205	36.89	1200	23.57	**0.474ns**
	Group 3	1520	97.75	1410	51.64	1405	43.78	1405	36.89	1400	23.57	**<0.001***
	p-value	**<0.001***		**<0.001***		**<0.001***		**<0.001***		**<0.001***		

Table (3): representing bucco-lingual alveolar ridge width at different bone level:

	Variables	**Baseline**		**4mm after socket**		**3m after implant**		**6m after implant**		**9m after implant**	
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Width of alveolar ridge at bone crest	**Group 1**	9.97	1.01	9.39	0.91	9.10	0.88	8.90	0.81	8.76	0.87
	Group 2	9.55	1.77	9.30	1.57	9.36	1.82	9.23	1.84	8.97	1.73
	Group 3	10.60	1.58	8.90	1.65	8.32	1.50	8.01	1.45	7.86	1.50
	p-value	**0.299ns**		**0.714ns**		**0.268ns**		**0.163ns**		**0.196ns**	
Width of alveolar ridge 2mmbelow crest	**Group 1**	11.02	1.17	10.47	1.09	10	0.97	10	0.94	9.9	0.99
	Group 2	11.32	1.85	10.98	1.63	10.87	1.69	10.68	1.68	10.55	1.59
	Group 3	12.5	1.37	10.8	1.23	10.25	1.14	9.92	1.11	9.85	1.09
	p-value	**0.082ns**		**0.692ns**		**0.321ns**		**0.362ns**		**0.391ns**	
Width of alveolar ridge 4mmbelow crest	**Group 1**	12.2	1.77	11.65	1.47	11.35	1.62	11.35	1.43	11.42	1.31
	Group 2	12.65	1.86	12.47	1.79	12.4	1.63	12.23	1.58	12.18	1.69
	Group 3	13.65	0.94	12.45	0.9	11.7	1.11	11.49	1.16	11.5	1.25
	p-value	**0.129ns**		**0.360ns**		**0.284ns**		**0.336ns**		**0.437ns**	

Table (4): Comparison between studied groups as regard Masson trichrome stain area percentage:

		Groups			**Stat. test**	**P-value**
		Group I (n = 10)	**Group II (n = 10)**	**Group III (n = 20)**		
	Mean	**35.9**	**26.6**	**19.1**	**F = 7.3**	**0.003 S**
Masson trichrome stain area %	**±SD**	**11.1**	**10.5**	**7.1**		
Post-Hoc test		**I vs II**	**II vs III**	**I vs III**		
LSD (Least sig. difference)		**9.3**	**7.4**	**16.7**		
p-value		**0.042 S**	**0.1 NS**	**0.001 S**		

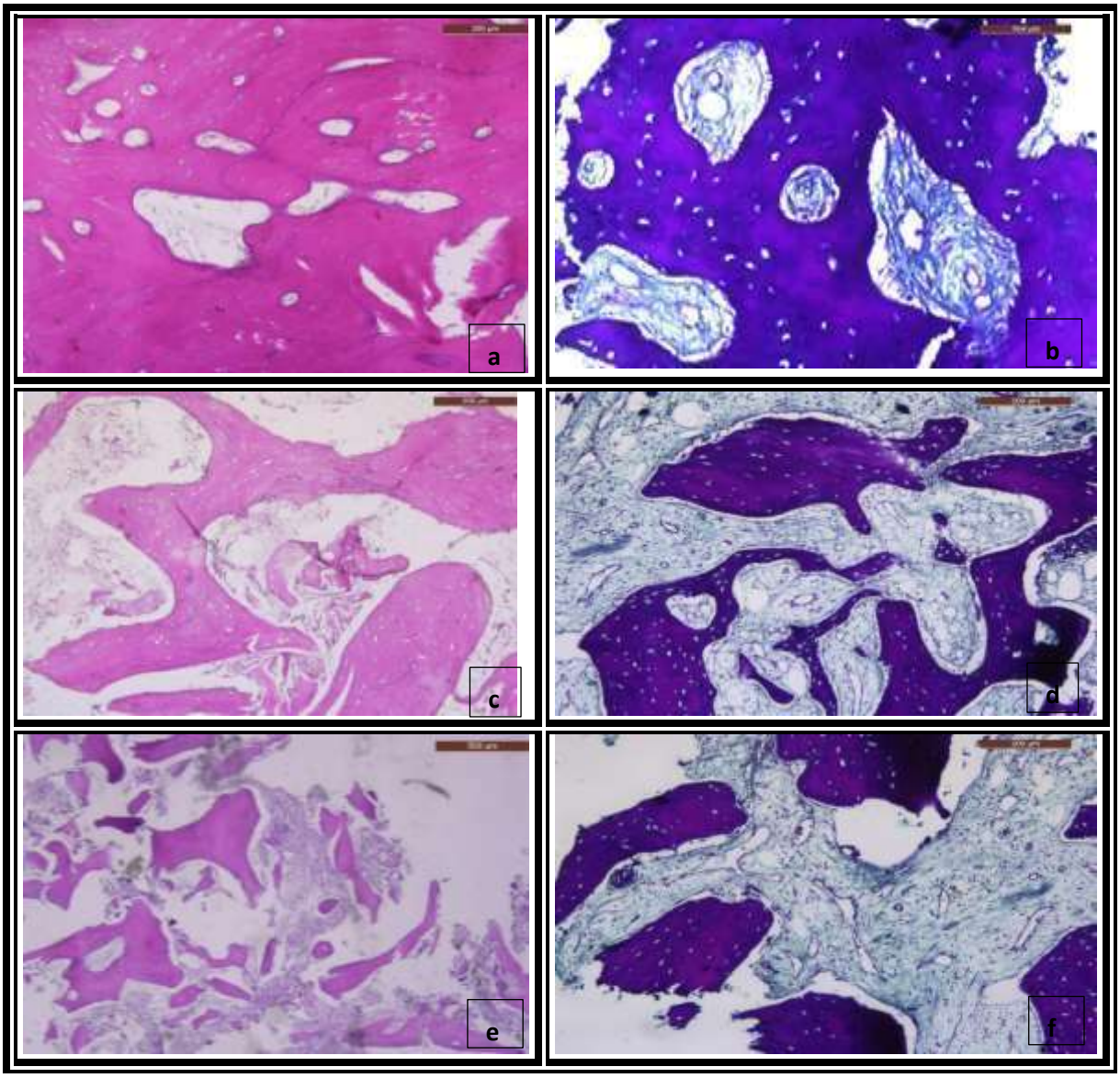

Fig2: Histological slides for the three groups a- Photomicrography of group (1) showing large sized trabeculae of osteoid tissue through highly cellular stroma which contain active plump of osteocyte in lacunae. The trabeculae were surrounded by active osteoplastic rimming. Note interconnection between bone trabeculae (H&E) b- Photomicrography of group (1) showing large amount of newly formed bone trabeculae (blue) with many osteocytes inside lacunae and surrounded by fibro cellular matrix with few blood vessels. Note union between bone trabeculae and transition from newly formed to mature bone (Masson's trichrome). C- Photomicrography of group (2) showing not well-formed trabeculae of osteoid tissue which contain plump of osteocyte in lacunae, but they were not interconnecting with each other (H&E**).** d- Potomicrography of group (2) showing newly formed bone trabeculae (blue) less than fully mineralized tissue appeared (red) in contrast to group (1), they are surrounded by few fibrous matrix (Masson's trichrome**).** e-Photomicrography of group (3) showing poorly formed bone trabecular without osteoplastic rimming (H&E x10).f- Photomicrography of group (3) showing least formed fully mineralized tissue appeared (red) (Masson's trichromex20).

Discussion: The extraction of a tooth for endodontic, traumatizing, or incurable periodontal disease is a traumatic surgery that instantly destroys the surrounding soft and hard structures [(25)]. After three months, the alveolar ridge's vertical and horizontal diameters might be reduced by 40% and 60%, respectively, due to remodeling of the alveolar bone following tooth extraction [(26)]. Ridge preservation is a post-extraction treatment used to reduce erosion of the alveolar ridge and increase the amount of bone that forms in the socket. A variety

of surgical methods and regenerative materials have been employed to preserve the socket, including as immediate implant implantation, bone grafting, osteogenic material, absorbable or non-absorbable membranes, and traumatic tooth extraction [27].

The present study aimed to compare clinically, radiographically, and histologically the effect of two different graft materials (calcium phosphate modified with silicon versus autogenous dentine chips**)** as a socket preservation for implant placement. Different graft materials are currently available for alveolar ridge preservation. Excellent osteogenic qualities of the CAPO-Si material have already been demonstrated in preclinical and clinical testing. Knabe et al. have conducted an in vitro study in this regard [28]. The current study was carried out on medically uncompromised patients and excluded smokers, expectant and nursing mothers, and patients with medical conditions, as these conditions impact the response to treatment in the form of healing term and pattern, which reflects on and affects the accuracy of the study results[29]. It was determined that most of the alveolus is filled with woven bone by 4–8 weeks following tooth extraction, and that the soft tissue keratinizes and completes the healing process in 4 months [30].

Minimum vertical bone resorption appeared to be unexpected even when evidence-based ridge preservation strategies were utilized. While socket preservation may lessen the amount of bone that changes, it cannot stop bone resorption [31].

Analysis of the radiographic results of alveolar bone width presented that, the coronal buccolingual width in the present study showed no statistically significant differences between (group 1), (group 2), and (group3) at different periods baseline, 4m after socket preservation, 3m after implant, 6m after implant, and 9m after implant and also at different socket level (at alveolar crest, 2mm below crest, and 4mm below crest). When we compered the height of the ridge of three groups at different periods baseline, 4m after socket preservation, and 3m, 9m after implant showed no statistically significant differences, but in group2 (autogenous tooth graft group) showed the least decrease in ridge height after 4m socket preservation then group1(calcium phosphate modified with silicon group) and the most decrease in ridge height is in group3 (control group), as mean height of the ridge at base line at (group 1), (group 2), and (group3) are : 25.1, 25.8, 25.3 then the height after 4m of socket preservation are :24.1, 25.5, 23.5 respectively. This in line with another study that evaluated through CBCT analysis the alveolar ridge dimensions before and 4 months after the ARP procedure reported a loss of 0.76 mm in the vertical dimension and a loss of 1.1 mm in the horizontal dimension [32] more over In the study by Andrade et al [33] the vertical and horizontal dimensions of the sockets grafted were preserved, and in some cases increased. Schwarz et al. [34] used an intact autogenous tooth root from which the cementum was mechanically removed. To perform horizontal alveolar augmentation while using Autogenous bone in the control group. The study's findings showed that the autogenous root dentin group's gain of alveolar bone was statistically substantially higher than the control group's autogenous bone gain. Not to be overlooked is the fact that this study also discovered that the autogenous root dentin group exhibited statistically significant less resorption of the substituted bone as compared to autogenous bone.

In a study by Aimetti et al. [35], discovered that after three months, test groups treated with calcium sulfate had a vertical loss of 0.5 mm, but the control group's alveoli were left empty of any biomaterial, resulting in a vertical loss of 1.2 mm. A statistically significant difference was shown in the results. The results of the present study showed that was a statistical significant difference in bone density between group1 (calcium phosphate modified with silicon group), group 2 (autogenous tooth graft group), and group3(control group) at different periods baseline, 4M after socket preservation, 3M after implant , 6m after implant, and 9m after implant but there is non-significant difference between group2 and group3 these results are in line with Study by Del CantoDíaz et al.[36] of alveolar ridge preservation used fresh dentin with demineralization as filling material, expressing densitometry in HU evaluated from CBCTs. In comparison to alveoli that had not been filled with any biomaterial, dentin-treated alveoli showed reduced vertical and horizontal cortical resorption as well as greater density values 16 weeks after ARP. Henao et al. [37] conducted a comparative study between two biomaterials utilized in ARP. A biphasic material consisting of hydroxyapatite and β-TCP was filled in the control group, while β-TCP with chitosan was placed in the test group. The bone density and quality in 37 alveoli were assessed by HU evaluation from CBCTs taken three months later. The mean densities in the β-TCP group were 1052 HU, while in the biphasic group they were 1020 HU. It was concluded that there were no significant differences among the biomaterials these findings are in agreement with our findings [38]. The chemical makeup of the tooth

and the alveolar bone are quite similar. The overall inorganic, organic, and water contents of enamel and dentin are identical to those of alveolar bone [39].

Because of its osteoconductive and osteoinductive qualities, autogenous dentin grafts have comparable histology results to autogenous bone grafts, making it an ideal bone graft material [39]. Concerning bone density, Group 1socket preservation with calcium phosphate modified with silicone showed a significantly higher bone density than group 2 (preservation with autogenous dentin graft four months after grafting). This might be due to the higher condensability of the alloplast material. This may have resulted in higher bone density at the time of implant installment.

It is important to know that the results of the present study showed that the implant stability was measured for the three groups with a statistical significant difference between primary and secondary stability and also between 3 different groups. The means of implant primary stability for Group 1, 2, and 3 were 68.5, 78.5, and 62 ISQ respectively. Implant secondary stability for Group 1, 2, and 3 were 75.5, 80.5, and 70 ISQ respectively. This showed the largest implant stability is for group 2 augmented with autogenous tooth graft. This contributed to the autogenous tooth graft had higher level of bone morphogenic protein-2 expression. This was similar to the study results of Sim et al. [40] and Manzano et al. [41] in all cases; secondary stability was higher than primary stability, in terms of ISQ. Thus, it could be confirmed that when using AutoBT autogenous boon graft the implant stability increases as time passes. Histological findings showed a statistically significant difference in Group 1 (calcium phosphate modified with silicon group) when compared to both group 2 (autogenous tooth graft group) and group 3 (control group) and there was no statistically significant difference between group 2 and group 3. Photomicrography of group1 showing large amount of newly formed bone trabeculae with many osteocytes inside lacunae and surrounded by fibrocellular matrix with few blood vessels. Photomicrography of group 2 showing newly formed bone trabeculae less than fully mineralized tissue appeared in contrast to group 1; they are surrounded by few fibrous matrices. These results are comparable to those of Shim et al. [42] who contrasted (using the ARP approach) a control group that used BHA alone with a test group that used synthetic hydroxyapatite plus bone morphogenetic protein-2. In biopsies taken at three months, the test group had a higher percentage of neo-formed bone (25.37%) compared to the control group's 6.13% and the test group had a higher proportion of residual biomaterial (12.03%) compared to the control group's 16.79%. The enhanced bone formation and maturation in SCPC-grafted sockets could be attributed to the controlled release of silicate ions, which play an important role in stimulating osteogenic gene expression and bone formation [43].

In another study, the major goal of a different clinical trial comparing Ivory Dentin GraftTM with Osteobiol GenOs® (Tecnoss) was to show that, after four months after grafting, Ivory Dentin GraftTM is not less effective than the comparator in terms of the amount and quality of regenerated bone at the graft site. In actuality, Ivory Dentin GraftTM's mean percentage of new bone formation 60.75% was significantly higher than the comparator's, which had only 42.81% of new bone. [44].

The histological examination of the present study resemble that obtained by using melatonin with β-tricalcium phosphate samples exhibited earlier bone maturation with complete bone formation in the test group than the control group [45]. Finally, augmentation the extraction socket with autogenous tooth graf, and implant were installed in the augmented area demonstrated that the use of tooth graft for the quick repair of an alveolar bone defects has been showed to be a good alternative, saving money over other graft materials. Conclusion: 1-Both the used grafted materials have been shown a successful socket peresrvation technique. 2- Autogenous tooth graft has shown promising results in socket preservation for implant placement. 3-The use of autogenous tooth graft has been shown to be a good alternative bone graft material. Compared to liraglutide, semaglutide exhibits a higher affinity for binding albumin, which could be attributed to the latter's longer fatty acid side chain **(46).** Liraglutide is the most effective example of an acylated GLP-1; it was approved by the FDA in 2010 and marketed under the Victoza® brand. Derived from natural GLP-1, ligandulose contains a 16-C fatty acid connected to Lys26 via a γ-Glu spacer, with Arg replacing Lys at position 34 **(47).**

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