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Graftless Maxillary Sinus Lifting with Simultaneous Dental Implant placement in Extraction Socket and Edentulous Ridge: A prospective Clinical Study

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ABSTRACT:

Aim: The present study aimed to evaluate the amount of bone formed after graftless maxillary sinus lifting procedure in edentulous ridges compared to newly extracted teeth sites when a simultaneous dental implant planned to be inserted.

Subjects and methods: Twenty patients who needed dental implant in the posterior maxilla having a reduced vertical bone height were divided into two groups, fresh extraction socket group (10 cases) and patients with edentulous ridges at the site of indicated implant. All implants were from the same company with the same diameter and length. Dental Cone Beam Computed Tomography (CBCT) examination was performed to assess the bone gain height radiographically at 6 months after surgery.

Results: The mean height of sinus elevation in extraction socket group was statistically significant higher than edentulous ridge group (4.02±0.84 and 2.63±1.56; respectively, P=0.023). Percentage change in the edentulous ridge group was (56.79±40.33), which is higher than that of extraction socket group (29.79±23.68) yet the difference was not significant (P=0.085).

Conclusion: Dental implants at the site of pneumatized bone with simultaneous sinus lifting without bone graft showed a good and successful outcome in regard to bone gain and increased bone height with the fresh extraction socket cases.

Key words: Alveolar Bone Loss, Dental implants, Maxillary sinus.

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1. Introduction:

Missing of teeth in the posterior maxilla commonly resulted in maxillary sinus pneumatization and reduced alveolar bone height, this will complicate the prosthetic rehabilitation of patients indicated for dental implants [1]. To overcome this issue, a sinus lifting procedure is performed in order to increase the alveolar bone height at the site of future implants reducing the sinus volume and allowing for new bone to be regenerated under the lifted Schneiderian membrane. This maneuver is a predictable treatment option for severely atrophic alveolar bone in the maxillary posterior region [2].

The minimal recommended residual alveolar bone at the site of pnuematized sinus is 4 to 5 mm to insure primary stability when one-stage sinus lifting and simultaneous implant placement is planned [3]. Maxillary sinus floor augmentation surgery is performed with or without the simultaneous use of biomaterial as a graft, including autologous, xenogeneic, demineralized or mineralized allogeneic bone, and alloplasts [4].

Although the use of graft materials shows a successful results in sinus lifting surgical procedure [5-8], graftless sinus lifting showed very similar outcomes. Moreover, graft less sinus lifting at the posterior maxilla is associated with lower surgical time and treatment costs when compared with graft aided procedures [9], and no difference in the density of the bone formed under lifted Schneiderian membrane with the use of allogeneic filling materials versus a graftless sinus procedure [6].
In graftless procedures, the formed bone at the floor of the maxillary sinus has been owned to the osteogenic potential of the maxillary sinus Schneiderian membrane (MSSM) and the bone-forming cells beneath the membrane [10, 11]. The immediate post extractive placement of implants allows to strongly reduce the time of rehabilitation, avoiding a second surgical phase [12, 13]. Up to our knowledge, there is a lack of evidence regarding the amount of bone formed after graftless sinus lifting procedure in edentulous ridges compared to newly extracted teeth sites when a simultaneous dental implant planned to be inserted.

The aim of the present clinical study was to compare the success of graftless sinus lifting procedure in edentulous ridges versus fresh extraction sites for dental implants inserted in the alveolus of posterior maxilla.

2. Subjects and Methods:

Patients:
This is a comparative clinical study included twenty patients aged between 37 and 58 years old who needed dental implants in the posterior maxilla and diagnosed with a reduced vertical bone height. The study participants were conveniently and judgmentally selected to meet the inclusion criteria of dental implant indication at the maxillary posterior area. The patients were divided into two groups, the first was (group A) “fresh extraction socket” (10 cases) and the second (group B) was the patients with “edentulous ridge” at the site of indicated implant. All the cases were nonsmokers and free of any systemic disease. The study protocol was approved by the Medical Research Ethical Committee, at the Faculty of Medicine and Health Sciences, University of Science and Technology, Aden, Yemen (No. MEC/AD002). Informed consents were gained from all patients before enrollment.
Intervention:

All participants didn't receive any drug before surgery. Antibiotics were administered for all patients postoperatively for 7 days (Amoxicillin/Clavulanic Acid 1 g twice a day). The surgical procedures were performed under local anaesthesia (2% lidocaine and 1:80,000 Epinephrine). Using crestal incision, the bone of posterior maxillary edentulous area of group B patients was exposed and mucoperiosteal flap was elevated then, an osteotomy made in the cortical and cancellous bone at the site of future implant.

In group A the drilling was done at the site of the extraction socket. Sinus membrane was raised using the implant itself at the time of implant insertion. All implants were from the same company with the same diameter and length to standardize the trial circumstances (implants with diameter of 4.5 mm and 10 mm length, B&B® dental implants, Italy). Careful and non-traumatic surgical technique was performed to ensure lateral anchorage for primary stability and gentle push toward sinus floor mucosa while insertion of implants. All surgical sites were closed using 4/0 Polyglactine braided suture (luxcryl 910®, luxsutures, Italy)

Postoperative evaluation: All patients in each group were evaluated radiographically for the residual bone height and distance for which the sinus floor membrane was elevated (figure 3), both measurements were in millimeters for all cases in each group.

Bone gain evaluation: Dental CBCT examination was performed to assess the bone gain height radiographically at 6 months after surgery. CBCT imaging was performed for each case using a Pax- Flex unit were used (Vatech, Hwaseong, Korea). The gain in bone height was measured by comparing the preoperative and final dental CT scans using special software programs. Bone height is presented in millimetres, figure 3 and 5.

Statistical analysis:

Data were presented as mean with standard deviation (SD) and percentage values. Data were explored for normality by checking the data distribution using Kolmogorov-Smirnov and Shapiro-Wilk tests. Parametric data were analyzed using independent t-test for intergroup comparisons. The significance level was set at $P \leq 0.05$ for all tests. Statistical analysis was performed with Statistical Package for Social Sciences IBM SPSS® statistics Version 25 for Windows.

3. Results:

Bone gain height:

The amount of available bone height at the planned implant site for each case in both groups with the percentage of increased bone height are presented in Table 1 and 2 for edentulous ridge group and extraction socket group; respectively. Mean and Standard deviation (SD) values for bone height in different groups were presented in table 3 and figures 1 and 2.

Residual bone of group B (Edentulous ridge group) showed statistically significant higher mean value when compared with that of group A (Extraction socket group) (7.37±1.56 and 5.98±0.84; respectively). (P=0.023). The mean height of sinus elevation in Extraction socket group (4.02±0.84) showed statistically significant higher mean value than edentulous ridge group (2.63±1.56) (P=0.023).

Percentage change in the edentulous ridge group was (56.79±40.33), which is higher than that of extraction socket group (29.79±23.68) yet the difference was not significant (P=0.085). There were no any complications occurred after surgical

procedures of all cases in both groups, figures 6,7,8 showed the final prosthetic steps of a selected case.

Bone loss after follow up period:

After 6 months of follow-up, Edentulous ridge group (0.95±1.54) showed higher mean value of bone loss than Extraction socket group (0.00±0.00) yet the difference was not significant (P=0.066).

4. Discussion:

For the purpose of dental implant placement in the maxillary posterior area with insufficient bone height, hard tissue augmentation is needed to provide enough bone height for implant primary support. The nongrafted sinus-lifting procedure with simultaneous implant placement showed predictable bone formation around inserted implants with an implant survival rate of 95.2% [14].

Although bone graft materials are an important additive for the long-term success of dental implants placed into the augmented maxillary sinus [8], a clinical study reported that new bone can form in the cases of graftless dental implants placement [15]. As reported in Mastrangelo's study, postextraction immediate implant placement procedures have the same success rate as that of delayed implants, it has been reported to be a safe and predictable procedure too [16].

The current comparative clinical study was found that new bone can be formed under the lifted sinus membrane successfully in both groups without any bone graft material. This emphasize the findings of previous studies which reported that the MSSM has an inherent osteogenic potential by the presence of its osteoprogenitor cells, which play a role in the bone formation process at the implant circumference [10, 11]. In addition, mesenchymal stem cells presented in the medullary bone at the surgical site migrate from bone marrow to the blood formed within the sinus [17].

Many authors [6, 18, 19] have evaluated the amount of bone formation after sinus lifting procedure, there was an increase in bone height and the success rate of dental implant was about 97.7 %. Similarly, the present study found a gain in bone height in both groups, with a mean of bone gain of 4.02 mm and 2.63 mm for fresh extraction socket and edentulous ridge groups respectively. Bassi et al., found a mean bone gain of 5.63 mm, this finding is nearly in agreement of the gained bone the extraction socket group in the present study [19].

In the present study, a very small degree of bone resorption (less than 1mm) has been occurred in the group of edentulous ridge, this finding is in agreement with that of Bassi's study who reported a marginal bone loss of <2mm after one year of follow up; nevertheless a bone resorption around dental implant less than 2 mm after one year is considered a normal finding of successful dental implant [20]. On the other hand, the group of fresh extraction socket implants has shown no bone resorption of any case. This results are in agreement with that of many studies one of them which concluded that a simultaneous and immediate implant placement after tooth extraction resulted in a significant bone formation with a lower rate of bone resorption when compared to edentulous ridge cases [18].

Other study reported a higher degrees of bone loss after placement of prosthesis in an immediately placed dental implant in postextraction sites with simultaneous sinus lifting procedure [16].

Dental implant research in the last few years were concentrated in how to minimize the time of dental implant insertion and final rehabilitation outcome [21].

Results of previous studies in this regard reported a similar degrees of osseointegration with different timing of implant placement weather immediate, immediate-delayed, or delayed [22-24]. A recent systematic review about the indirect sinus lifting procedures without bone graft agreed the finding of the present study, this review reported a mean bone height gain of 3.43 mm with implant survival rates between 93.5 and 100%. This review concluded that indirect sinus lifting without bone graft is a predictable technique to manage reduced bone height in the posterior maxilla [25].

Considering all limitations of the present study, including the small sample size, it can be concluded that dental implants at the site of pneumatized bone with simultaneous sinus lifting without bone graft showed a good and successful outcome in regard to bone gain and increased bone height with the fresh extraction socket cases when compared to edentulous ridge cases.

Conflict of Interest:

No potential conflict of interest relevant to this article was reported.

Table 1. Amount of available bone height under sinus and sinus elevation in group B (edentulous ridge).

	Bone under maxillary sinus (mm)		Percentages of bone change (%)		
Case	Residual Bone	Sinus Elevation	% (out of residual bone)	% (out of total bone height after lifting)	% (Difference)
Case 1	8.1	1.9	23	19	77
Case 2	9	1	11	10	89
Case 3	8.3	1.7	20	17	80
Case 4	7	3	43	30	57
Case 5	6.9	3.1	45	31	55
Case 6	7.8	2.2	28	22	72
Case 7	5.3	4.7	89	47	11
Case 8	4.2	5.8	138	58	-38
Case 9	8.2	1.8	22	18	78
Case 10	8.9	1.1	12	11	88

All implant used was 4,2*10, Distal apical bone loss from 1 to 3 mm in 3 case

Table 2. Amount of available bone height under sinus and sinus elevation in group A (fresh extraction socket).

	Bone under maxillary sinus (mm)		Percentages of bone change (%)		
Case	Residual Bone	Sinus Elevation	% (Out of residual bone)	% (Out of total bone height after lifting)	% (Difference)
Case 1	5.3	4.7	89	47	11
Case 2	6	4	67	40	33
Case 3	4.6	5.4	117	54	-17
Case 4	7.4	2.6	35	26	64
Case 5	5.9	4.1	69	41	30
Case 6	6.1	3.9	64	39	36
Case 7	5.9	4.1	69	41	30
Case 8	7.3	2.7	37	27	63
Case 9	5.6	4.4	79	44	21
Case 10	5.7	4.3	75	43	24

All implant used was 4,5*10 no apical bone loss

Table 3. Bone height before surgery and amount of sinus elevation in the two groups.

Parameter	Bone height (Mean±SD)		P-value
	Extraction socket group	Edentulous ridge group	
Residual bone (mm)	5.98±0.84	7.37±1.56	0.023*
Sinus elevation (mm)	4.02±0.84	2.63±1.56	0.023*
Percentage change (%)	29.79±23.68	56.79±40.33	0.085

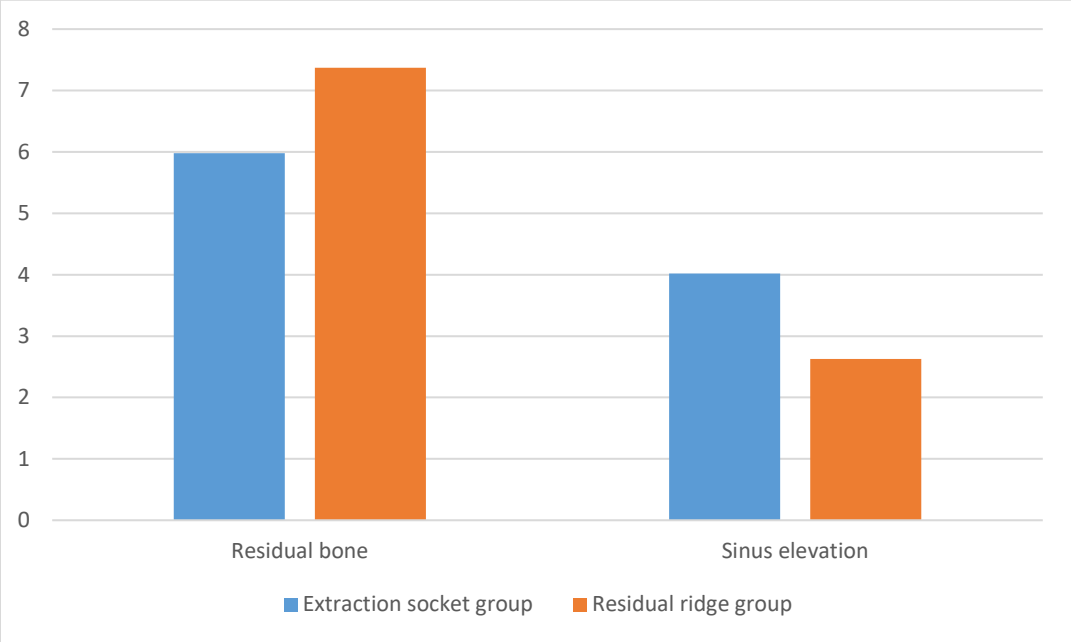

Figure 1. Mean bone height in different groups in millimeters.

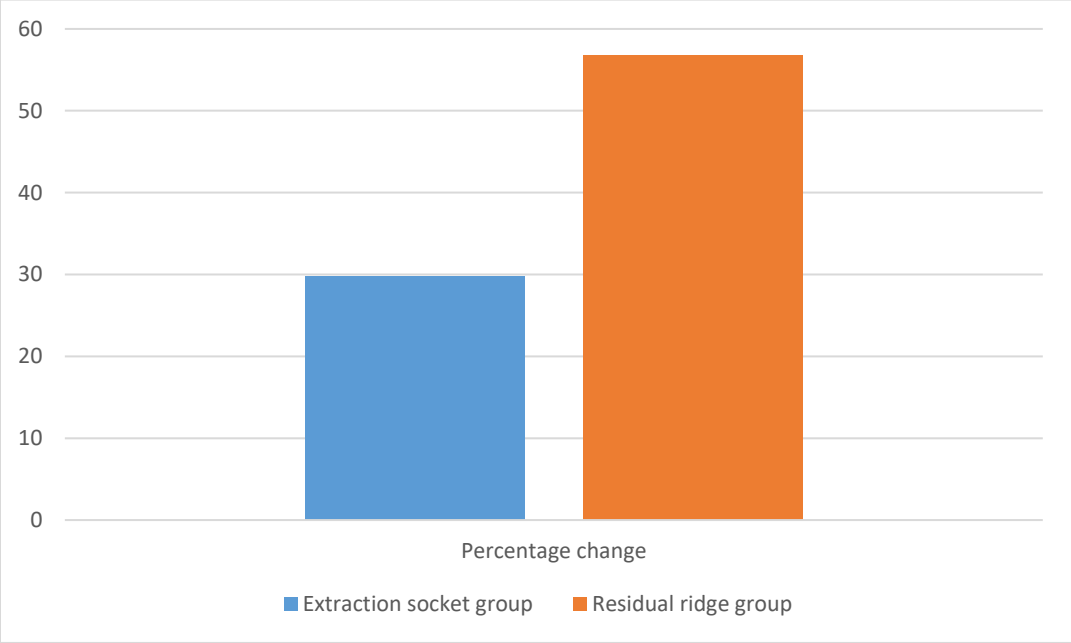

Figure 2. Percentage change in one height from before and after sinus elevation for both groups.

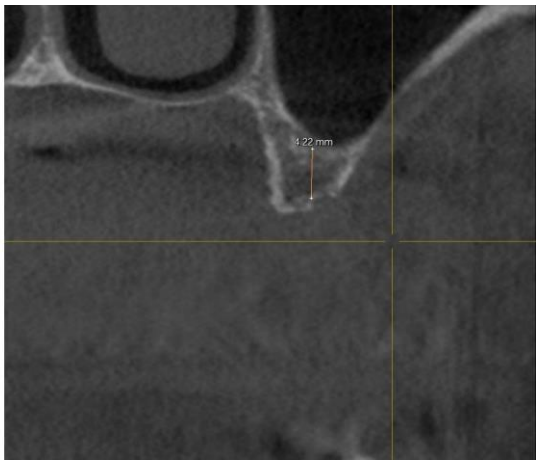

Figure 3. Pre- operative radiograph showing the residual bone at the implant site, showing pneumatized sinus and reduced bone height.

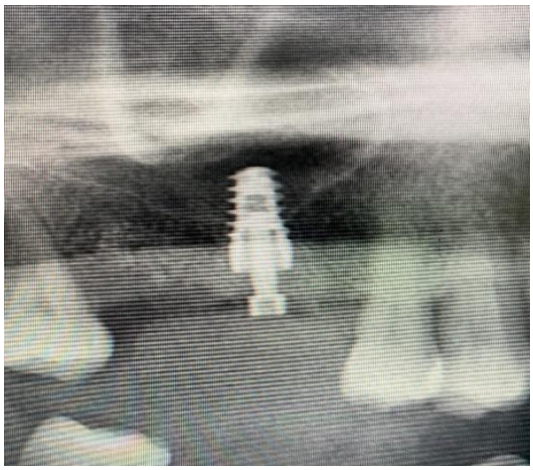

Figure 4. Implant with in the maxillary sinus showing a new bone gain around the intra sinus part of the implant.

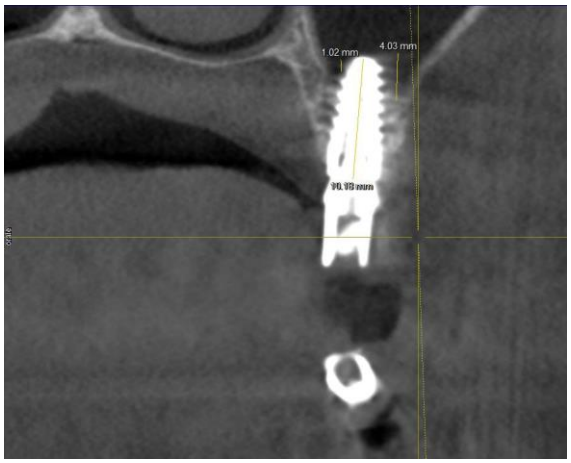

Figure 5. Measurements of the gained bone, after the healing period; the abutment is now in place.

Figure 6. Clinical photo with the implant site; healing screw is in place.

Figure 7. A screw retained crown is attached to the abutment.

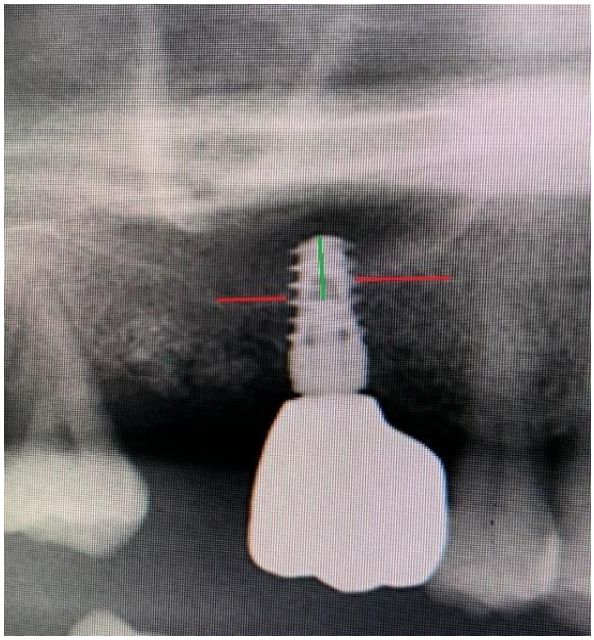

Figure 8. Final radiographic view of the implant with final prosthesis.

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