Evaluation of hard and soft tissue changes of the extraction sockets following immediate implant placement or delayed implant placement using different techniques in the aesthetic zone (Randomized clinical trial)

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Abstract

**Aim of the study:** Evaluate the effect of immediate implant and delayed implant placement with socket preservation on hard and soft tissue with and without releasing flap after 6 months.

**Material and Methods:** Thirty-two patients indicated for tooth extraction were randomly allocated into. Group 1 (flapless immediate implant placement with bone graft) Group 2 (immediate implant placement with bone graft after flap) Group 3 (flapless alveolar socket preservation with bone graft with delayed implant placement after 3 months) and group 4 alveolar socket preservation with xenogenic bone graft after flap with delayed implant placement after 3 months). Hard tissue was evaluated using CBCT superimposition after 6 months. **Results:** showed that delayed implant with socket grafting significantly less bone volume loss after 6 months either with a flap or flapless tooth extraction than immediate implant placement either with a flap or flapless where the percentage of remaining bone volume was 93.7% in flapless socket preservation with delayed implant and 93.9% in socket preservation with flap and delayed implant and 88.8% in immediate implant with flap and 89.3% in the flapless immediate implant.

**Conclusions:** Both immediate and socket preservation with delayed implant decrease amount of bone loss after extraction, however, there was a significant difference as delayed implant with socket preservation causes less hard tissue loss.

**Keywords:** Extraction socket, extraction socket preservation, immediate implant, delayed implant, xenogeneic bone graft, flap/flapless tooth extraction, bone volume

**I. INTRODUCTION**

Tooth extraction is a common dental procedure that take place daily. Extraction of tooth cause reduction of the alveolar ridge at the site where the tooth once existed. These dimensional changes can make it difficult for dentists to replace the tooth in the esthetic position, and possibly hinder the chance to have a dental implant. For this reason, grafting using bone graft can be performed into the tooth socket to help maintain the dimensions of the alveolar tissues. This is a technique called socket grafting for alveolar ridge preservation[1].
The literature has recommended that an implant placement in a fresh extraction socket may partly reduce the alveolar ridge reduction after tooth extraction but now clinical evidence shows that the resorption of the buccal plate will still happen, both vertically and horizontally[2]. also causes a reduction in the number of surgeries by combining both procedures of tooth extraction and implant placement in the same time and the overall treatment time, as the prosthetic phase started as early as 3 to 6 months after extraction, thus result in more patient satisfaction[3].

Attempts to maintain stable post-extraction peri-implant tissues include a variety of wound closure techniques that use different types of flaps and grafting materials. Flap elevation and soft tissue management for wound closure are controversial issues, as different authors have advocated for open flap surgery and primary closure through suturing, whereas others have performed flapless surgery and allowed healing to occur via secondary intention[4].

The long-term success of implant treatment depends on the sustained integrity of the bony interfacial response to dental implants. Periapical radiographs are commonly used to monitor changes in bone level around implants, however, these radiographic images contain distortion and can’t measure the volume of bone. The increase in use in CBCT had resulted in significant improvement in measuring the volume of the bone loss after extraction which can be used in measuring bone volume after tooth extraction[5].

II. MATERIAL AND METHODS:

**Trial design:** This study is a randomized clinical trial. Which was approved by the Ethics Committee of Scientific Research - faculty of Dentistry, Cairo University. The study protocol was registered in ClinicalTrials.gov Identifier: NCT03690973.

**Participants:** The present study is a randomized clinical trial included 32 patients, each patient participated with a single non-restorable tooth in the esthetic zone, which was extracted for socket preservation either with xenogenic bone graft and delayed implant or immediate implant, the study was conducted on the outpatient clinic, Department of Oral Medicine and Periodontology, Faculty of Dentistry, Cairo University between 2018 and 2019.

**Eligibility criteria**

**Inclusion criteria include:** Age: Above 18 years, Patients with single non-restorable teeth in anterior or premolar area, Patients with adequate bone volume for the dental implant procedure, Patients with good oral hygiene, Patient consent approval and signing, Type ( I ) extraction socket, Thick phenotype.

**Exclusion criteria include:** Smokers, Systemic disease that contraindicates surgical implant placement, Presence of any acute infection at the site of surgery, localized periodontitis, Pregnancy.

Eligible individuals were divided into four equal groups:

- Intervention 1 Immediate implant placement with xenogenic bone using the flapless technique.
- Intervention 2 Immediate implant placement with xenogenic bone and releasing flap.
- Intervention 3 Alveolar socket preservation with xenogenic bone graft using the flapless technique.
- Intervention 4 Alveolar socket preservation with xenogenic bone graft and releasing flap.

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Procedures:
1. The surgical procedure was done under local anesthesia using a local infiltration technique.
2. Minimally invasive extraction was performed using periotome to preserve the alveolar bony integrity. Socket will be irrigated by sterile saline and curetted to remove any remnants of the periodontal ligament.
3. Xeno-graft had augmented all of the four groups.

Intervention for group 1:
- Releasing of soft tissue flap and application of bone graft and membrane then closure with suture at the time of extraction with delayed implant placement after 3 months, CBCT was done within first 7 days.

Intervention for group 2:
- Bone grafting then immediate implant placement and closure with suture, CBCT was done within first 7 days.

Intervention for group 3:
- Releasing of soft tissue flap and application of bone graft then dental implant and membrane then closure with suture at the time of extraction.

Intervention for group 4:
- Application of bone graft then delayed implant placement after 3 months.

Post-operative care:
- Sutures were removed after 10 days.

Second stage:
- After 3 months CBCT was performed for group 1 and group 4.
- Dental implant was placed after 3 months.
- After 6 months CBCT was performed for group 2 and group 3.
- Implant exposure procedure was performed under local anesthesia. Healing collars will be screwed.
- After 9 months CBCT will be performed for group 1 and group 4.
- Implant exposure procedure was performed under local anesthesia. Healing collars will be screwed.
- Superimposition will be done to compare for bone changes.

Prosthetic phase:
- After 7 days healing collars were replaced by permanent abutments.
- Impressions will be taken and fixed crown will be fabricated accordingly.
(A) preoperative photo of immediate implant group with flap, (B) periotome application, (C) alveolar socket, (D) implant placement, (E) healing of gingiva, (F) crown placement, (G) preoperative cross sectional CBCT, (H) post operative 6 months CBCT, (I)
preoperative wrapped volume by mimics software, (J) preoperative measurement, (K) postoperative 6 months wrapped volume, (L) postoperative measurement

Outcomes:
Primary outcome Dimensional bone changes
It was measured using CBCT
• Before Extraction
• Immediately after implant placement.
• After 6 months during prosthetic phase.
• Superimposition was done for evaluation of volumetric bone change

III. RANDOMIZATION:

Allocation - sequence generation:
The allocation sequence was generated using computer-generated random numbers. A list was created on (https://www.random.org/); the patients were randomly classified into four groups.

Allocation concealment mechanism:
According to the allocation sequence obtained from the computer software, the numbers that were generated randomly from the software were written in small folded opaque papers then insert into an opaque envelope. Implementation The main investigator (A.M.SH) referred all participants' numbers to the supervisor (A.Z.) who generated the random sequence and assigned the patients

Blinding:
The current clinical trial was a single-blinded clinical trial. Blinding included the statistician. It was impossible for both the operator who performed the surgical procedure or the patients to be blinded as the interventions were completely different.

Statistical methods
Data management and statistical analysis were performed using the Statistical Package for Social Sciences (SPSS) version 24. Numerical data were summarized using means, standard deviations, median and range. Data were explored for normality using Kolmogrov-Smirnov test and Shapiro-Wilk test. Comparisons between the 4 groups were done using One Way ANOVA test. All p-values are two-sided. P-values ≤0.05 were considered statistically significant.

Results
There is statistically significant decrease of volume between pre- and post-treatment values among all studied groups. Mean ± SD volume distribution among studied groups was as following; (from 2278.55±396.63 to 2159.74±395.11 among group 1), (from 2185.55±264.15 to 2058.10±257.43 among group 2), (from 2173.61±390.40 to 1951.06±386.02 among group 3) and (from 2246.60±335.66 to 2026.93±335.71 among group 4).
**Table: Pre and post-operative volume change among studied groups.**

<table>
<thead>
<tr>
<th>Volume</th>
<th>Group 1 n=8</th>
<th>Group 2 n=8</th>
<th>Group 3 n=8</th>
<th>Group 4 n=8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-operative mean±SD</td>
<td>2278.55±396.63</td>
<td>2185.55±264.15</td>
<td>2173.61±390.40</td>
<td>2246.60±335.66</td>
</tr>
<tr>
<td>Post-operative mean±SD</td>
<td>2159.74±395.11</td>
<td>2058.10±257.43</td>
<td>1951.06±386.02</td>
<td>2026.93±335.71</td>
</tr>
<tr>
<td>Paired t test</td>
<td>P&lt;0.001*</td>
<td>P&lt;0.001*</td>
<td>P&lt;0.001*</td>
<td>P&lt;0.001*</td>
</tr>
<tr>
<td>% of change</td>
<td>6.1%</td>
<td>6.7%</td>
<td>11.2%</td>
<td>10.7%</td>
</tr>
</tbody>
</table>

Parameters described as mean±SD *statistically significant if p<0.05

**IV. DISCUSSION**

This study aims to evaluate hard tissue changes after extraction radiographically either after immediate implant placement or socket preservation using flap or flapless technique in the maxillary aesthetic zone. Retaining of hard and soft tissue volume, which was lost after tooth removal, can potentially reduce the need for the more challenging augmentation procedures used in implant-supported rehabilitation [6]. Placement of dental implant is considered successful only when it fulfill the functional and esthetic requirements, therefore both adequate alveolar bone volume and favorable alveolar ridge architecture are important considerations to obtain a positive functional and esthetic rehabilitation [7]

Bone loss occurred in all treatment groups this could be due to the buccal plate obtains blood supply from the periodontal ligament, the bone marrow, and the outer periosteum, if we consider that the buccal bone wall in maxillary anterior teeth was in most cases <1 mm thick the bone at this site will be mostly comprised of cortical bone, when a tooth is extracted, the blood supply from the periodontal ligament withdraws and the only remaining blood supply comes from the periosteum [8]

The results of the present study proves that raising a flap in the flapped alveolar socket preservation group with delayed implant placement shows a statistically significant difference between the preoperative volume with mean ±SD 2278.55±396.63 and postoperative volume with
mean ±SD 2159.74±395.11 where about 93.9% bone volume is present were in harmony with the results of the study conducted by Pang et al.,[9] who evaluated clinically and radiographically an alveolar ridge preservation technique with xenograft and absorbable collagen membrane and then restoration with delayed implants where bone volume reduction was 193.79 (21.47) mm³ at 3 months and 262.06 (33.08) mm³ at 6 months that was statistically significant.

\[ \text{also}\text{ Esposito et al.}, [10] \text{concluded that marginal bone level decrease which is statistically significant.}\]

Furthermore, this study showed that the flapless socket preservation group with delayed implant placement yielded statistically significant results between Pre-operative mean ±SD was 2185.55±264.15 and Post-operative 2038.10±257.43 mean ±SD where about 93.3% bone volume present these results in accordance with the results of the study done by Barone et al.,[6], who concluded that there was increased width resorption of the postextraction site after treatment via a full thickness mucoperiosteal flap.

The present study presented that raising a flap in immediate implant group lead to decrease in the volume of bone to 88.8% where there was statistically significant difference between Pre-operative volume mean ±SD was 2173.61±390.40 and Post-operative volume was 1931.06±386.02 these results in accordance with the results of the study done by Grassi et al.[5] where they found a decrease in the horizontal and vertical bone dimension before and after treatment in all groups.

V. CONCLUSION

It was concluded that The use of bone graft in socket preservation reduce amount of bone resorption occur after extraction with delayed implant than immediate implant

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**Declaration of interests**

The authors declare no conflict of interest.

**REFERENCES:**

5. Grassi, F.R., et al., Dimensional changes of buccal bone plate in immediate implants inserted through open flap, open flap and bone grafting and flapless techniques: A cone-beam computed


