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Case Series

Application of CBCT for evaluation of socket preservation using composite bone graft with A-PRF membrane and collagen membrane – A case series

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ABSTRACT

Alveolar bone loss following tooth extraction is common. Socket preservation techniques, involving bone grafts and membranes, aim to mitigate this loss. This study evaluates the efficacy of a composite bone graft (bioglass and A-PRF gel) combined with A-PRF and collagen membranes for socket preservation, using Cone Beam Computed Tomography (CBCT) to assess dimensional changes over 6 months post-extraction. A case series of 5 patients requiring tooth extraction was included in the study. Clinical parameters, including plaque index, gingival bleeding, and keratinized tissue height, were recorded at baseline and six months. CBCT scans were performed immediately after extraction and at the six-month follow-up to measure crestal bone height and width. The results demonstrated a minimal decrease in crestal bone width (1.1 mm) and height (0.9 mm) at six months.The plaque index and gingival bleeding on probing remained stable throughout the study. The composite bone graft combined with A-PRF and collagen membranes offers an effective approach for minimizing alveolar bone loss and preserving ridge dimensions over six months, with promising implications for improving implant outcomes.

1. Introduction

Marked alveolar bone loss following extraction can be anticipated due to various naturally occurring remodeling process. This inturn reduces the success rate of implant placed. So, inorder to preserve or reduce the bone loss following extraction alveolar ridge preservation has been put forward.

It was 1st performed by Osburn et al in 1974 by retaining the extracted tooth within the socket.[1] But the retention of the tooth was not always possible, So the use of bone grafts for socket preservation started from mid-1980s and after that many graft materials have been researched to test their efficacy for socket preservation. In our study we tested the efficacy of composite bone graft which is a combination of bioglass bone graft and A-PRF gel along with A-PRF and Collagen membrane.

Bioglass is an excellent osteostimulator with osteoconductive capacity, besides they are also highly biocompatible. It was 1st discovered by Hench and colleagues in 1969.[2] They are shown to have capacity to bond to both the soft tissue and hard tissue moreover their bonding rates can also be controlled by modifying their combinations. They are shown to form hydroxyl carbon apatite layer within hours following in vivo thus stimulating the bone formation. A-PRF prepared by centrifuging at 1500 rpm for 14 minutes are shown to consisits of large amount of leucocytes and sustained growth factor release for 10 days (Kobayashi et al). They are shown to promote primary wound healing when used alone in

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socket preservation. The composite bone graft used in our study prepared using bioglass and A-PRF are shown to have both osteoconductive and osteostimulatory property thus showing better bone formation than the conventional graft techniques. Bovine derived collagen membrane is shown to reduce or counteract the amount of alveolar bone loss following extraction by acting as scaffold for the osteoblastic cells to lay down new bone matrix.[3]

Conventional Cone Beam Computed Tomography (CBCT) are shown to be accurate, cost effective, non-invasive and simple also a low radiation procedure to measure the dimensional changes following socket preservation.[4] So, here we tested the efficacy of socket preservation using CBCT taken immediately following extraction and 6^{th} month following extraction.

2. Case Series

This study was conducted in department of Periodontology, Meenakshi Ammal Dental College and Hospital. Five patients requiring extraction due to periodontal or endodontic reasons were taken. The following clinical parameters were measured at baseline and 6^{th} fmonth following extraction: Plaque index (Silness and Loe, 1964), Bleeding on probing (Ainamo and Bay, 1975), Keratinized tissue height, Gingival thickness. Besides, the crestal bone height and width were also measured at baseline and 6^{th} month following extraction using CBCT.

The inclusion and exclusion criteria are as follows:

2.1. *Inclusion criteria*

1. Age >18 years.
2. Extraction of mandibular or maxillary teeth due to caries, root fracture, periodontal disease.
3. Adequate oral hygiene.
4. Systemically healthy with no contraindication for extraction.

2.2. *Exclusion criteria*

1. Women who are Pregnant.
2. Patients with bone metabolic disorders like osteoporosis, osteomalacia, fluorosis, primary hyperparathyroidism, etc
3. Patients who are currently taking drugs that influences the bone metabolism
4. Patients who had been using bisphosphonates in last 4 years
5. Persons who smokes more than 10 cigarettes per day

2.3. *Surgical procedure*

Teeth were extracted in department of Oral and MaxilloFacial surgery after they were diagnosed to be hopeless. Then the extracted sockets were debrided to remove any granulation tissue within and saline irrigation was done (Figure 1). The sockets were then filled with composite bone graft cautiously inorder to avoid overfilling of the socket (Figure 2). Then the A-PRF membrane was placed on top of it which was then covered with collagen membrane (Figures 3 and 4). Following this the sockets were sutured using 4-0 silk sutures using horizontal mattress sutures (Figure 5).

2.4. *Post operative instructions*

The patient was then advised to take Amoxicillin 500mg every 8hours for 5 days, Zerodol P twice a day for 2 days and 0.2% Chlorhexidine mouthrinse for seven days was prescribed.

2.5. *Radiographic analysis*

The CBCT system's midline laser beam was adjusted to the skull's midsagittal plane for CBCT. The horizontal laser beam was perpendicular to the skull's Frankfort plane. The scan took 18 seconds and the voxel size was 0.3 millimetres (5.56 mAs, 110 kVp). The CBCT software (QRNNT 2.17, Quantitative Radiology, Verona, Italy) was used to rebuild the raw data set. CBCT were taken at baseline and 6 months following extraction(Figures 6 and 7).

Figure 1: immediately following extraction:

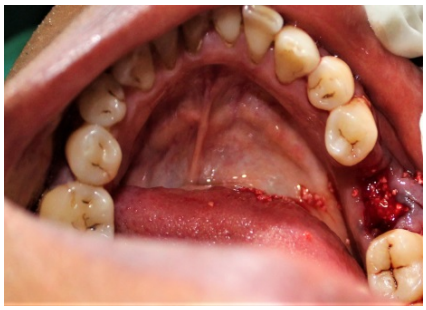

Figure 2: Composite bone graft placed

Figure 3: A-PRF membrane placed

Figure 4: GTR membrane placed

Figure 5: Suturing done:

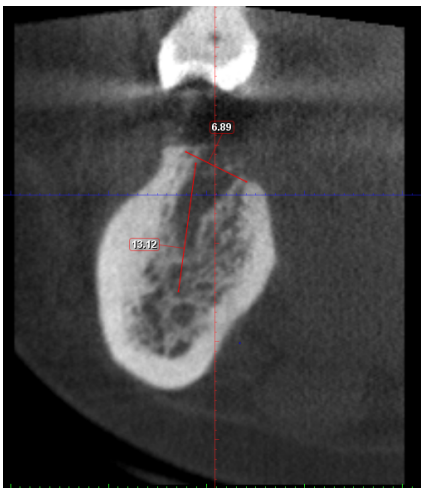

Figure 6: CBCT measurement at baseline:

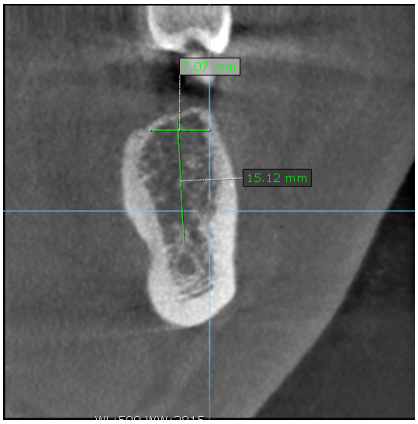

Figure 7: CBCT measurements 6 months following extraction:

3. Results

The gingival index, plaque index and gingival bleeding on probing remained unchanged at 6^{th} month following extraction. The dimensional changes were measured for each patient using the normalized ratio formulae:

$$\text{Normalized ratio} = \frac{lenght\ of\ reference\ after}{length\ of\ reference\ line\ before}$$

There seems to be a minimal decrease in crestal bone width of around 1.1mm at 6^{th} month following extraction. The crestal bone height decrease of around 0.8mm was evident. This was very minimal when compared to the alveolar bone loss that occurs during spontaneous heling. The sockets when left to heal spontaneously are shown to produce a mean crestal bone width decrease of 2.73mm and mean crestal bone height decrease of around 1.71mm (Couso-Queiruga et al 2020).

Table 1: Clinical parameters at baseline and 6 months post-operatively

Parameters measured	Baseline normalized ratio	6 Months normalized ratio
Crestal bone width	1.370±0.30	1.097±0.93
Crestal bone height	2.437±0.57	2.43±0.75
Keratinized tissue height	2.01±0.01	4.53±0.51
Gingival tissue thickness	0.85±0.20	0.78±0.36
Gingival bleeding on probing	0.89±0.24	0.93±0.40
Plaque index	1.077±0.49	1.293±0.61

There was a coronal shift in the keratinized tissue height following socket preservation at 6^{th} month follow up in comparison to baseline. There is a decrease in gingival thickness from baseline to 6^{th} month follow-up (Table 1).

4. Discussion

The aim of our study was to test the efficacy of CBCT for the assessment of dimensional changes following ridge preservation. CBCT gives 3D and cross-sectional views of the jaws, and the resulting images' linear measures are utilised in presurgical implant planning to determine alveolar height and width, and hence the required implant size. Linear measures are also utilised in orthodontics and in determining the size of a tumour in the jaw. According to studies, 94% of linear CBCT measurements are accurate to within 1mm.[5] So, it should be the most precise and non-invasive method for measuring AR volume and morphology. For the purposes of standardisation, the pictures were always recorded and reconstructed at the same place in this investigation, using the reference plane identified by anatomic landmarks on CBCT sections. A drop in picture quality caused by soft tissue loss, metallic replacements, and patient action can impact the precision of calculating the distance in patients. Clear and reasonably fixed points representing the relevant anatomic features were identified and used to generate lines and sections for corrections and measurements to increase accuracy and repeatability.

Lambert et al[6] has also developed a method to standardize the measurements taken using CBCT using a custom made template but that technique required a custom made template and also they used it only for posterior maxilla, here in our study we used the technique given by Xia et al, where the distances were measured using the fixed anatomic location and this technique was also simple.[7] In mandibular region the inferior alveolar nerve location was taken as the fixed anatomic location from where the length or the height of the ridge was measured. The width of the ridge was measured as horizontal distance in the central part of the alveolar ridge.

Around 50% horizontal ridge resorption is anticipated within 6 months following extraction.[8] Inorder to reduce the amount of bone augmentation done during implant placement, it's necessary to reduce the amount of bone loss following extraction. One such procedure is socket preservation which is usually done using bone grafts with or without the use of membranes. Studies evaluating the efficacy of various materials including the deprotinized bovine bone mineral,[9] alloplast,[10] Demineralized Freeze dried bone graft, bone morphogenetic protreins[11], autografts[12] and xenografts have been done. Besides Camargo et al in 2000[13] also evaluated the efficacy of guided bone regeneration in socket preservation.

Our study done using composite bone graft along with A-PRF and Collagen membrane produced a minimal crestal bone width decrease of 1.1 mm and crestal bone height decrease of 0.9mm at 6 months following extraction. This was in accordance to the study by Lekovic et al where he reported a mean crestal bone width decrease of 1.3mm.[14] Besides, Fan et al in 2021, did an experimental study on dogs to assess the efficacy of socket preservation using Bio-oss collagen membrane over spontaneous healing and stated a vertical bone loss of 0.8-0.9mm which is in accordance to our study.[15]

This could be attributed to the use of graft materials and membranes that have the capacity to alter the volumetric changes following extraction,

There was a coronal shift of keratinized tissue height during 6^{th} month follow-up and this was in accordance to the study done by Iasella et al in 2003.[16] Besides there was a decrease in gingival thickness following socket preservation and this was in accordance with the study done by Schneider et al in 2014. This occurs because of the fibroblasts migrating from the wound margin they then develops to myofibroblasts in areas that was not previously colonized by bone forming cells.

The other parameters including the plaque index, gingival bleeding on probing remained constant throughout the study and this was in accordance to the study done by Barone et al in 2012.[17] This could be attributed to the good oral hygiene maintenance by the patients throughout the study period.

Based on the present study it can be concluded that socket preservation following extraction reduces the alveolar bone loss to a greater extent, that inturn to reduce the need for bone augmentation during implant placement. Moreover, the increase in keratinized tissue and decreased gingival thickness improved esthetics in anterior tooth region.

But further studies, using composite bone graft with A-PRF and collagen membrane analysed using CBCT in large number of patients standardized based on their age, sex and location of extraction site would provide further information on the efficacy of socket preservation using this material and also the ability of CBCT in analyses of alveolar ridge dimensions.

5. Conclusion

So, within the limitations of this study it can be concluded that CBCT could be a safe and effective tool to analyze the dimensional changes following socket preservation. Moreover, the use of Composite bone graft along with A-PRF and Collagen membrane provides an excellent preservation of the alveolar socket height and width during 6 months follow-up.

6. Conflict of Interest

None.

7. Source of Funding

None.

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