SOCKET PRESERVATION USING TWO TYPES OF BONE REPLACEMENT GRAFT MATERIAL- A CLINICAL COMPARATIVE STUDY-6 MONTHS

Dissertation submitted to

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation titled **"SOCKET PRESERVATION USING TWO TYPES OF BONE REPLACEMENT GRAFT MATERIAL- A CLINICAL COMPARATIVE STUDY-6 MONTHS"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. G. SIVARAM, M.D.S.,** Professor, Department of Periodontology, Ragas Dental College and Hospital, Chennai.

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CERTIFICATE

This is to certify that this dissertation titled "**SOCKET PRESERVATION USING TWO TYPES OF BONE REPLACEMENT GRAFT MATERIAL- A CLINICAL COMPARATIVE STUDY-6 MONTHS**" is a bonafide record of work done by **Dr. C. Guhanathan** under my guidance during the study period 2014-2017.

This dissertation is submitted to **THE TAMILNADU DR.MGR MEDICAL UNIVERSITY** in partial fulfilment for the degree of **MASTER OF DENTAL SURGERY, BRANCH II- PERIODONTOLOGY.** It has not been submitted (partial or full) for the award of any other degree or diploma.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
SP	Socket Preservation
ARP	Alveolar Ridge Preservation
Beta-TCP	Tri Calcium Phosphate
DFDBA	Demineralised Freeze Dried Bone Allograft
GBR	Guided Bone Regeneration
PRF	Platelet Rich Fibrin
FGG	Free Gingival Graft
EDS	Extraction Defect Sounding
CPS	Calcium Phospho Silicate
WKG	Width of Keratinized Gingiva

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Introduction

INTRODUCTION

Socket preservation at the time of extraction has evolved as one of the most significant procedures in the modern periodontal paradigm for maintenance of health & function. The first attempts to preserve the alveolar ridge started in 1960[8], where by the submerged root concept was introduced as a ridge preservation technique[23 103]. The term socket preservation was first coined by Cohen (1988) for a procedure designed for prosthetic socket maintenance, ridge preservation, and ridge augmentation. It provides for greater control and greater predictability while preventing site collapse and esthetic compromise. A number of clinical studies have shown that dimensional changes and significant alterations in post extraction ridge will occur (Atwood, 1963[8]; Schropp and colleagues, 2003[83]; Araujo & Lindhe, 2005[4])

Replacement of missing tooth by immediate implant placement has become a common surgical protocol in clinical practice. This therapeutic concept was introduced in 1976 as an alternative protocol to the classical delayed implant surgical protocol proposed by Branemark. Experimental studies on animal models evaluated by histomorphometric measurements showed that a marked bone resorption occurred following immediate implant placement. Vignoletti et al 2012[101] compared the dimensional alterations of the alveolar ridge that occurred 6 weeks after immediate implant placement and demonstrated that the mean vertical bone loss was 2.32±0.36 mm and

consistently present in the sockets where immediate implants were installed. These experimental studies clearly demonstrate that immediate implant placement fails to prevent the resorptive crestal changes described after tooth extraction.

In vitro and vivo studies on extraction socket healing is a two stage process[79]. In the first phase bundle bone is completely resorbed causing a reduction in the vertical ridge. In the second phase, the buccal wall and the woven bone are remodelled causing the horizontal and further vertical ridge reduction. When socket grafting is adopted, the first phase and vertical bone loss still occur, however, the second phase and the horizontal contraction are minimized. Nevins et al[76] reported that 79% of grafted sites underwent less than 20% buccal plate loss. Therefore most of the authors advocated socket grafting to be performed at the time of extraction prior to implant placement.

Socket preservation seems to be a predictable treatment modality and the surgical outcome on preservation is often related to various factors.

Types of interventions for socket preservation include[49]:

- Socket grafting (autograft, allograft, xenograft, alloplastic materials);
- Socket sealing (soft tissue grafts);
- Guided Bone Regeneration(GBR) (resorbable/non-resorbable barriers);
- Biological active materials (growth factors) and
- Combinations of the above techniques/materials.

Bone substitutes for socket grafting seem to be available in either Particulate or Putty form. Particulate grafts during grafting procedures have to be condensed into the surgical area. Over condensation will cause a detrimental effect to the regenerative potential as the distance between the particles is diminished and the diffuse distance for oxygen and other nutrients is increased[87]. Other disadvantages include containment of the graft particles, graft dislodgment as the flap is sutured back into position. The inability to standardize the distribution of the particles in the graft materials during packing in various defects is a drawback of such biomaterials.

Putty form graft materials have been used in bone regeneration procedures with good clinical outcomes. Putty form biomaterials have significantly superior handling characteristics compared with particulates. These include ease of placement, enhanced particle containment, and a viscous consistency that has allowed for unique delivery systems to be developed[10].

Babbush et al 1998[9] was the first author to report the successful use of putty bone grafts for bone augmentation in post-extraction sockets and has elucidated the advantages of graft containment by the resorbable carrier. Alloplastic bone putty in post-extraction sockets has the benefits of ease of handling, no need for the rehydration of the graft, and direct placement in the socket via a cartridge delivery system that minimizes intra operative time thus minimizing patient discomfort.

Allograft bone putty material in the form of Demineralized Freeze Dried Bone Allograft (DFDBA) is considered to be a preferred material of choice for socket grafting because of its Osteoconductive and Osteoinductive activity[47], alternative to autogenous graft which is still considered as a gold standard[15].

There is limited literature evidence that evaluated alloplastic material versus allograft material in putty forms as bone substitutes in socket preservation procedure. Hence, the present clinical study aims to evaluate clinically and radiographically the soft and hard tissue changes following socket preservation procedures using two different types of Putty form of Bone replacement Grafts.

Aim and Objectives

AIM AND OBJECTIVES

AIM:

To evaluate the soft and hard tissue dimensional changes following placement of two different types of socket fill bone substitutes in Extraction Defect Sounding (EDS) classification type I and type II defects over a period of 6 months.

OBJECTIVES:

1. To clinically compare and evaluate the soft tissue dimensional changes in two different types of socket fill bone substitutes in extraction sockets over a period of 6 months.

2. To radiographically compare and evaluate the hard tissue dimensional changes in two different types of socket fill bone substitutes in extraction sockets over a period of 6 months.

3. Descriptive analysis of the percentage of vital bone, new osteoid, residual graft, fibrous tissue formation in two different types of socket fill bone substitutes after 6 months.

Review of Literature

REVIEW OF LITERATURE

SOCKET PRESERVATION

Contemporary socket preservation techniques involve the placement of different biomaterials in the socket[104]. The choice of biomaterials that will be used is correlated to the purpose of the clinical situation demands/ needs.

Definition:

Ridge preservation = preserving the ridge volume within the envelope existing at the time of extraction

Ridge augmentation = increasing the ridge volume beyond the skeletal envelope existing at the time of extraction.

The socket preservation techniques have been broadly classified by

Bartee BK et al 2001[11]

A classification of a socket preservation technique (Based on resorbability pattern of graft material)

1. **Long-term ridge preservation:**
   - ❖ For pontic site development.
   - ❖ Improve stability of removable appliances.
   - ❖ Non restorable materials are used.

- ❖ Placement of implants in these sites is not favoured.

2. **Medium-term or transitional ridge preservation:**

- ❖ Resorbable bone graft is used.
- ❖ Placement of endosseous implant in the site after an initial healing period.

3. **Short-term ridge preservation:**

- ❖ Maintain the post extraction alveolar dimensions.
- ❖ To allow for the placement of an implant in the shortest time possible.

HEALING OF EXTRACTION SOCKETS[55]

Socket filled with blood from severed vessels

⇩

Formation of fibrin network + platelets

⇩

Blood clot or coagulum (1st 24hrs)

⇩

Blood clot acts as a physical matrix, helps in movement of cells

(mesenchymal) and G.F

⇩

Neutrophils and macrophage enter wound, & digest bacteria & tissue debris to sterilize wound

⇩

Fibrolysis of blood clot

⇩

Coagulum replaced by granulation tissue (2-4days)

⇩

Vascular network formed (1 week)

⇩

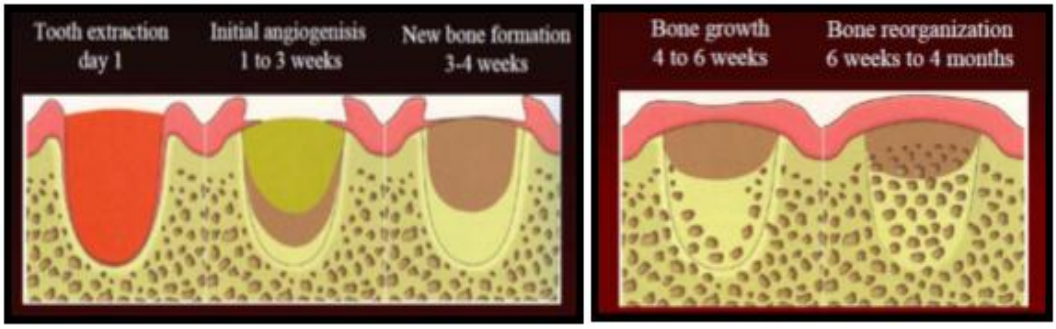
Marginal portion of extraction socket is covered with Connective tissue rich in vessels & inflammatory cells (end of 2nd week)

⇩

Alveolus is filled with woven bone (4-6 weeks) & soft tissue becomes keratinized.

⇩

Mineral tissue within socket is reinforced with lamellar bone deposited over woven bone (4-6months).



ALVEOLAR RIDGE REMODELLING AFTER EXTRACTION: [97]

Maxillary and mandibular bony complexes are composed of several anatomical structures with function, composition and physiology. Alveolar process develops following tooth eruption. Bundle bone lining alveolar socket, extends coronally forming crest of buccal bone & makes part of periodontal ligament structure as it enclose Sharpeys fibres[31 75]. Clinical and cephalometric studies from the 1950 to the 1970 described the resorption pattern in the post

extraction anterior ridge of the edentulous mandible/maxilla. Atwood[7] et al 1957 divided factors affecting the rate of resorption into 4 categories: anatomic, metabolic, functional and prosthetic. Tallgren[91] et al 1972 demonstrated 400% higher residual ridge resorption in the mandible compared with the maxilla.

Remodelling occurs in 2 stages:

- In first phase bundle bone resorbed rapidly & replaced with woven bone which causes increase in reduction in bone height especially in buccal aspect of socket. Buccal plate has increased resorption as it is thinner, 0.8mm in anterior teeth and 1.1mm in posterior teeth[50].

- In second phase the outer surface of alveolar bone is remodelled causing overall horizontal & vertical resorption[42].

OTHER FACTORS FOR ALVEOLAR BONE RESORPTION:[42]

- Disuse atrophy.

- Reduced blood supply.

- Localized inflammation plays a role in bone resorption.

- Surgical trauma from extraction induces micro trauma to surrounding bone which accelerates bone resorption.

RATIONALE FOR SOCKET PRESERVATION

To minimise loss of alveolar bone to acceptable levels, atraumatic extraction & limiting flap elevation are essential. One of the most primary goals of alveolar socket preservation is the prevention of the rapid reduction of buccal plate of bone. The buccal plate is composed of vulnerable bundle bone. Elevating the periosteum from buccal bone to create a mucoperiosteal flap compromises the blood supply of the exposed bone surface, leading to osteoclastic activity and bone resorption[34].

The main objective of socket preservation:

Primary Goals:

- To reduce loss of alveolar bone volume (3 dimensionally).
- To regenerate bone faster allowing earlier implantation and restoration.
- To enable the regenerated tissues to provide implant osseointegration.
- To improve the esthetic outcome of the final prosthesis.

Secondary Goals:

- To enable installation and stability of a dental implant.
- To reduce need for additional bone grafting procedures.

INDICATIONS FOR SOCKET PRESERVATION (chen et al)

- Maintenance of alveolar bone ridge volume after tooth extraction.
- High aesthetic region.
- Narrow alveolar crest.
- Thin buccal and lingual alveolar walls (thinner than 2 mm) and a thin gingival biotype.
- Alveolar ridge fenestrations.
- Immediate implant placement.
- As a temporary procedure (in children, where bone growth is not completed).

CONTRA INDICATIONS FOR SOCKET PRESERVATION

- Local contraindication
    - Inflammatory process.
- General contraindications
    - Uncontrolled diabetes.
    - Tumours.

- Use of medications (eg. bisphosphonates, mmunosuppressants).
- Radiation and Chemotherapy.

CLASSIFICATION OF EXTRACTION SOCKETS:

Salama and Salama[81], 1993: (Based on Pre-operative site of extraction).

- **Class One:** socket that has intact walls and is favourable for immediate implant placement with or without bone grafting.
- **Class Two**: socket with a missing labial wall, necessitating the use of guided tissue regeneration (GTR) and a bone graft in conjunction with implant placement.
- **Class Three:** socket that does not provide any implant anchorage and requires the application of a staged implant insertion as well as bone-grafting procedures.

Meltzer A[73], 1995: (Based on intact walls).

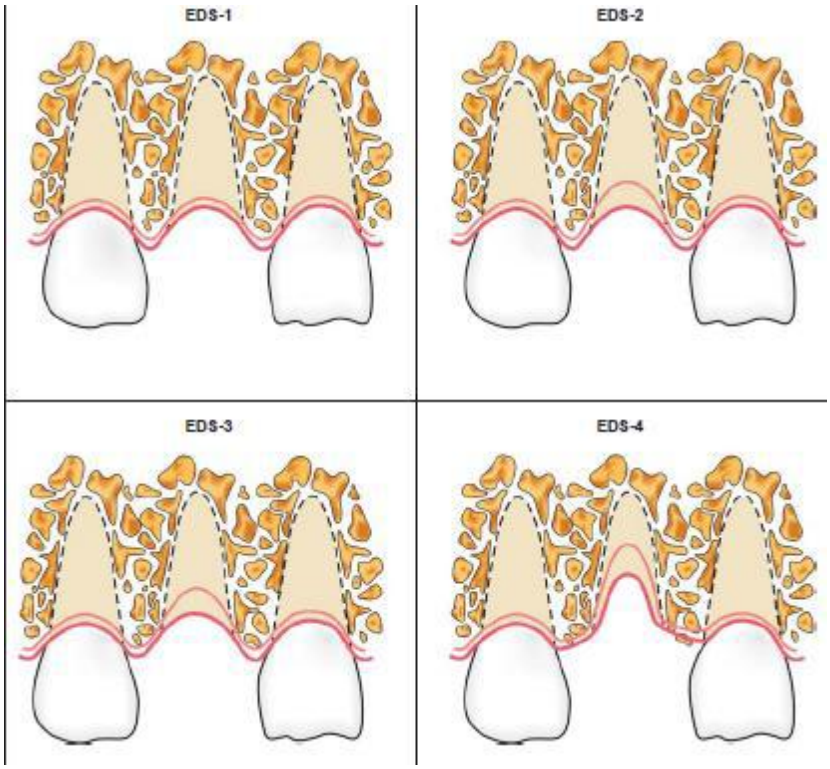
- **CLASS I:** Intact bony housing, no wall involvement.
- **CLASS II:** 3 intact walls, 1 wall with dehiscence or fenestration.
- **CLASS III:** Type1: adequate height, inadequate horizontal width and fenestration
- **CLASS IV:** Inadequate vertical height.

Caplanis N, Lozada JL, Kan JY[20]. 2005(Classification based on hard and soft tissue architecture surrounding extraction defect).

Table 1

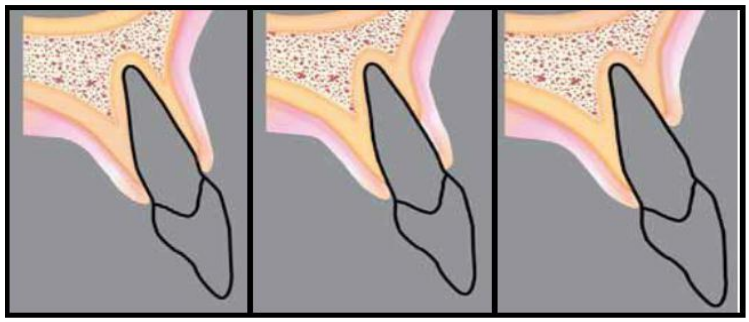
The Extraction Defect Sounding Classification

Defect Type	General Assessment	#Socket Walls Affected	Biotype	Hard Tissue	Distance to Reference	Ideal Soft Tissue	Treatment Recommendations
EDS-1	Pristine	0	Thick	0 mm	0-3 mm	Predictable	Immediate implant (one-stage)
EDS-2	Pristine to slight damage	0-1	Thin or thick	0-2 mm	3-5 mm	Achievable but not predictable	Site preservation or immediate implant (one- or two-stage)
EDS-3	Moderate damage	1-2	Thin or thick	3-5 mm	6-8 mm	Slight compromise	Site preservation then implant placement (two-stage)
EDS-4	Severe damage	2-3	Thin or thick	≥6 mm	≥9 mm	Compromised	Site preservation then site development then implant placement (three-stage)



Elian Cho Froum [33]et al 2007: (based on soft tissue/ alveolar bone housing)

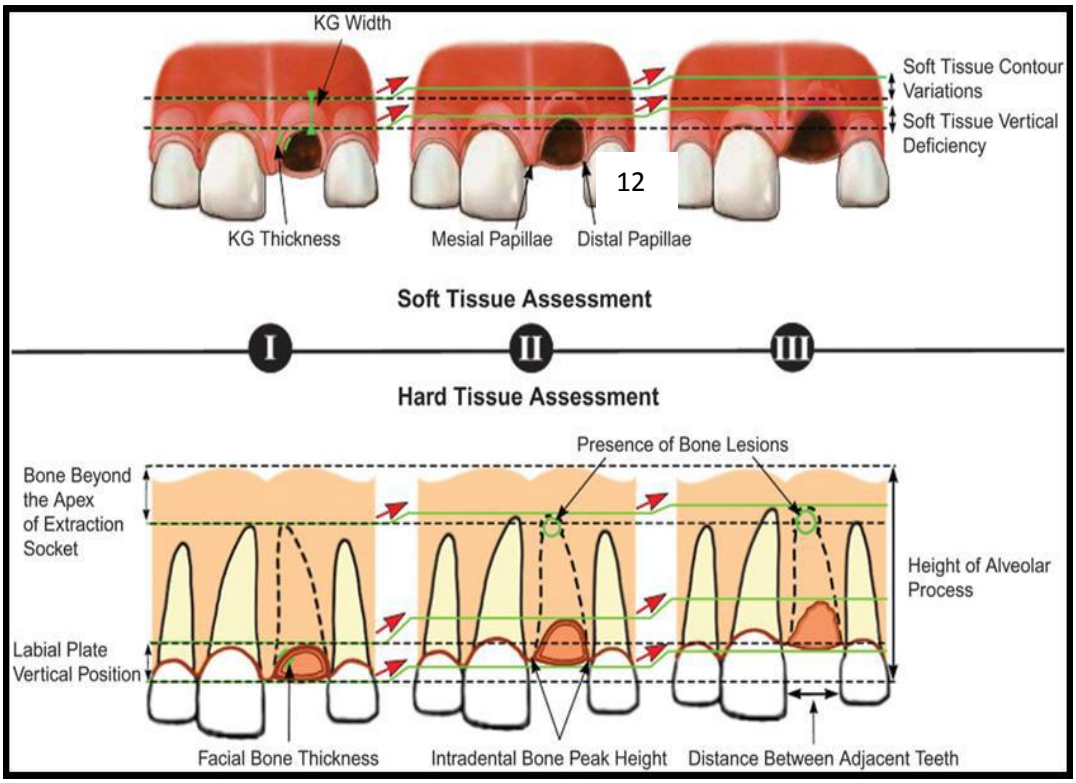
- **Type I socket:** Soft tissue and buccal plate of bone present which is ideal for immediate implant placement. If buccal plate of bone is more than 2mm and implant placement is not immediate, grafting may not be necessary.
- **Type II socket:** Soft tissue is present but buccal plate of bone is missing. Bone grafting of socket is necessary with possible need for cell occlusive membrane. Delayed placement of implant may be recommended especially in esthetic areas.
- **Type III socket:** Both soft tissue and buccal plate of bone are missing. Ridge augmentation procedures including bone grafting with space maintaining membranes are necessary and delayed placement of an implant is recommended.



Socket Classification by Elian et al 2007

Juodzbalys G, Sakavicius D, Wang HL[58] 2008:

(Based upon soft and hard tissue parameters only for maxillary anterior/single rooted/esthetic region).



Extraction socket soft and hard tissue assessments and extraction socket types. I, II, and III = assessment scores.

Evian et al [35]2010

- **Type I:** The bony socket is intact, and the soft-tissue form is undisturbed.

- **Type II:** The bony socket is intact in the coronal aspect of the socket, but a fenestration is present in the apical area. The soft tissue remains intact and undisturbed.
- **Type III:** Bone loss is present in the coronal aspect of the socket. The soft tissue remains intact and undisturbed.
- **Type IV:** Bony defects exist in conjunction with soft-tissue deformity. Often, the severity of this defect precludes implant placement.

Proposed mechanism of socket preservation[11]

The exact mechanism of alveolar ridge resorption and preservation has been said to involve a complex cascade of events.

Biomechanical Stimulation:

Many authors have suggested that the random orientation of the graft placed in extraction sites provides physiologic and bioelectric stimulation of the adjacent bone via attachment and load transmission from the overlying prosthesis during normal jaw function. There by inducing indirect physiologic forces on the bone graft interface may contribute to bone preservation.

Wound Isolation and the Scaffolding Effect:

Wound isolation by the principles of guided bone regeneration with membranes prevents invagination of the oral epithelium into the socket, favouring bone-regenerating cells to complete the bone fill. The presence of an

osteoconductive bioactive framework or scaffold allows osteoblasts to migrate and form bone more efficiently within the extraction space, which facilitates bone healing.

Modification of Cellular Activity:

The physiochemical and structural characteristics of implanted bioactive material evokes a cellular response from the adjacent tissues by providing a biomimetic environment for initiating bone repair.

Studies on dimensional changes following extraction:

Schropp (2003)[83] A prospective study (humans) to assess bone formation in the alveolus and the contour changes of the alveolar process following tooth extraction, by means of measurements on study casts, linear radiographic analyses, and subtraction radiography. The results demonstrated 2/3rd of hard &soft tissue changes occur in first 3months (crest width loss of 3.8mm, 30%) & 50% crestal width lost in 12 months period (6.1mm). There is increased horizontal alveolar ridge reduction (29-63%, 3.79mm) and vertical bone loss (11-22%) (1.2mm on buccal, 0.8mm on mesial, 0.80 on distal) at 6 months time interval.

Araujo MG and Lindhe J (2005)[4] conducted an experimental study in dogs to assess the dimensional ridge alterations following tooth extraction with elevation of buccal and lingual full thickness flap. Primary closure of the extraction sites was achieved with mobilized gingival tissue. During follow

up, marked dimensional changes occurred at the buccal than at the lingual aspect and also ridge reductions occurred during the 1st 8 weeks.

Trombelli L et al (2008)[97] conducted a cross sectional study on modelling and remodelling of human extraction sockets. A semi quantitative analysis of tissues and cell populations involved in the various stages of process of modelling/remodelling was done. Results of the study showed large amounts of granulation tissue in early phase, between the early and intermediate phase showed woven bone and matrix. Osteoblasts peaked at 6-8 weeks and remained constant there after, small number of osteoclasts also seen. Connective tissue formed during the first few weeks.

Vander Weijden F et al (2009)[99] in a systematic review to assess the alveolar bone dimensional changes in humans following tooth extraction. Alveolar width change and socket fill were selected as outcome variables.

- The results showed a mean reduction in alveolar width of 3.87mm.
- Socket fill in height as measured relative to the original socket floor was on an average 2.57mm.
- The mean clinical mid buccal height loss was 1.67mm.
- The mean crestal height change as assessed on radiograph was 1.53mm.

Ten Heggeler et al (2011)[94] in a systematic review with the aim to assess the benefits of socket preservation procedures following tooth

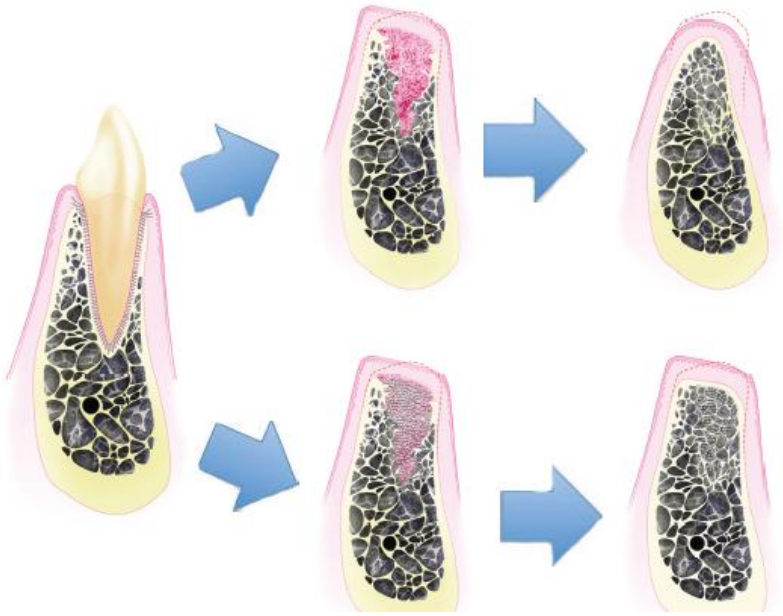
extraction in non molar region as compared with no additional treatment with respect to bone level. Studies have reported data concerning the dimensional changes in alveolar height and width after tooth extraction with or without additional treatment like bone fillers, collagen, growth factors or membranes. To conclude the review stated that in natural healing group after extraction, a reduction in width ranging between 2.6 -4.56 mm and in height between 0.4-3.9mm was observed. Socket preservation techniques may aid in reducing the bone dimensional changes following tooth extraction. However, they do not prevent bone resorption so that a loss in width up to 3.48 mm and in height up to 2.64 mm is still present.

Weng et al (2011)[106] in a systematic review on prospective controlled studies in humans to provide a basis for an expert consensus on the current status of socket preservation (SP) and ridge preservation(RP) procedures on the day of tooth extraction. Results showed that horizontal ridge loss was reduced by 59%, and vertical ridge loss by 109%, if SP/RP was applied after tooth extraction. The need for hard tissue augmentation at implant placement was five times higher, if no SP/RP was performed on the day of tooth extraction. To conclude SP/RP seems to be effective in maintaining ridge dimensions after tooth extraction. No recommendations for a specific technique or material can be concluded.

Tan et al (2012)[92] Systematic review was done to assess post-extraction alveolar hard and soft tissue dimensional changes in humans. In

hard tissue changes, horizontal dimensional reduction (3.79 ± 0.23 mm) was more than vertical reduction (1.24 ± 0.11 mm on buccal, 0.84 ± 0.62 mm on mesial and 0.80 ± 0.71 mm on distal sites) at 6 months. Soft tissue changes demonstrated 0.4–0.5 mm loss of thickness at 6 months on the buccal and lingual aspects. Human re-entry studies showed horizontal bone loss of 29–63% and vertical bone loss of 11–22% after 6 months following tooth extraction. These studies demonstrated rapid reductions in the first 3–6 months that was followed by gradual reductions in dimensions thereafter.

Farmer M and Darby I (2013)[36] conducted a prospective study in humans to evaluate the ridge dimensional changes following single tooth extraction in aesthetic zone. Hard and soft tissue measurements were taken before extraction and after 6-8 weeks of healing which was followed by implant placement. The results showed a marked bone loss in the mid point of coronal portion of buccal aspect (4mm loss).



Studies on socket preservation techniques:

Fickl et al (2008)[37] an animal experimental volumetric study was done to evaluate tissue alterations after tooth extraction with and without surgical trauma. The sites were assigned to one of the following treatments: Group 1- no treatment; Group 2- flap elevation and repositioning; Group 3- the extraction socket was filled with BioOss Collagen and closed with a free soft-tissue graft; Group 4 – after flap elevation and repositioning the extraction socket was treated with BioOss Collagen and a free soft-tissue graft. The "flapless groups" demonstrated significant lower resorption rates both when using socket-preservation techniques and also the treatment of the extraction socket with BioOss Collagen and a free gingival graft seems beneficial in limiting the resorption process after tooth extraction.

Fickl et al 2008[38] An animal study was done to assess dimensional changes of the alveolar ridge contour after different socket preservation techniques. All groups displayed contour shrinkage at the buccal aspect. Only the differences between the two test groups (group 1 with BioOss collagen, & group 2 BioOss collagen with free soft tissue graft) and the control group (no treatment) were significant at the buccal aspect. Socket preservation techniques, used in the present experiment, were not able to entirely compensate for the alterations after tooth extraction however.

Cardaropoli D, Cardaropoli G 2008[22] A clinical and histologic study in humans was done to assess the possibility of preserving the buccal and lingual plates of a post extraction socket from resorption using bone filler (Osteoconductive) and covered by collagen membrane. The results demonstrated that it was possible to preserve about 85% of the initial ridge dimensions, allowing for correct implant placement. From a histologic point of view, new bone formation was detected in all sites, with a 25% average residual presence of the graft particles. This investigation confirms the benefit of augmenting an extraction socket with bone substitutes.

Oghli AA, Steveling H 2010[77] A clinical study in humans was conducted to compare atraumatic extraction and socket seal surgery. Three groups; group A- atraumatic extraction; group B- atraumatic extraction sealing the socket with autogenous soft tissue graft; and group C- atraumatic extraction with socket seal surgery and collagen matrix impregnated with

gentamicin. Casts were used to measure the width of the alveolar bone at the extraction area using the incisal edge of the adjacent teeth as a reference point. There was no significant difference in bone resorption in extraction sites among the groups. The local application of gentamicin presented more vascular ingrowth in the blood clot and granulation tissue beneath the graft, thereby supplying better nourishment during the initial healing phase of the graft.

Del Fabbro et al (2011)[29]A systematic review was done on prospective comparative studies to assess if the use of autologous platelet concentrates may be beneficial to the healing of extraction sockets. Favourable effects on hard and soft tissue healing and postoperative discomfort reduction were reported. The study concluded that standardization of experimental design is needed in order to detect the true effect of platelet concentrates in regenerative procedures of extraction sockets.

Ren E. Wang & Niklaus P. Lang et al (2012)[105] conducted a study in humans to evaluate different alveolar ridge preservation procedures and techniques. They concluded that implants placed into fresh extraction sockets do not prevent resorption of the alveolar bone. Also ridge preservation using bone substitutes together with a collagen membrane based on GBR principles has shown clear effects on preserving alveolar ridge height as well as ridge width. Soft tissue grafts or primary closure did not show beneficial effect on preventing the alveolar bone resorption.

Antonio Barone et al (2012)[12] conducted a randomized clinical study in humans to evaluate and compare implants placed in augmented vs non augmented sockets in terms of the need for additional augmentation procedures, success rate and marginal bone loss. Test group received xenograft following extraction and control group being extraction without any graft. Implants inserted after 7 months of healing and loaded after 4 months following insertion. The cumulative implant success rate at the 3-year follow-up visit reached 95% in both groups. Comparison of marginal bone level changes between the two groups was not statistically significant. However, grafted sites allowed placement of larger implants and required less augmentation procedures at implant placement when compared to naturally healed sites.

Orgeas et al (2013)[102] A systematic review of the literature was conducted to evaluate the efficacy of different surgical techniques in maintaining residual bone in the alveolar process following tooth extractions. Randomized controlled trials studies were taken and six meta-analyses were performed by dividing those studies into three groups with regard to the use of barriers and grafting (barriers alone, graft alone, or both). Statistically significant ridge preservation was found for studies that used barriers alone; the pooled weighted mean was 0.909 mm (95% confidence interval, 0.49 to 1.32 mm) for bone height, while the mean for bone width was 2.966 mm (95% confidence interval, 2.33 to 3.59mm). The study concluded that Socket

preservation procedures are effective in limiting horizontal and vertical ridge alterations in post-extraction sites. The meta-analysis indicates that the use of barrier membranes alone might improve normal wound healing in extraction sites.

Chan et al 2013[24] A systematic review of human clinical trials that compared histologic components of soft and hard tissues in augmented sockets and naturally healed sites were included. The mean percentages of vital bone and connective tissue in natural healing sockets were 38.5% ± 13.4% and 58.3% ± 10.6%, respectively. Limited evidence implied that vital bone fraction was not different with demineralized allografts and autografts and increased by 6.2% to 23.5% with alloplasts in comparison to nongrafted sites. Residual hydroxyapatite and xenograft particles (15% to 36%) remained at a mean of 5.6 months after socket augmentation procedures. The study concluded that the use of grafting materials for socket augmentation might change the proportion of vital bone in comparison to sockets allowed to heal without grafting.

Hauser et al 2013[46] A randomised controlled study in humans was done to investigate whether the use of platelet-rich fibrin (PRF) membranes for socket filling could improve microarchitecture and intrinsic bone tissue quality of the alveolar bone. Twenty-three patients requiring premolar extraction followed by implant placement were randomized to three groups: (1) simple extraction and socket filling with PRF, (2) extraction with mucosal

flap and socket filling with PRF, and (3) controls with simple extraction without socket filling. Analysis by micro-computed tomography showed better bone healing with improvement of the microarchitecture ($P < 0.05$) in group 1. This treatment had also a significant effect ($P < 0.05$) on intrinsic bone tissue quality and preservation of the alveolar width. An invasive surgical procedure with a mucosal flap appeared to completely neutralize the advantages of the PRF. These results supported the use of a minimally traumatic procedure for tooth extraction and socket filling with PRF to achieve preservation of hard tissue.

Suttapreyasri et al 2013[89] an human clinical study was done to investigate the influence of platelet-rich fibrin (PRF) on early wound healing and preservation of the alveolar ridge shape following tooth extraction. At the first week, the horizontal resorption on buccal aspect of PRF (1.07 ± 0.31 mm) was significantly less than that of the control (1.81 ± 0.88 mm). Platelet-rich fibrin demonstrated the tendency to enter the steady stage after the fourth week following tooth extraction, whereas in the control group the progression of buccal contour contraction was still detected through the eighth week. Radiographically, the overall resorption of marginal bone levels at mesial and distal to the extraction site in PRF (0.70, 1.23 mm) was comparable to that of the control (1.33, 1.14 mm). The result demonstrated neither better alveolar ridge preservation nor enhanced bone formation of PRF in the extraction

socket. The use of PRF revealed limited effectiveness by accelerated soft-tissue healing in the first 4 weeks.

Antonio Barone et al 2013[13] Evaluated soft tissue changes of extraction sockets, a comparison of spontaneous healing Vs ridge preservation with secondary soft tissue healing and showed a better preservation of facial keratinized tissue when compared to control sites; grafted sites allowed the placement of longer and wider implants when compared to implants inserted in non-grafted sites.

Vanessa Vanhoutte et al 2014[100] Described an accurate technique to evaluate soft tissue contour changes after performing socket preservation procedures using a "saddled" connective tissue graft combined with the insertion of slowly resorbable biomaterials into the socket and showed it could completely counteract the bone remodelling in terms of external soft tissue profile. The minor changes found in the cervical region might disappear with the emergence profile of the prosthodontic components.

Maria l. Geisinger 2015[43] conducted a systematic review to evaluate whether socket preservation at the time of tooth extraction improve soft tissue volume and/or implant esthetics. Even though no consensus of evidence exists to improve soft tissue quantity and/ or quality at future implant sites following socket preservation procedures. But the above studies suggest that the addition of soft tissue grafting to hard tissue intra socket grafts for ridge preservation

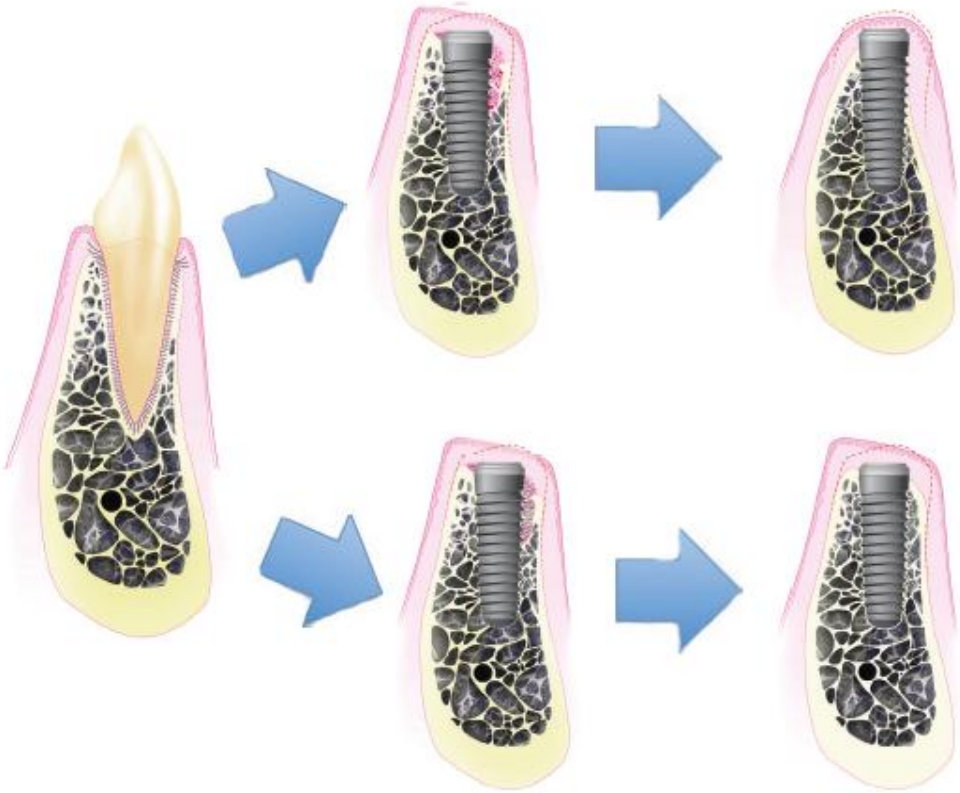
may improve soft tissue contours and reduce volumetric loss from baseline in patients with intact buccal bone.

Nikos Mardas et al 2015 [70]conducted asystematic review with the aim of whether Alveolar ridge preservation procedures improve implant treatment outcomes compared to unassisted socket healing. The outcomes were based on implant placement feasibility, need for further augmentation, survival/success rates and marginal bone loss. And also to estimate the size effects of these outcomes in three different socket preservation techniques- GBR, Socket filler, and Socket seal. The conclusions within the limitations of the study showed there is no clear evidence to support that implant placement feasibility increased following ARP when compared with unassisted socket healing, but there is a reduction in the need for additional augmentation. Comparing the different ARPs, there is no clear evidence to demonstrate which procedure has a superior impact on implant outcomes.

Sanz et al - The 4th EAO Consensus Conference 2015 [82]proposed therapeutic concepts and methods for improving dental implant outcomes in three specific clinical situations; fresh extraction sockets, posterior maxilla with limited bone height and posterior mandible with limited bone height. No clear evidence that Alevolar Ridge Procedures following extraction improved implant related outcomes; decision of preserving alveolar ridge should be based on patient related and local factors (i.e. tooth location, reason for

extraction, treatment duration, healing time, cost benefit and patient expectations and preferences).

Duong T. Tran et al 2016[96] Compared dental implant survival rates when placed in native bone and grafted sites. The cumulative survival rates at 5 and 10 years were 92% and 87% for implants placed in native bone and 90% and 79% for implants placed in grafted bone. There was no difference in the dental implant survival rate when implants were placed in native bone or bone-grafted sites. Tobacco use and lack of professional maintenance were statistically significantly related to increased implant loss.



Healing of the extraction socket, with post extractive implant placement, with and without socket grafting.

STUDIES RELATED TO ALLOPLAST

Horowitz et al 2009[48] A human study was conducted to determine the efficacy of an alloplastic graft material, consisting of a pure-phase beta-tricalcium phosphate (beta-TCP), in the preservation of ridge volume after tooth extraction and before dental implant placement. Measurements of alveolar width were made at the time of extraction and the time of implant placement. Approximately 6 months after surgery, the sites were re-entered for

implant placement. Cores were taken using a trephine bur and histomorphometric analysis was done, and results showed much of the graft material had resorbed and been converted to vital alveolar bone. The width of the extraction sockets was preserved to 91% of the preoperative width. The study concluded that extraction socket grafting with the pure phase beta-TCP and covered with either a resorbable collagen or dense poly tetra fluoroethylene barrier is a predictable method for preserving alveolar dimensions.

Leventis et al 2010 [65]reported the use of beta TCP granules coated with Poly lactic-co-glycolic acid (PLGA) to preserve the dimensions and architecture of the alveolar ridge after atraumatic extraction. This method provided a stable scaffold and deferred the in growth of unwanted soft tissue. At re-entry after 4 months adequate newly formed bone was observed, allowing optimal placement of implant.

Bozidar M. B. Brkovic 2012 [17] conducted a study in humans on healing extraction sockets filled with β- tricalcium phosphate and type I collagen (β-TCP/Clg) cones with barrier membrane(group A) or without a barrier membrane (Group B). The horizontal dimension of the alveolar ridge was significantly reduced 9 months after socket preservation in the non membrane group. There was bone formation with no significant differences between the two groups in the areas occupied by new bone (Group A=42.4%;Group B=45.3%), marrow (A= 42.7%; B=35.7%), or residual graft

(A=9.7%; B=12.5%).Both groups demonstrated sufficient amounts of vital bone and socket morphology to support dental implant placement after the 9-month healing period.

Mahesh et al 2012 [67] A study was conducted in humans to histologically evaluate the bone regeneration potential of a novel synthetic calcium phospho silicate putty (CPS) graft substitute. After extraction of the involved teeth, CPS putty graft was placed, a 26 sockets were covered with a collagen plug. Cores were taken for histological evaluation prior to implant placement. Histomorphometric analysis revealed an average vital bone content of 49.5 (± 20.7). A residual graft content of 4.3% (± 7.8) was observed following a healing time of 4.9 (± 0.8) months. The study concluded that the CPS putty is a good choice for socket bone regeneration in implant-related surgeries.

Takahashi et al 2013 [90] An animal experimental study was conducted where extraction socket was filled with beta-tricalcium phosphate β-TCP), a collagen sponge, βTCP/collagen (TCP/Col) for socket preservation. At 4 weeks after surgery, the TCP granule was retained in the bone defects and active bone formation was observed in the TCP/Col group and the β-TCP group, whereas in the collagen and the control groups, connective tissue grew into the defect. Most TCP granules grafted in the defects were resorbed and only a few residuals were evident at 8 weeks after surgery. These results exhibited that the TCP/Col composites could sufficiently maintain bone width

and height for the preservation of the extraction socket. In addition TCP/Col had an easy manipulative capability than TCP granules alone.

Mahesh et al 2013[68] A clinical study in humans was conducted to histologically evaluate and compare bone regeneration in extraction sockets grafted with either a putty alloplastic bone substitute (CPS) or particulate anorganic bovine (BO) xenograft utilizing the socket-plug technique. A bone core was obtained during the implant procedure (4-6months) from each site and evaluated for histomorphometric analysis, and the results revealed that residual graft values were significantly higher in the BO group (25.60%±5.89) compared to the CPS group (17.40%±9.39) ($P<0.05$). The amount of new bone regenerated was also statistically significantly higher in the alloplast group (47.15% ± 8.5%) as compared to the xenograft group (22.2% ±3.5%) ($P<0.05$). Putty calcium phosphosilicate alloplastic bone substitute results in more timely graft substitution and increased bone regeneration when compared to an anorganic bovine bone xenograft.

Kotsakis et al 2014[60] In a human clinical study compared the efficacy of beta TCP putty alloplast (group 1) with anorganic bovine bone (group 2) particulate graft; Postgrafting radiographs revealed adequate bone fill in all sockets of both test groups. An average decrease of 0.83 ± 0.32 mm and 0.88 ± 0.30 mm in ridge height was noted for group 1 and group 2 respectively. The vertical change in both test groups was similar and less than that of the control group, which presented a mean reduction of 1.12 ± 0.23 mm, but this

difference was not statistically significant. At 5 months post-grafting, the mean reduction in the bucco-lingual dimension was 1.26 ± 0.41 mm for group 1 and 1.39 ± 0.57 mm for group 2, while sockets in the control group lost a mean of 2.53 ± 0.59 mm.

Takahiro Ikawa et al 2016[51] Ridge Preservation after Tooth Extraction with Buccal Bone Plate Deficiency Using Tunnel Structured b-Tricalcium Phosphate Blocks-Histologic Pilot Study in Beagle Dogs showed widths of the alveolar ridge were significantly greater at test sites than at control sites. The amount of woven bone was significantly greater at test sites (62.4% – 7.9%) than at control sites (26.8% – 5.3%), although that of connective tissue and bone marrow was significantly greater at control sites than at test sites.

STUDIES RELATED TO ALLOGRAFT (DFDBA)

In a restrospective study of 607 titanium plasma sprayed implants placed in regenerated bone (with DFDBA), 97.2% of maxilla implants and 97.4% of mandible implants were successful for an average of 11 years. Even higher success rates in augmented bone have been reported by **Simion and co-workers**[86]**.** These numbers compare very favourably with the success rates for implants placed in pristine bone.

Robert A.Wood and Brian L. Mealey 2012[108] conducted a study in humans by histologic comparison of healing following tooth extraction with

ridge preservation using mineralized versus demineralized freeze-dried bone Allograft showed newly formed vital bone constituted 81.26% of the total bone area in the DFDBA group compared to 50.63% in the FDBA group, whereas residual bone graft material constituted only 18.74%of the total bone area in the DFDBA group compared to 49.37% in the FDBA group. The differences between the DFDBA and FDBA groups were statistically significant.

Valeria De Risi et al 2015 [30] conducted a systematic review and meta analysis of histological and histomorphometric data of Alveolar ridge preservation procedures and reported that alloplasts and xenografts showed a higher percentage (35%) of residual graft particles 7 months post op, whereas allografts showed a lowest rate.

Jeremiah Whetman & Brian L. Mealey2016[107] Compared the effect of healing time on new bone formation following tooth extraction and ridge preservation with DFDBA, results showed significantly higher percent new vital bone formation was found in the long-term healing group, 47.41%, compared to the short-term healing group, 32.63% . There was no significant difference in percent residual graft, percent connective tissue/other, or ridge dimensional changes.

According to systematic review, consensus statements and recommendations of the **1st DGI consensus conference, Aerzen, Germany –**

2010[106] socket preservation/ridge preservation seems to be effective in maintaining ridge dimensions after tooth extraction. But no recommendations for a specific technique or material has been suggested.

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Materials and Methods

MATERIALS AND METHODS

Patient selection:

20 patients (10 in each group) selected from the outpatient department of periodontics, Ragas Dental College & hospital, Chennai who are indicated for socket preservation followed by endosseous implant placement and restoration were included in the study.

CRITERIA FOR SELECTION OF PATIENTS:

INCLUSION CRITERIA:

Overall criteria

- The present clinical trial included patients between the age group of 25 to 45 years.
- Participants in both the groups exhibited high compliance, with good oral hygiene practice throughout the study period.
- The plaque and the bleeding index of the present study group exhibited less than 20% level at all times of the study period.
- Absence of systemic or medical conditions which would influence the outcome of socket preservation/ implant therapy.

Site criteria

- Edentulous sites – single rooted teeth (with intact adjacent dentition on both the sides)
- No periapical pathology present on the tooth needed for extraction/followed by socket preservation.
- Adequate width of keratinized tissue (at the surgical site).
- Residual crest of the alveolar bone is 3mm to the CEJ of the adjacent teeth.
- Group participated in the present study were Type I & II extraction socket morphology based on Extraction Defect Sounding (EDS) classification[20].

Exclusion criteria:

- Tooth with acute or chronic infections were excluded.
- Patients with history of drug allergy or radiation therapy.
- Patients who are smokers were excluded from the study groups..
- Patients who are exhibiting occlusal disharmony, parafunctional habits (bruxism) and patients with TMJ disorders.

- Females who are pregnant, lactating and those under hormonal replacement therapy were excluded from the study group.

STUDY DESIGN:

- In the present randomized prospective clinical trial, a total of 20 patients (4M & 16F), in the age group of 25 – 45 years were selected for socket preservation and followed up.

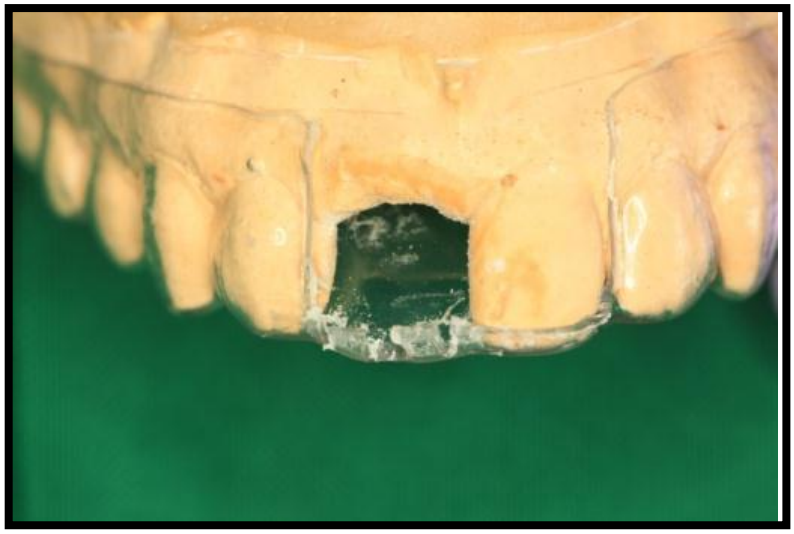
PRE SURGICAL PROTOCOL:

1. **Pre-Treatment Records:**

    - Detailed medical and dental history were recorded before the patients were included in the study groups.
    - Routine blood investigations.
    - Diagnostic casts for working models and study models.
    - Soft tissue parameters were assessed clinically.
    - Hard tissue parameters were assessed by intra oral periapical radiographs taken using long axis paralleling cone technique.
    - Clinical photographs for documentation.

2. Study models and fabrication of guidance stent:

Study models were taken and occlusal analysis was performed. A clear guidance vacuum formed thermoplastic matrix incisal guidance stent was fabricated. These stent had three grooves corresponding to the mesio-buccal, mid-buccal and disto-buccal line angles of the adjacent tooth. These grooves were used as a reference guide for assessment of clinical parameters during the course of the study period.



3. Obtaining written consent from the patient:

Patients who were enrolled into the study groups were given educational, motivational and adequate instructions on oral hygiene maintenance and its role on importance on the success of implant therapy. The college Institutional Review board approved this study and an informed written consent was obtained from all the patients.

Primary outcome:

- Hard tissue parameters: (using radiographic methods)
    - Amount of Socket fill
- Soft tissue parameters :
    - Relative position of Gingival margin
    - Gingival biotype
    - Width of keratinized Gingiva

Secondary outcomes:

- Implant placement feasibility at the socket preservation site.
- Need for further augmentation was assessed.
- Level of marginal bone changes over a time period.

CLINICAL PARAMETERS:

All clinical data regarding hard and soft tissue dimensions were recorded by one independent dental examiner at different time periods.

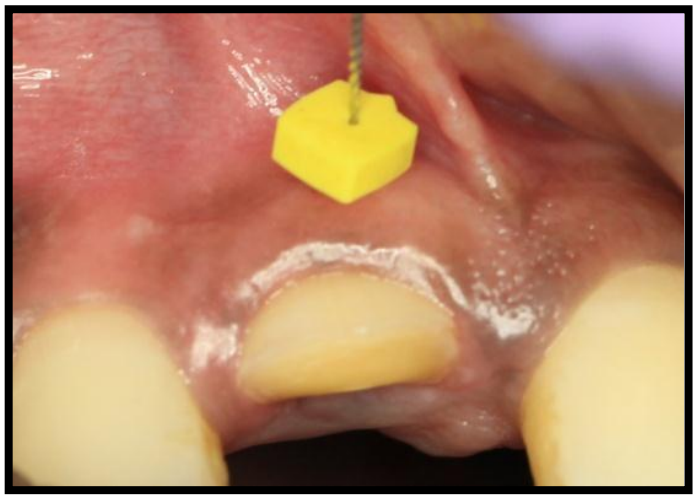
SOFT TISSUE MEASUREMENTS:

1. Assessment of gingival tissue biotype:

The gingival biotype was assessed as being thick or thin based on transgingival probing using a reamer. Biotype was assessed at baseline, 3 months and 6 months after socket preservation. It was assessed based on

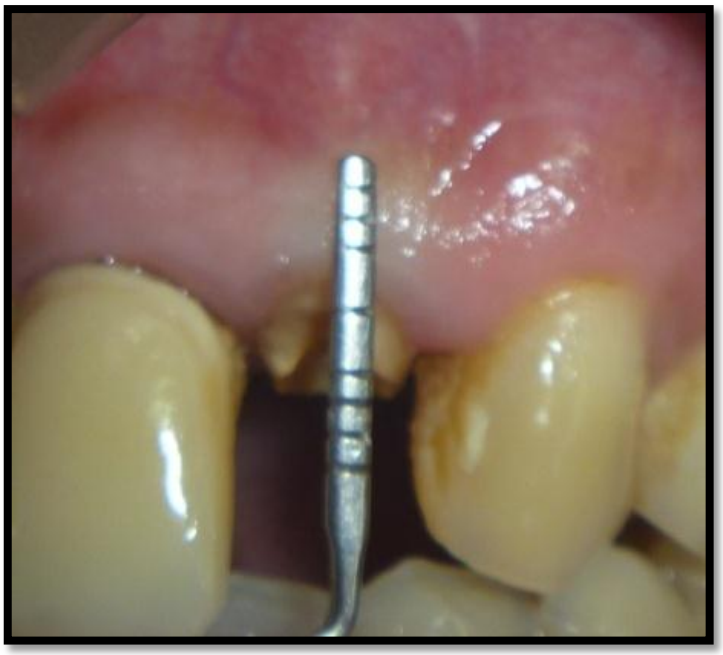
Claffey's classification (1986)

- Thick gingival tissue biotype : ≥ 1.5mm
- Thin gingival tissue biotype : < 1.5mm



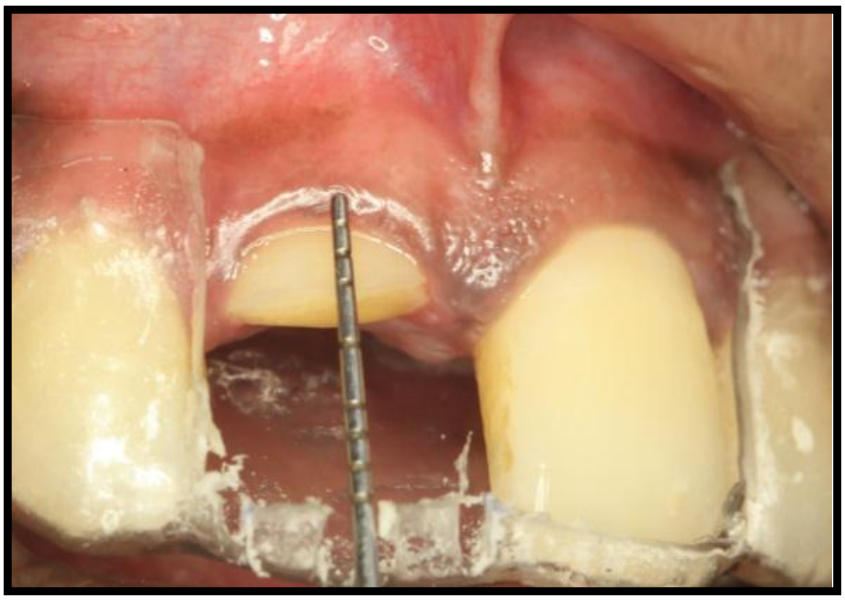
2. Width of keratinized gingiva (mm):

The width of keratinized gingiva was measured from the gingival margin to the mucogingival junction using a Williams periodontal probe at mid-buccal region and was calculated at baseline, 3months and 6 months.



3. Relative position of the marginal gingiva (mm):

The relative position of the marginal gingiva was measured from a fixed reference point. The incisal edge or the cusp tip of the adjacent teeth was considered as the reference point for anterior and posterior teeth respectively. The position of the marginal gingiva was measured at the mesio-buccal, mid-buccal and disto-buccal sites and the sum of average value was recorded. The gingival recession was determined by the difference in the relative position of marginal gingiva at different time intervals compared to the baseline value.

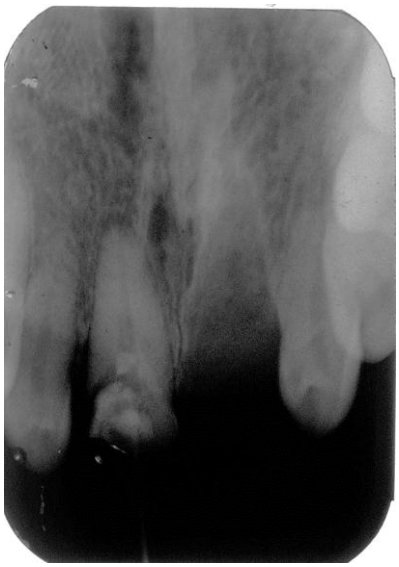


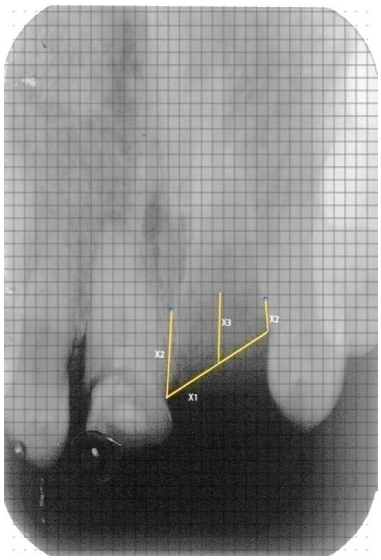
HARD TISSUE MEASURMENT:

The hard tissue measurement was recorded at the time of socket preservation (baseline) and at 6 months (at the time of implant placement) and the amount of bone fill following socket preservation were measured using intra oral periapical radiographs which were taken using a long cone

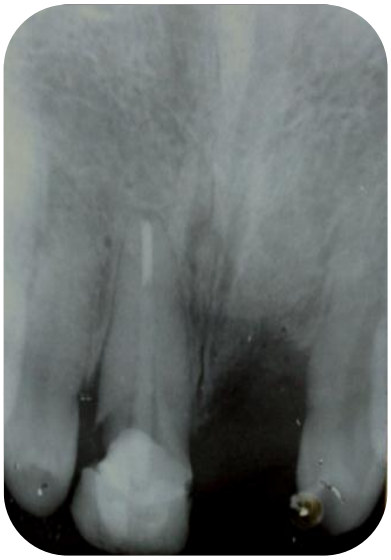
paralleling technique[92] and all the intraoral periapical radiographs were converted into a digital image using an HP image scanner and Grid analysis was performed, to analyze the radiographic dimensional changes. The distance between the CEJ of adjacent teeth and coronal aspect of alveolar crest was measured on mesial, mid-buccal and distal surfaces. Radiographic analysis was at baseline, 6 months during the study period.

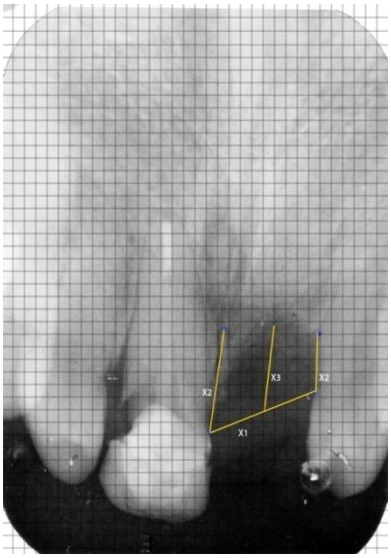
Immediately at the time of extraction:





Postoperative radiographs (6 months):





(X ray magnification done at 2x times)

X 1: Line joining the adjacent Cemento-Enamel Junction

X 2: Line joining the CEJ of adjacent teeth to the mesial & distal aspects of the existing alveolar crest..

X3: Line joining the Mid-point of X 1 to the most coronal part of alveolar crest.

SURGICAL PROCEDURE:

Extraction Defect Sounding (EDS) classification was used to categorize the sites. EDS-1 & EDS-2 sites were selected.

Surgery was carried out under strict aseptic condition with 10ml of 0.2% Chlorhexidine mouth rinse. Local anaesthesia with lignocaine hydrochloride 2% with Adrenaline 1:80000 was administered at the surgical site. Atraumatic extraction of the tooth was performed using suitable Periotome to severe the periodontal ligament fiber attachments and the tooth was extracted using forceps. Care was taken to preserve the integrity of the buccal bone wall.

Socket grafting

After extraction, the socket was carefully curetted and saline irrigation was done to remove any surgical debris and granulation tissue that is present and the socket was inspected for the presence of all intact bony plates.

Group1: Beta tri calcium phosphosilicate (Novabone putty/Alloplast) graft material was directly delivered to the extraction socket with the cartridge.

Group2: Demineralised freezed dried bone (surefuse putty/Allograft) graft material was directly delivered to the extraction socket.

Materials in both groups were placed in small increments according to the manufacturer's instructions. This was gently condensed into the alveolar socket with a Bone condenser/plugger. In both groups materials were transferred through a cartridge syringe into the alveolar socket to the level of the bone crest and slowly compressed until the extraction sockets were completely filled to the height of the existing alveolar bone crest.

PLATELET RICH FIBRIN (Fig 1)

PRF was prepared by the technique introduced by **Dr. Joseph Choukroun et al 2001**[32] in France, where patients own peripheral venous blood 10ml is withdrawn and equally transferred into two vaccutainer of 5ml each and without any anticoagulant or chemicals is immediately centrifuged at 3000rpm for 10 minutes. PRF is formed in test tube as gel between lighter clear platelet poor plasma and the packed red blood cells. The Vaccutainer is kept in straight position without shaking, the upper part clear plasma is pipetted out, then the remaining PRF gel and the bottom part RBC's are left in tube, then tilting the tube in approximate 45 degree angle by using the tweezer the PRF gel is retrieved out, the few red blood cells sticking to the PRF gel is sliced out. Now the gel is placed on the wet gauze bed in the petridish, the gel is again covered with wet gauze, with uniform force; it is then lightly pressed to form a membrane. The membrane obtained is folded and trimmed to required size of the defect, then placed over the grafted site and secured.

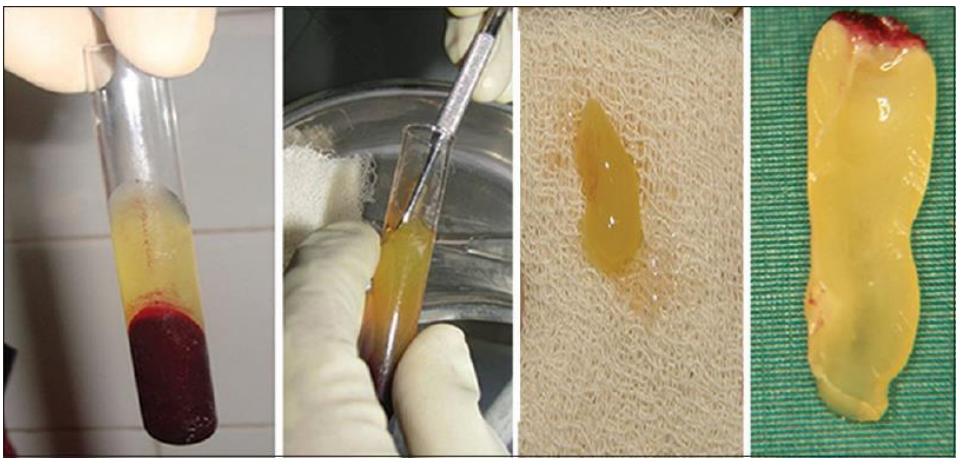


Figure 1: Preparation of PRF

Free Gingival Graft (FGG):

Primary tissue closure was achieved without compromising the blood supply of the surgical area by placing an autogenous free gingival graft as a socket seal. Surgically by measuring the dimensions of the socket opening, a sterile aluminium foil template was used and graft harvested from the palatal region. Caution was taken to ensure that the outline of the FGG is slightly larger than the aluminum foil template. FGG is placed, secured and sutured using 3-0 vicryl sutures over the grafted socket, and non eugenol periodontal pack was given.

Postsurgical instructions included antibiotics (amoxicillin 500 mg three times daily for 7 days), non-steroidal anti-inflammatory drugs (ibuprofen 400 mg four times daily for 3 days) and chlorhexidine 0.2% oral gel for topical application was given to the subjects in both the groups. Patients were

also instructed to refrain from brushing or any mechanical trauma in the area for 2 weeks and care was also taken to maintain a good oral hygiene status at the surgical site. Postoperative evaluations were done at 1, 3, and 6 months to check for complications, including infection, wound dehiscence, graft exposure and resorption.

In the present study initially 20 subjects participated for socket preservation procedure. One subject from group 1 was excluded from the study group because of fenestrations and dehiscence at the time of surgery. Similarly one subject from Group 2 at 3 month time period opted out of the study because of physiological reasons (Pregnancy).

Clinical and radiographic postoperative measurements were recorded at approximately 6 months by the same examiner who had performed the baseline measurements and was not involved in the surgical treatment. The subjects in both groups were followed up for implant placement.

Implant placement surgery:

All patients in the present study opted for implant placement as a rehabilitation. Socket preserved sites were scheduled for implant surgery at 6 months time interval. Augmented sites were reentered via a crestal incision that was connected with sulcular incisions on the neighbouring teeth. A full-thickness mucoperiosteal flap was raised (Fig 2). Core biopsy using 2mm diameter trephine bur for a length of 6mm obtained and sent for

histopathological analysis. Subsequent preparation of the implant bed was executed according to the surgical protocol proposed by the implant manufacturer. The appropriate size of each implant was selected and placed (Fig 3). Primary closure of the site was obtained and the patients were followed up for future loading. Implant primary stability was achieved in all subjects with no additional grafting procedure needed.

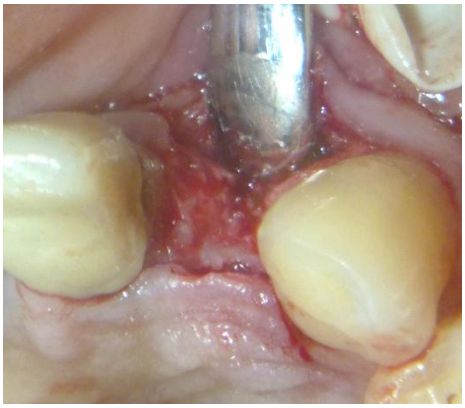


Figure 2: Elevation of the Flap

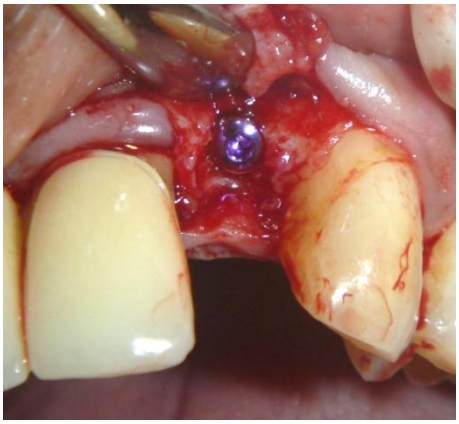
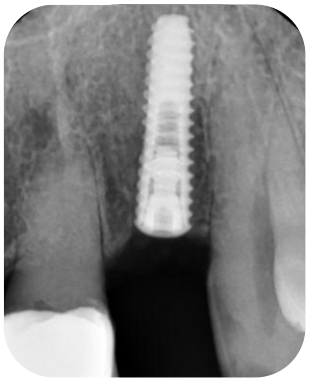


Figure 3: Implant placement done 3.5X11.5 (Osstem TS III system)

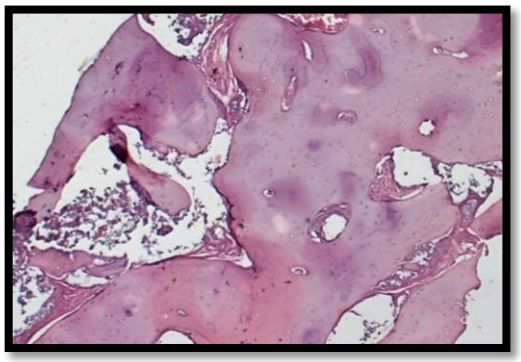
X ray post Implant



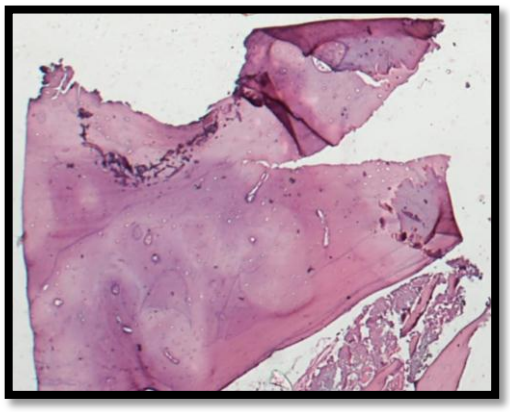
Histologic Processing:

Biopsies were decalcified, embedded in paraffin, sectioned longitudinally into multiple 4-mm-thick sections, and stained with Harris's hematoxylin and counterstained with eosin. Each section was examined at a minimum of 20x magnification, and the entire area of the section was evaluated. Digital images of each section were acquired and used to trace the areas identified as vital bone, new osteoid, residual particle, and connective tissue.

Group 1- Alloplast:



Group 2 Allograft:

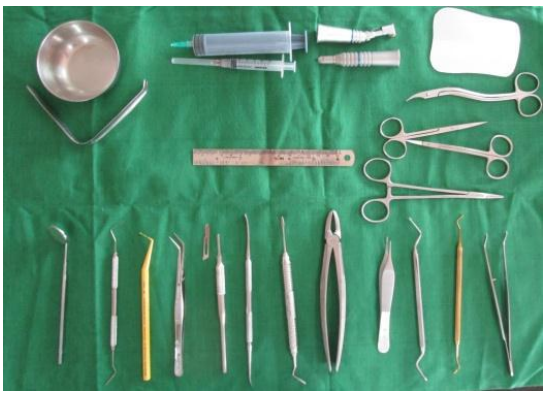


Armamentarium:

- Mouth mirrors
- Straight probes
- Explorers
- Tweezers
- William's periodontal probe
- Flexible Plastic periodontal probe with marking of 10 mm.
- Thermo plastic stent
- Bard Parker handle No. 3 with Blade No.15,Blade No. 11
- Disposable syringes 2ml,10ml and 20ml (irrigation)

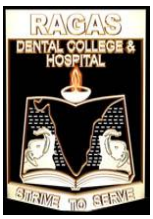
- Periosteal elevator
- Anterior and posterior periotomes
- Extraction forceps
- Adson tissue holding forceps
- Bone curettes
- Bone graft carrier
- Bone graft condenser/ plugger
- Needle holder
- Goldman Fox tissue cutting scissors
- Suture cutting scissors
- Dappen dish
- Isotonic saline (0.9% w/v)-500ml
- Sterile bowl
- Bone replacement graft material:
    - Alloplast - Novabone putty 0.5 cc
    - Allograft - Surefuse putty 0.5 cc

- Atraumatic 3-0 silk sutures/ vicryl suture 3-0
- Non eugenol pack (Coe pack)
- Trephine drill of 2mm diameter with 10mm length
- Endosseous implant system kit (Osstem)^{TM}
- Endosseous implants(Osstem)^{TM} of variable length and diameter
- Implant Physiodispensor / 20:1 reduction gear hand piece
- Aluminium foil
- Surgical gloves
- Disposable mouth mask
- Disposable syringes (unolok syringe)(0.45x38mm/26x1$^{1/2}$)
- Local anaesthetic solution (Xylocaine 2 % with adrenalin 1:80,000).
- Cheek retractor and Suction tip
- Sterile water



Group 1- Alloplast (CPS-Putty)

Group 2- Allograft (DFDBA Putty)



RAGAS DENTAL COLLEGE & HOSPITAL
2/102, EAST COAST ROAD, UTHANDI, CHENNAI-119
Phone: (044) - 24530003-06
DEPARTMENT OF PERIODONTOLOGY

CASE SHEET

Pt Name : **Date :**

Age / Sex: **Op No :**

Address : **Occupation:**

Contact No :

Chief Complaint :

History of Present Illness :

Past Dental History :

Past Medical History :

Family History :

Habits :

CLINICAL EXAMINATION

Tooth to be extracted :

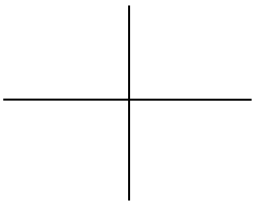
Skeletal Jaw Relationship:

Class I ☐ **Class II** ☐ **Class III** ☐

Oral hygiene: Good / Fair / Poor

Presence of any pathological lesion radiographically: Yes / No

Tooth notation:



PARAMETERS :

Soft tissue parameters:

Clinical assessment	Site	Baseline		3 months		6months	
		Group 1	Group 2	Group 1	Group2	Group 1	Group 2
Gingival biotype							
Width of keratinized gingiva in mm	Mid buccal						
Relative position of marginal gingiva	Mesiobuccal						
	Mid buccal						
	Distobuccal						

Hard tissue parameter: (Digital radio visualography)

Radiographic assessment	Site	Baseline		6 months	
Marginal bone level changes		Group 1	Group 2	Group1	Group 2
	Mesial				
	Mid crestal				
	Distal				

Routine lab investigations: Yes/No

Diagnosis:

Treatment plan:

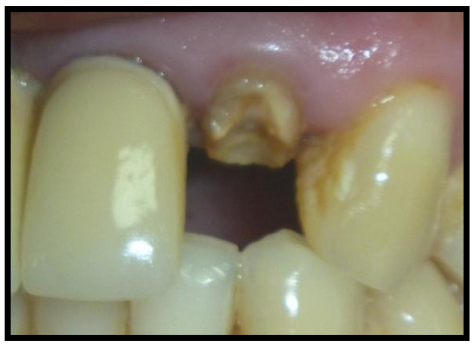
Group 1: putty form alloplast bone graft material was used as ARP/SP.

Group 2: putty form allograft bone graft material was used as ARP/SP.

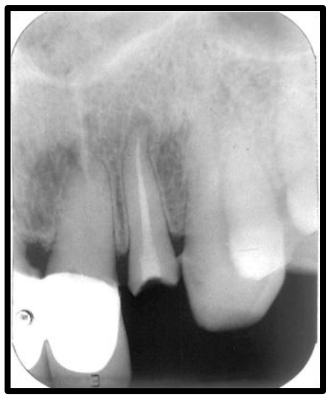
Photographs

Case: 1

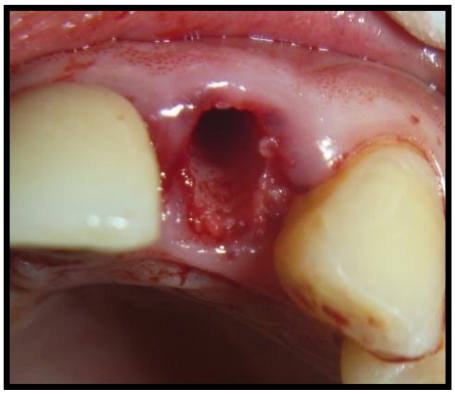
Clinical Pre-OP Picture



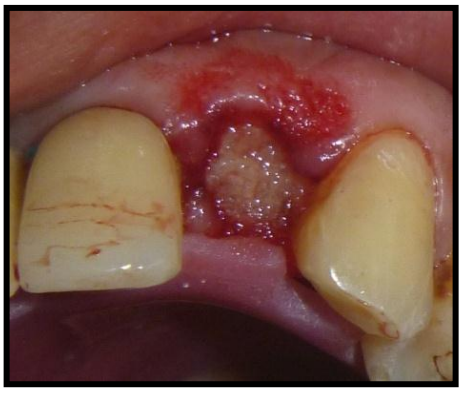
Radiograph Pre-op view



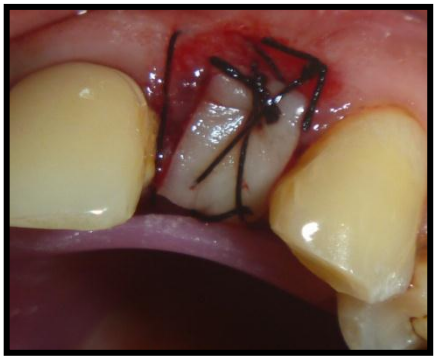
Socket after complete debridement



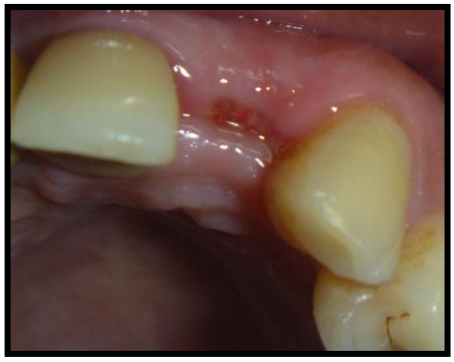
Socket Grafting with Alloplast



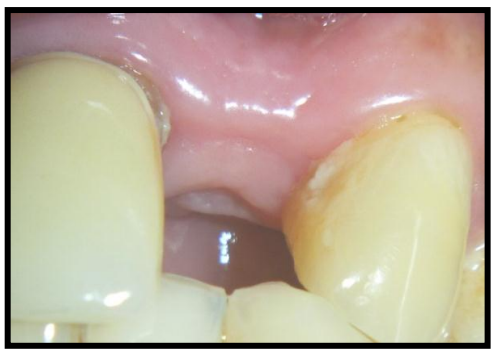
FGG placed & secured using 3-0 Silk Sutures



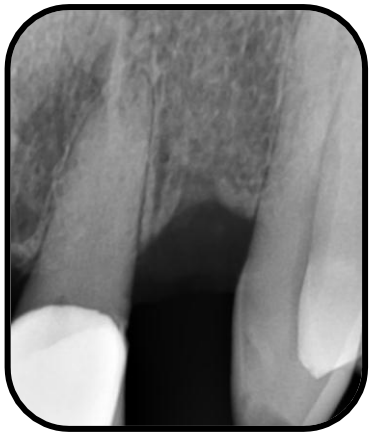
Clinical 1 month post-op



Clinical 6 month post-op

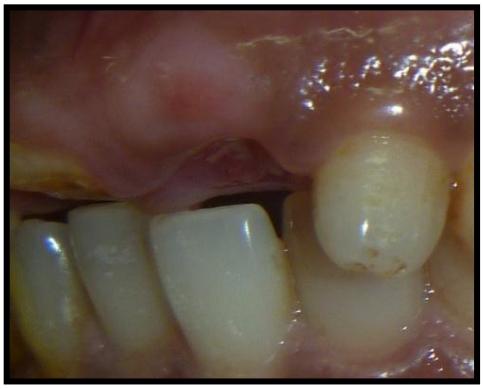


Radiograph 6 month post-op

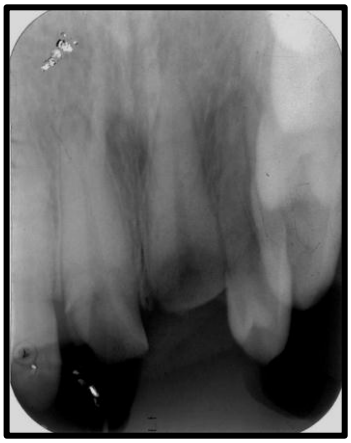


Case 2:

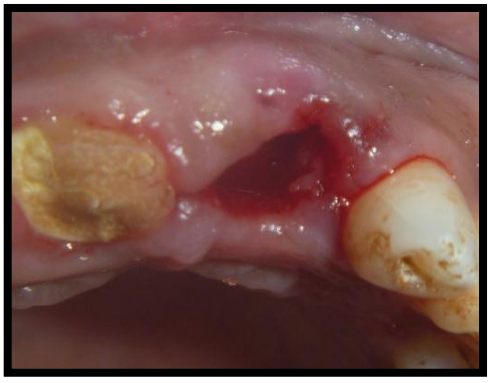
Clinical Pre-op Picture



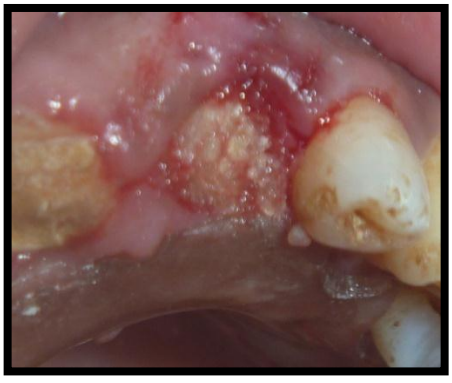
Radiograph Pre-op view



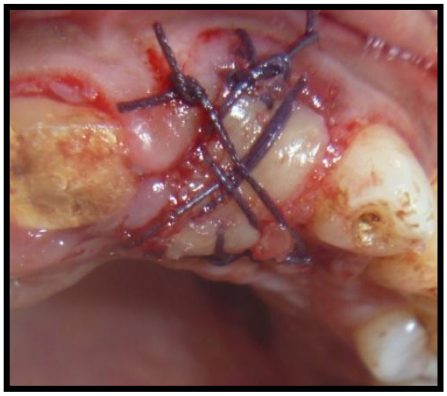
Socket after complete debridement



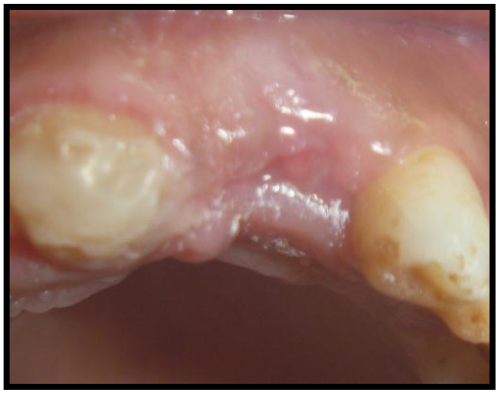
Socket Grafting with Allograft



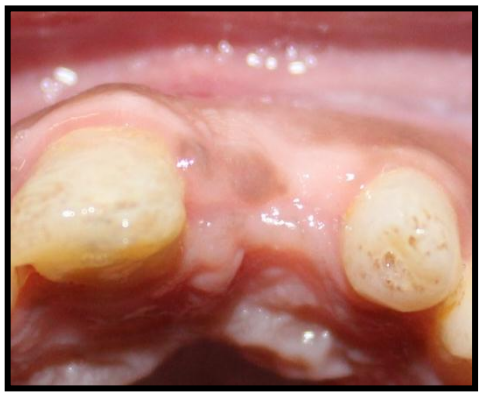
FGG placed & secured using 3-0 Silk Sutures



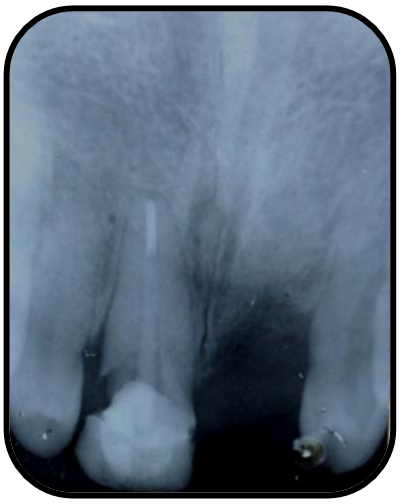
Clinical 1 month post-op



Clinical 6 month post op



Radiograph 6 month post op



Results

RESULTS

The present clinical study was done to evaluate the soft and hard tissue changes following socket preservation procedures using two types of Bone substitutes. The soft and hard tissue parameters were evaluated at different time intervals over a period of 6 months. Clinical assessment of soft tissue includes the gingival biotype, the width of keratinized gingiva, and the relative position of marginal gingiva. Radiographical assessment included evaluation of the marginal bone changes on mesio-buccal, mid buccal and disto-buccal aspect of the socket preserved site over a period of 6 months.

Statistical Analysis:

The Normality tests Kolmogorov-Smirnov and Shapiro-Wilks tests results reveal that the variables do not follow Normal distribution. Therefore to analyse the data non parametric methods was applied. To compare the values between Group-I and Group-II Mann Whitney test is applied. To compare values between time points Friedman ANOVA for repeated measures is applied, Bonferroni adjusted P-values are calculated for pairwise comparisons. To compare proportions between groups Chi-Square test is applied, if any expected cell frequency is less than five then Fisher's exact test is used. McNemar's Chi-Square test is applied to compare proportions between time points. SPSS version 22.0 is used to analyse the data. Significance level is fixed as 5% ($\alpha = 0.05$).

CLINICAL PARAMETERS:

Gingival Biotype:

At baseline 13 sites presented with thin biotype and 5 sites presented with thick biotype. The percentage distribution of thin biotype was 72.2% and thick biotype was 27.8% and remained the same throughout the study period.

Mean width of keratinized gingiva:

The average width of keratinized gingiva (WKG) at mid buccal aspect was calculated and the mean width of keratinized gingiva and standard deviation at the socket preserved site at baseline - 2.89mm ±0.78, 3 months - 2.56mm ± 0.73 and 6 months - 2.56 mm ±0.73 for Group 1. For Group 2, at Baseline - 3mm ±0.71 , 3 months - 2.78mm ± 0.44 and 6 months - 2.78 mm ± 0.44.

Mean WKG values were subjected to statistical analysis and the difference in the mean width of keratinized gingiva between baseline, 3 months and 6 months were calculated. No statistically significant difference with a **p value of 0.051** for Group I **& p value of 0.135** for Group 2.

Inter group comparison of width of keratinized ginigva at various time periods was also not stastistically significant showing a **p-value of 0.737** at baseline; **p-value of 0.315** at 3 months; and **p-value of 0.315** at 6 months.

Relative position of marginal ginigva:

The relative position of marginal gingiva was measured at the mesio-buccal, mid-buccal and disto- buccal aspect from a fixed reference point and the average calculated.

The mean level of marginal gingiva for **Group 1** at base line,3 months and 6 months were 7.96mm ± 2.62, 8.56 mm ±2.88 and 8.63mm ±2.81 respectively. These values were subjected to statistical analysis and the difference in the relative position of marginal gingiva between baseline, 3 months and 6 months were compared. There was statistically significant difference in the relative position of marginal gingiva between 0-6 months with a **p value of 0.029,**And between 0-3 months and 3-6 months was not significant with a **p value of 0.135 and 0.999** respectively.

In **Group 2** the mean level of marginal gingiva at base line,3 months and 6 months were 8.56mm ± 2.37, 9.56 mm ±2.39 and 9.67mm ±2.45 respectively. These values were subjected to statistical analysis and the difference in the relative position of marginal gingiva between baseline, 3 months and 6 months were compared. There was statistically significant difference in the relative position of marginal gingiva from baseline to 3 months with a **P-value of 0.04**and from baseline to 6 months with **p value of 0.004**. The mean difference between3-6 months was not significant with a **p value of 0.999.**

Hard tissue-Radiographic mean marginal bone level changes:

Mesial:

Radiographs taken at baseline and 6 months were converted into a digital image using an HP image scanner and Grid analysis was used, to analyze the radiographic crestal dimensional changes. The bone level changes on the mesial side were measured from the CEJ of the adjacent tooth to the level of the existing alveolar crest. The mean value at baseline for group 1 is 1.94±0.30, and for group 2 is 2.11±0.49; at 6 months for group 1 is 2.44±0.30 and for group 2 is 2.39±0.49 respectively.

Intra-group comparison during the time period between baseline and 6 months in group 1 was statistically significant with a **p value of 0.003**, whereas for group 2 it was not statistically significant with a **p value of 0.238.**

Inter-group comparison of marginal bone levels at mesial aspect at baseline and 6 months were not statistically significant with a **p-value of 0.463 and 0.883** respectively.

Mid-buccal:

The mean value at baseline for group 1 is 2.22±0.26, and for group 2 is 2.33±0.35; at 6 months for group 1is 2.89±0.42 and for group 2 is 3.28±0.44.

Intra-group comparison during the time period between baseline and 6 months in group 1 and group 2 was statistically significant with a **p value of 0.014 and 0.006** respectively.

Inter-group comparison of marginal bone levels at mid-buccal aspect at baseline and 6 months were not statistically significant with a **p-value of 0.518 and 0.078 respectively**.

Distal:

The mean value at baseline for group 1 is 1.89±0.22, and for group 2 is 2.22±0.51; at 6 months for group 1is 2.33±0.25 and for group 2 is 2.33±0.61.

Intra-group comparison during the time period between baseline and 6 months in group 1 was statistically significant with a **p value of 0.005**, whereas for group 2 it was not statistically significant with a **p value of 0.527**

Inter-group comparison of marginal bone levels at distal aspect at baseline and 6 months were not statistically significant with a **p-value of 0.113 and 0.658** respectively.

Tables and Graphs

TABLE 1 : DESCRIPTIVE SITE DISTRIBUTION

Group I

S.No	Graft material	Site	Gender	Age	Healing period
1	Novobone	12	F	41	6 months
2	Novobone	24	F	36	6 months
3	Novobone	14	F	45	6 months
4	Novobone	14	F	45	6 months
5	Novobone	15	M	40	6 months
6	Novobone	23	F	40	6 months
7	Novobone	21	F	45	6 months
8	Novobone	22	M	43	6 months
9	Novobone	25	F	25	6 months
10	Novobone	11	M	45	-

Group II

S.No	Graft material	Site	Gender	Age	Healing period
1	Surefuse	24	F	39	6 months
2	Surefuse	22	F	38	6 months
3	Surefuse	23	F	44	6 months
4	Surefuse	21	F	22	6 months
5	Surefuse	35	M	27	6 months
6	Surefuse	22	F	43	6 months
7	Surefuse	21	F	26	6 months
8	Surefuse	12	F	21	6 months
9	Surefuse	23	F	38	6 months
10	Surefuse	23	F	34	6 months

TABLE 2: GINGIVAL BIOTYPE (THIN/THICK) AT DIFFERENT TIME INTERVALS

Group I

Case No	Baseline (mm)	3 months (mm)	6 months (mm)
1	Thin	Thin	Thin
2	Thin	Thin	Thin
3	Thin	Thin	Thin
4	Thin	Thin	Thin
5	Thick	Thick	Thick
6	Thick	Thick	Thick
7	Thin	Thin	Thin
8	Thick	Thick	Thick
9	Thin	Thin	Thin

Group II

Case No	Baseline (mm)	3 months (mm)	6 months (mm)
1	Thin	Thin	Thin
2	Thin	Thin	Thin
3	Thin	Thin	Thin
4	Thick	Thick	Thick
5	Thick	Thick	Thick
6	Thin	Thin	Thin
7	Thin	Thin	Thin
8	Thin	Thin	Thin
9	Thin	Thin	Thin

TABLE 3: WIDTH OF KERATINIZED GINGIVA AT DIFFERENT TIME INTERVAL (MID BUCCAL)

Group I

Case No	Baseline(mm)	3 months(mm)	6 months (mm)
1	3	2	2
2	3	2	2
3	3	3	3
4	2	2	2
5	2	2	2
6	4	3	3
7	3	3	3
8	4	4	4
9	2	2	2

GroupII

Case No	Baseline(mm)	3 months(mm)	6 months (mm)
1	2	2	2
2	3	3	3
3	4	3	3
4	3	3	3
5	2	2	2
6	4	3	3
7	3	3	3
8	3	3	3
9	3	3	3

TABLE 4 : RELATIVE POSITION OF MARGINAL GINGIVA MEASURED ON MESIO BUCCAL, MID BUCCAL & DISTO BUCCAL ASPECT AT DIFFERENT TIME INTERVALS

Group I

S.No	Baseline(mm)			3 Months(mm)			6 Months(mm)		
	MesioBuccal	Mid Buccal	DistoBuccal	MesioBuccal	Mid Buccal	DistoBuccal	MesioBuccal	Mid Buccal	DistoBuccal
1	6	7	6	6	7	6	6	7	6
2	9	10	9	11	11	11	11	11	11
3	9	10	9	9	11	9	9	11	9
4	4	5	4	4	5	4	5	5	4
5	6	7	6	6	7	6	6	7	6
6	7	6	6	7	8	7	7	8	7
7	11	12	12	12	13	12	12	13	12
8	7	6	6	7	8	7	8	8	7
9	11	12	12	12	13	12	12	13	12

Group II

S.No	Baseline(mm)			3 Months(mm)			6 Months(mm)		
	MesioBuccal	Mid Buccal	DistoBuccal	MesioBuccal	Mid Buccal	DistoBuccal	MesioBuccal	Mid Buccal	DistoBuccal
1	9	10	9	11	11	11	11	11	11
2	7	6	6	7	8	7	7	8	7
3	6	7	6	6	7	6	6	7	6
4	11	12	12	12	13	12	13	13	12
5	7	6	6	7	8	7	8	8	7
6	8	7	8	9	9	9	9	9	9
7	10	12	11	11	13	12	11	13	12
8	7	6	7	8	8	9	8	8	9
9	11	12	12	12	13	12	13	13	12

TABLE 5: RADIOGRAPHIC MARGINAL BONE LEVELS ON MESIO BUCCAL, MID BUCCAL & DISTO BUCCAL AT BASELINE AND 6 MONTHS

Group I

S.No	Baseline(mm)			6 Months(mm)		
	MesioBuccal	Mid Buccal	DistoBuccal	MesioBuccal	Mid Buccal	DistoBuccal
1	1.5	2	1.5	2	3	2
2	2	2	2	2.5	2.5	2.5
3	2	2.5	2	2.5	2.5	2.5
4	2	2.5	2	2.5	3.5	2.5
5	1.5	2	2	2	2.5	2.5
6	2	2	2	2.5	3	2.5
7	2.5	2.5	1.5	3	3.5	2
8	2	2.5	2	2.5	2.5	2.5
9	2	2	2	2.5	3	2

Group II

S.No	Baseline(mm)			6 Months(mm)		
	MesioBuccal	Mid Buccal	DistoBuccal	MesioBuccal	Mid Buccal	DistoBuccal
1	2	2	2	3	3	3
2	2	2	2	2.5	3	2
3	1.5	2	2	2	3	2.5
4	2	2.5	2	3	3.5	2.5
5	1.5	2	1.5	1.5	2.5	1
6	2.5	2.5	3	2.5	3.5	3
7	3	3	3	2	3.5	2.5
8	2	2.5	2	2.5	3.5	2.5
9	2.5	2.5	2.5	2.5	4	2

TABLE 6a: DESCRIPTIVE STATISTICS FOR MEAN WIDTH OF KERATINIZED GINGIVA AT DIFFERENT TIME INTERVALS

	Mean ± SD	
	Group I	**Group II**
Baseline	2.89 (0.78)	3.00 (0.71)
3 Months	2.56 (0.73)	2.78 (0.44)
6 Months	2.56 (0.73)	2.78 (0.44)

TABLE 6b: INTRAGROUP COMPARISON OF WIDTH OF KERATINIZED GINGIVA AT DIFFERENT TIME INTERVALS

Group	**Width of keratinized gingiva**	**Mean Rank**	**P-Value**	**Significance**
Group-I	Baseline (mm)	2.33	0.051	Not Significant
	3 months(mm)	1.83		
	6 months (mm)	1.83		
Group-II	Baseline (mm)	2.22	0.135	Not Significant
	3 months(mm)	1.89		
	6 months (mm)	1.89		

TABLE 6c: INTERGROUP COMPARISON OF WIDTH OF KERATINIZED GINGIVA AT DIFFERENT TIME INTERVALS

Variables	Group	N	Mean Rank	P-Value	Significance
Width of keratinized gingiva Baseline	Group-I	9	9.11	0.737	Not Significant
	Group-II	9	9.89		
Width of keratinized gingiva 3 months(mm)	Group-I	9	8.39	0.315	Not Significant
	Group-II	9	10.61		
Width of keratinized gingiva 6 months (mm)	Group-I	9	8.39	0.315	Not Significant
	Group-II	9	10.61		

TABLE 7a: DESCRIPTIVE ANALYSIS OF MEAN RELATIVE POSITION OF MARGINAL GINGIVA AT DIFFERENT TIME INTERVALS

	Mean ± SD	
	Group I	**Group II**
Baseline	7.96 (2.62)	8.56 (2.37)
3 Months	8.56 (2.88)	9.56 (2.39)
6 Months	8.63 (2.81)	9.67 (2.45)

TABLE 7b: INTRAGROUP COMPARISON OF MEAN RELATIVE POSITION OF MARGINAL GINGIVA AT DIFFERENT TIME INTERVALS

Group	Marginal Gingiva	Mean Rank	P-Value	Significance
Group-I	Baseline (mm)	1.28	**0.002**	**Highly Significant**
	3 months(mm)	2.22		
	6 months (mm)	2.50		
Group-II	Baseline (mm)	1.11	**0.001**	**Highly Significant**
	3 months(mm)	2.28		
	6 months (mm)	2.61		

TABLE 7c: BONFERRONI ADJUSTED TEST FOR PAIR WISE COMPARISON

Marginal gingiva	P-Value			
	Group-I	**Significance**	**Group-II**	**Significance**
Baseline vs 3 months	0.135	Not Significant	**0.040**	**Significant**
Baseline vs 6 months	**0.029**	**Significant**	**0.004**	**Highly Significant**
3 months vs 6 months	0.999	Not Significant	0.999	Not Significant

TABLE 7d: INTERGROUP COMPARISON OF MEAN RELATIVE POSITION OF MARGINAL GINGIVA AT DIFFERENT TIME INTERVALS

Variables	Group	N	Mean Rank	P-Value	Significance
Marginal gingiva Baseline	Group-I	9	8.67	0.492	Not Significant
	Group-II	9	10.33		
Marginal gingiva 3 Months	Group-I	9	8.50	0.421	Not Significant
	Group-II	9	10.50		
Marginal gingiva 6 Months	Group-I	9	8.28	0.329	Not Significant
	Group-II	9	10.72		

Table 8a: MEAN RADIOGRAPHIC CHANGES IN MESIO BUCCAL MARGINAL BONE LEVELS AT BASELINE TO 6 MONTHS

	Mean ± SD	
	Group I	**Group II**
Baseline	1.94 (0.30)	2.11 (0.49)
6 Months	2.44 (0.30)	2.39 (0.49)

Table 8b: INTRAGROUP COMPARISON OF RADIOGRAPHIC MARGINAL BONE LEVELS AT BASELINE AND 6 MONTHS

Group	Radiographic marginal bone levels at MesioBuccal	Mean Rank	P-Value	Significance
Group-I	Baseline	0.00	**0.003**	**Highly Significant**
	6 months	5.00		
Group-II	Baseline	5.00	0.238	Not Significant
	6 months	3.20		

Table 8c: INTERGROUP COMPARISON OF RADIOGRAPHIC MARGINAL BONE LEVELS AT BASELINE AND 6 MONTHS

P-Value	Group	N	Mean Rank	P-Value	Significant
Radiographic marginal bone levels at MesioBuccal Baseline	Group-I	9	8.67	0.463	Not significant
	Group-II	9	10.33		
Radiographic marginal bone levels at MesioBuccal 6 Months	Group-I	9	9.67	0.883	Not significant
	Group-II	9	9.33		

Table 9a: MEAN RADIOGRAPHIC CHANGES IN MID BUCCAL MARGINAL BONE LEVELS AT BASELINE TO 6 MONTHS

	Mean ± SD	
	Group I	**Group II**
Baseline	2.22 (0.26)	2.33 (0.35)
6 Months	2.89 (0.42)	3.28 (0.44)

Table 9b: INTRAGROUP COMPARISON OF RADIOGRAPHIC MARGINAL BONE LEVELS AT BASELINE AND 6 MONTHS

Group	**Radiographic marginal bone levels at Mid Buccal**	**Mean Rank**	**P-Value**	**Significance**
Group-I	Baseline	0.00	**0.014**	**Significant**
	6 months	4.00		
Group-II	Baseline	0.00	**0.006**	**Highly Significant**
	6 months	5.00		

Table 9c: INTERGROUP COMPARISON OF RADIOGRAPHIC MARGINAL BONE LEVELS AT BASELINE AND 6 MONTHS

P-Value	Group	N	Mean Rank	P-Value	Significant
Radiographic marginal bone levels at Mid Buccal Baseline	Group-I	9	8.78	0.518	Not significant
	Group-II	9	10.22		
Radiographic marginal bone levels at Mid Buccal 6 Months	Group-I	9	7.39	0.078	Not significant
	Group-II	9	11.61		

TABLE 10a: MEAN RADIOGRAPHIC CHANGES IN DISTO BUCCAL MARGINAL BONE LEVELS AT BASELINE TO 6 MONTHS

	Mean ± SD	
	Group I	**Group II**
Baseline	1.89 (0.22)	2.22 (0.51)
6 Months	2.33 (0.25)	2.33 (0.61)

TABLE 10b: INTRAGROUP COMPARISON OF RADIOGRAPHIC MARGINAL BONE LEVELS AT BASELINE AND 6 MONTHS

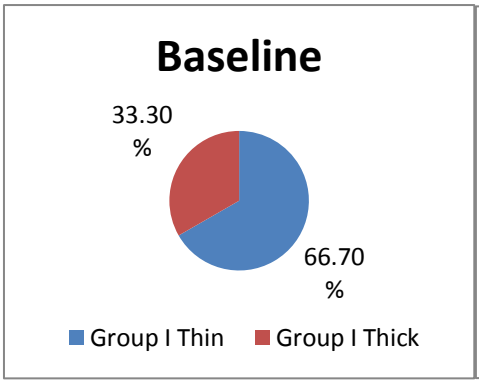
Group	Radiographic marginal bone levels at DistoBuccal	Mean Rank	P-Value	Significance
Group-I	Baseline	0.00	**0.005**	**Highly Significant**
	6 months	4.50		
Group-II	Baseline	3.50	0.527	Not significant
	6 months	4.38		

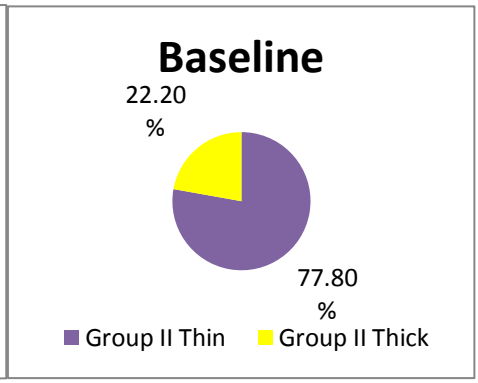
TABLE 10c: INTERGROUP COMPARISON OF RADIOGRAPHIC MARGINAL BONE LEVELS AT BASELINE AND 6 MONTHS

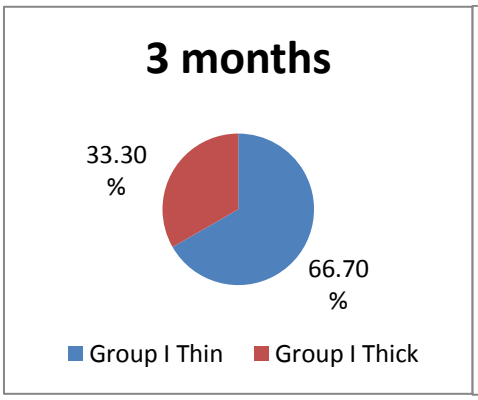
P-Value	Group	N	Mean Rank	P-Value	Significant
Radiographic marginal bone levels at DistoBuccal Baseline	Group-I	9	7.83	0.113	Not significant
	Group-II	9	11.17		
Radiographic marginal bone levels at DistoBuccal 6 Months	Group-I	9	9.00	0.658	Not significant
	Group-II	9	10.00		

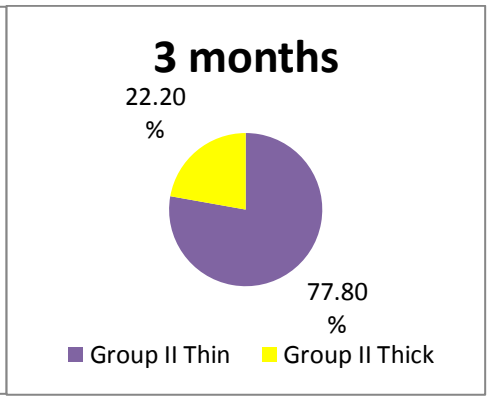
GRAPH 1 : PERCENTILE DISTRIBUTION OF GINGIVAL BIOTYPE AT DIFFERENT TIME PERIODS

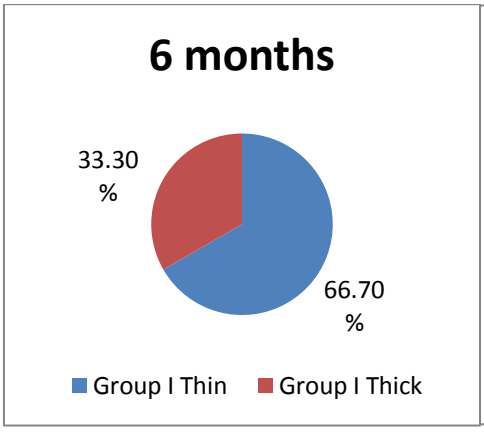
Group I **Group II**

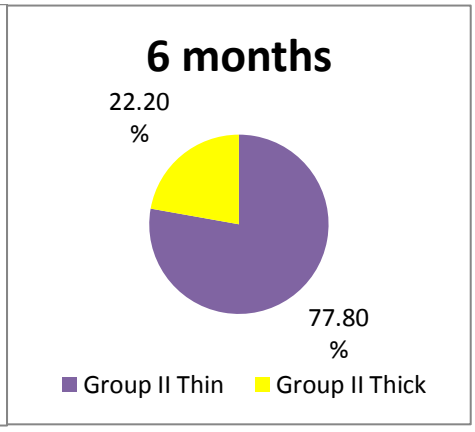




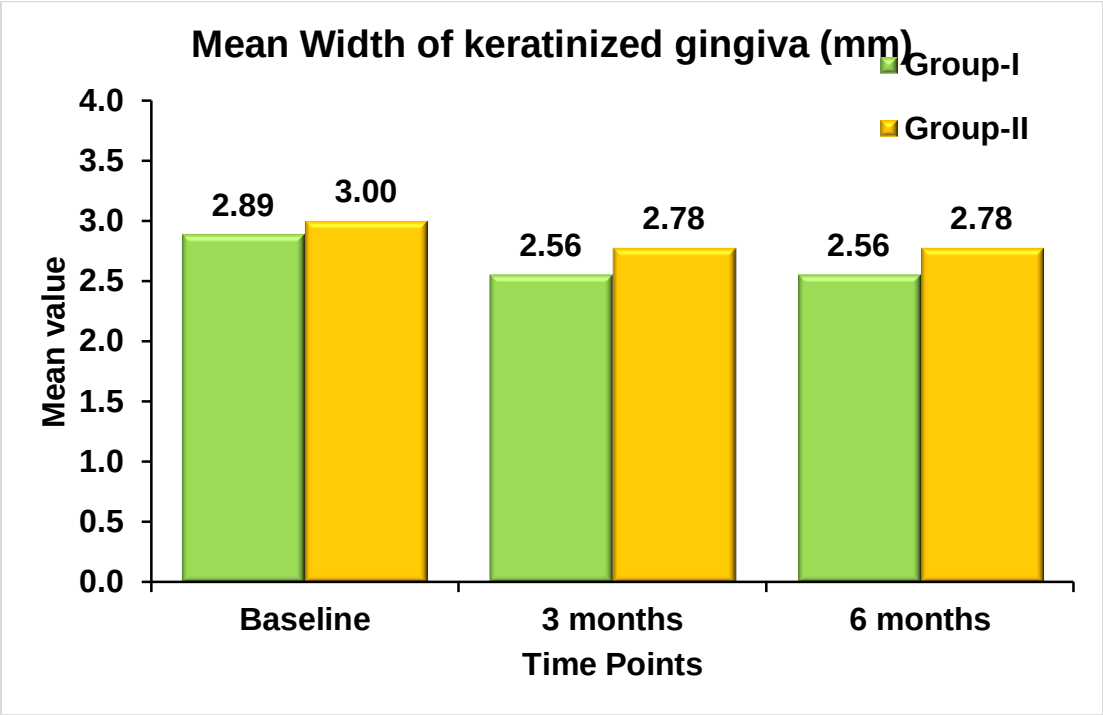




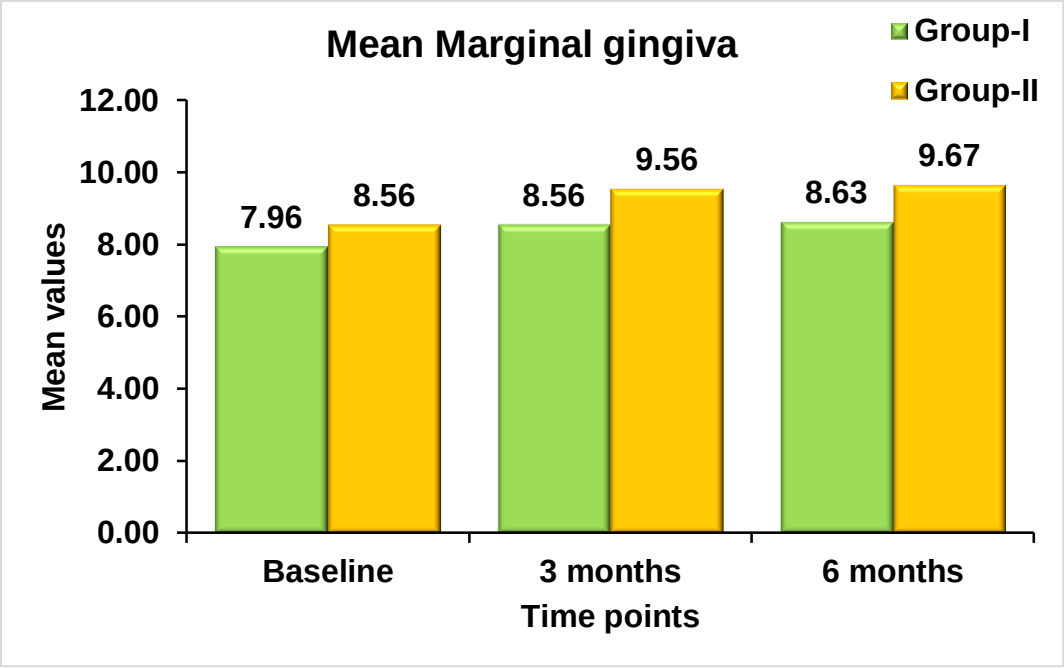




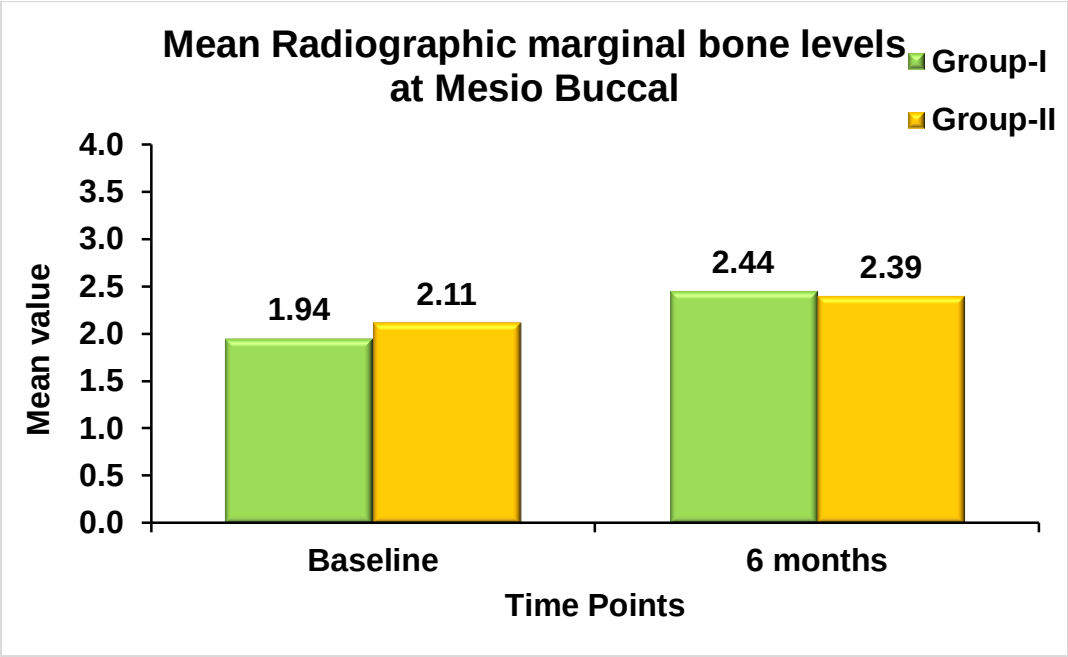
GRAPH 2: MEAN WIDTH OF KERATINIZED GINGIVA (MM)



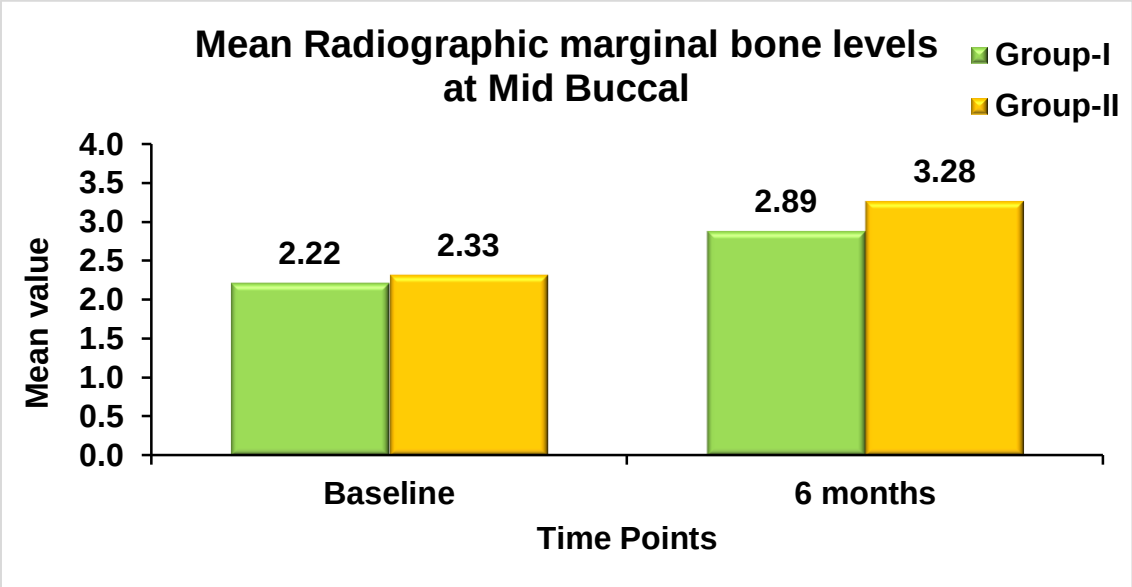
GRAPH 3: MEAN MARGINAL GINGIVA (MM)



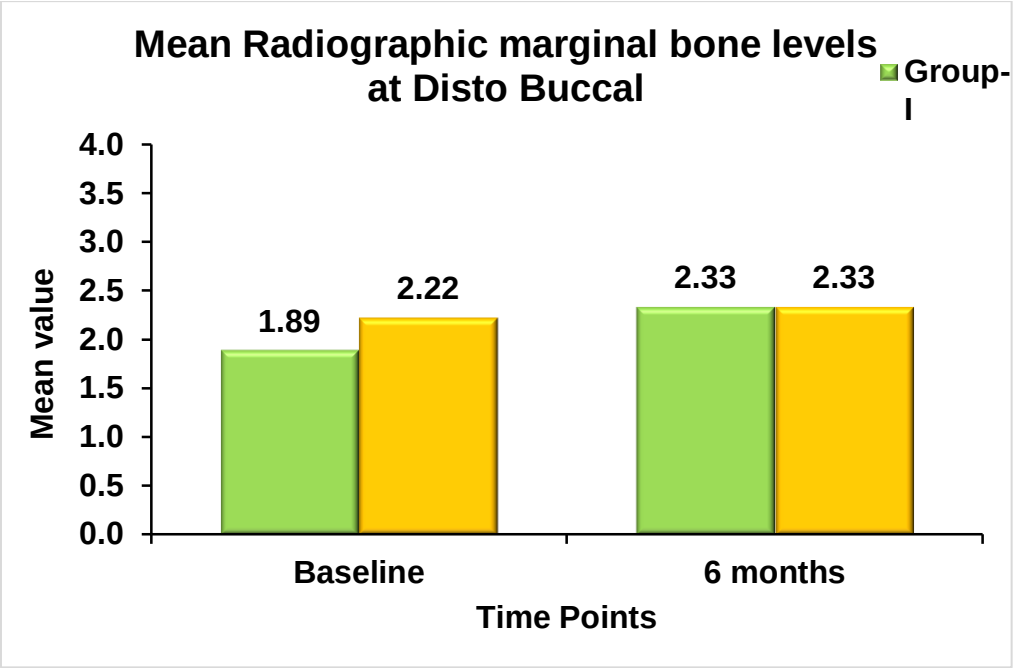
GRAPH 4: MEAN RADIOGRAPHIC MARGINAL BONE LEVELS AT MESIO BUCCAL



GRAPH 5: MEAN RADIOGRAPHIC MARGINAL BONE LEVELS AT MID BUCCAL



GRAPH 6: MEAN RADIOGRAPHIC MARGINAL BONE LEVELS AT DISTO BUCCAL



Discussion

DISCUSSION

Ridge resorption following tooth extraction is a challenging situation for clinicians as there is deficiency of soft tissue as well as hard tissue. This changes has been well demonstrated in various animal studies under histological observation (**Cardopoli et al 2003**)[21]. There are 3-dimensional changes following freshly extracted socket with pronounced changes on the buccal aspect with greater loss of vertical and horizontal dimension. The role of bundle bone has been investigated in several animal experiments (**Araujo and Lindhe 2005**)[5].

When implants are planned, the maintenance of stable ridge volume will help in simplifying subsequent treatment and optimising clinical outcomes. Alveolar ridge preservation (ARP)/ Socket preservation (SP) are procedures specially designed to eliminate or limit the negative effect on post extraction resorption which aids and facilitates implant placement in ideal prosthetic driven position for favourable esthetic outcome[56].

There is literature evidence to support the fact that implant placement feasibility increases following ARP/SP in comparison with unassisted socket healing. Numerous studies have employed variety of techniques and materials[94] and have compared the clinical outcomes with unassisted healing of extraction sockets alone. However till date no studies have demonstrated a clear superiority for technique or the choice of graft materials[106].

In the present study the chosen biomaterials for ARP/SP is in the form of putty consistency for both the groups. In comparison to particulate graft, putty form had a significant superiority in terms of enhanced viscosity, reduced particulate contamination, ease of placement & had a unique delivery system[10].

All patients who enrolled in the present study were randomly divided into 2 groups using coin toss method and underwent scaling and root planing. The patients were placed on periodontal maintenance care and followed up throughout the time period. Atraumatic extraction was performed in all patients followed by ARP/SP using alloplast putty form biomaterial in group 1 & in group 2 allograft putty form biomaterial was used. In both the groups primary closure of the socket site were achieved using PRF/FGG[62] autograft. Soft tissue and hard tissue were evaluated at baseline, 3 months & 6 months.

Soft tissue changes:

Gingival biotype:

In the present study there were no changes in gingival phenotype in both the groups throughout the study period. This was in accordance with the clinical study by **Jung et al 2004[57]**. Since PRF/FGG were used in both the groups, it resulted in successful integration of FGG autograft with no necrosis which prevented the changes in the gingival architecture.

Width of keratinized gingiva:

In the present clinical study atraumatic extraction using periotome was performed and no flap repositioning was done. A tension free wound closure was obtained in both the groups using FGG autograft which maintained the dynamicity of keratinized tissue throughout the study period. This was in accordance with **Landsberg & Bichacho**[62].

Relative mean position of marginal gingiva:

In the present study intragroup comparison of both groups showed a statistically significant result in mean relative position of the marginal gingiva from baseline to 6 months.

In the present clinical study majority of the subject (13 out of 18) who participated had a thin gingival phenotype. During the surgical procedure there is a possibility that dead space is formed between the soft tissue graft (FGG/PRF) and bone replacement material. This may undergo inflammatory changes at the coronal level of the soft tissue margin, which might have contributed to some level of tissue shrinkage that was reflected as changes in the position of the marginal gingiva.

The other reason that might have contributed was the stress and strain caused due to the severing of the marginal tissue from the underlying periosteum. This may have led to marginal bone level changes which mimics

the regional accelerated phenomena (RAP) of the bone resulting in soft tissue level changes.

Marginal bone level changes:

Group 1 :

Intragroup analysis was done to evaluate the changes in marginal bone level. In the present clinical study, alloplast group tends to show dimensional crestal bone level changes on the mesial, mid-buccal & distal marginal bone at 6 months time period. In the present study almost 75% of the maxillary anterior teeth had a relatively thin buccal plate at the time of extraction (thickness <2mm) which primarily consists of cortical bundle bone. This is susceptible to rapid resorption and remodelling that could have contributed to the change in marginal bone levels. This is in accordance with study by **Spray et al[88] & Lindhe et al[5].**

Group 2:

Allograft group tends to show dimensional crestal bone level changes on the mid-buccal region only for marginal bone level at 6 months time period. Variations in the level of cortical bone of the adjacent teeth maybe responsible for the observed difference between the groups. Axial inclination of the tooth may also be a contributing factor for the loss in the mid-buccal region. This is in accordance with the study by **Barone et al 2008[12].**

In the present clinical study inter group comparisons of soft and hard tissue parameters were not statistically significant between the groups. From the above result it can be inferred that material of choice used in the putty form does not influence the clinical outcome. This clinical outcome was in accordance with systematic review, consensus statements and recommendations of the **1st DGI consensus conference, Aerzen, Germany - 2010**[106] socket preservation/ridge preservation.

Descriptive analysis of Histological report:

The best section of each specimen for the above groups was examined under a light microscope at a minimum of 20x magnification to differentiate vital bone, residual particles, osteoid and Connective tissue with an imaging software and grid scale. All bone samples consisted of mineralized bone and bone marrow with trabecular bone. Both groups were characterized by the presence of mineralized immature and lamellar bone. Trabecular bone was surrounded by osteoid which was lined by osteoblast like cells. Newly formed bone was characterized by irregular, large lacunae containing osteocytes. Both groups showed areas of new bone deposition associated with residual graft particles with no fibrous tissue encapsulation or inflammatory cellular infiltration. Particles of resorbing graft were dispersed and well incorporated into the newly mineralized bone. In some samples, new bone was noted inside the pores of the graft material. Reversal lines seen in both groups were suggestive of bone remodelling.

Descriptive analysis of graft in both the groups:

	Group 1	Group 2
Vital Bone	43%	55%
New osteoid	21%	19%
Residual graft	32%	20%
Fibrous connective tissue	4%	6%

In the present study percentage of vital bone was evaluated in both the groups because this is the primary bone needed at the bone-to-implant contact region. Percentage of residual graft particle was analysed for resorptive capacity of the graft material since this material is not favourable at the implant bone interface. New osteoid tissue indicates that a lamellar bone will later form a woven bone . Fibrous encapsulation of the graft particles were also assessed.

LIMITATIONS OF THE STUDY:

Some of the limitations of the present clinical study which might have a significant impact on the results obtained include:

- Small sample size.
- Relatively short duration.
- Hard tissue morphology was assessed 2-dimensionally only.

- Following implant placement and loading, further follow up was not reported .

FUTURE CONSIDERATIONS:

- The patients who participated in the present study should be followed up to determine the success rate of the implant and also to assess the stability of the hard and soft tissues over the years in the fully functional implant.
- Longitudinal studies with a larger sample size should be carried out.
- Advanced radiographic aids should be employed to assess the hard tissues and soft tissues both during pre-treatment planning and also to assess the changes in the parameters over a period of time.
- Socket seal procedures should be further investigated in comparison with other ARP/SP interventions.
- The role of other factors like reason for extraction, tooth type and location, buccal plate thickness should be investigated.

Summary and Conclusion

SUMMARY AND CONCLUSION

The aim of the current study is to evaluate the soft and hard tissue dimensional changes following placement of two different socket fill bone substitutes in Extraction Defect Sounding (EDS) classification type I and type II defects over a period of 6 months.

20 patients were selected from the out-patient department of periodontics of Ragas Dental College and Hospital, Chennai. All the patients who were meant for extraction followed by implant placement and restoration were included in the study. Atraumatic extraction was done followed by socket grafting using putty form of alloplast in group 1, and group 2 received putty form allograft biomaterial. PRF/FGG autograft was used to approximate the socket entrance and tension free primary closure attained in both the groups. Clinical and radiographic assessment was done at baseline, 3 months and 6 months.

Within the limitations of the study the following conclusions can be elucidated:

1. In the present clinical study gingival phenotype remained constant throughout the study period in both the groups.
2. In the present clinical study the width of keratinized gingiva was maintained throughout the study period.

3. Intra group comparison of relative position of marginal gingiva showed minimal marginal gingival position changes which were statistically significant from baseline to 6 months time interval.
4. Intra group comparisons of marginal bone level changes from baseline to 6 months showed minimal crestal bone loss, which was also statistically significant.
5. Inter group comparisons did not show stastistically significant result for the relative position of the marginal gingiva & marginal bone level changes in both the groups.

From the above inference of the present study it can be elucidated that till date there is no biomaterial which can be held as a superior material in ARP/SP. However the key factors that aid in preserving the alveolar bone housing are flapless technique, atraumatic extraction of the tooth, preservation of the thin cortical plate, obtaining tension free primary socket closure with various biological mediators prevent soft tissue collapse that can help in implant placement in three dimensional prosthetic position.

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Annexures

ANNEXURE -I

Consent Form

I……S/o,d/o,w/o…… ……aged……years…… ……..residing at…… ……do solemnly .

And state as follows.

I have been explained about the nature and purpose of the study in which I have been asked to participate.

I give my consent after knowing full consequence of the dissertation/thesis/study and I undertake to cooperate with the doctor for the study.

I have been given the opportunity to ask questions about the procedure.

I also authorize the Doctor to proceed with the study and I will cooperate with the doctor.

I have also agreed to come for regular follow up for a period of atleast one year.

I am also aware that I am free to withdraw the consent given at any time during the study in writing.

The patient was explained the procedure by me and has understood the same and with full consent signed in (English/Tamil/Hindi/ Telugu?.....) before me.

Signature of the PG student **Signature of the Patient**

Signature of the Guide: **Signature of the HOD**

ANNEXURE –II

RAGAS DENTAL COLLEGE & HOSPITAL
(Unit of Ragas Educational Society)
Recognized by the Dental Council of India, New Delhi
Affiliated to The Tamilnadu Dr. M.G.R. Medical University, Chennai
2/102, East Coast Road, Uthandi, Chennai - 600 119. INDIA.
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TO WHOMSOEVER IT MAY CONCERN

Date: 06/01/2017

From

The Institutional Ethics Board,

Ragas Dental College and Hospital,

Uthandi,

Chennai- 600119

The dissertation topic titled **"Socket Preservation using two types of Bone Replacement Graft materials- A Clinical Comparative Study – 6 months"** submitted by **Dr. C. Guhanathan.,** has been approved by the Institutional Ethics Board of Ragas dental college and hospital.

Dr. N.S.Azhagarasan,MDS,

Member secretary,

Institutional Ethics Board,

Ragas Dental College and Hospital.

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