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Evaluation and Comparison of Autogenous Masticatory Mucosal Grafts in Extraction Socket filled with G-Bone and Modified G-Bone Substitutes: A Split Mouth Study

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ABSTRACT

Background: Tooth extraction generally leads to significant loss of bone at extraction site. Grafting fresh extraction sockets with bone substitutes and sealing them with autogenous soft tissue grafts prevents bone loss and preserves the ridge dimensions at the extraction site. Mucosal grafts from hard palate or tuberosity have been used in combination with various ridge augmentation procedures for surgical correction of localized alveolar ridge defects, however there is a dearth of literature depicting the use of these mucosal grafts along with G-bone and modified G-bone substitutes.

Materials and Methods: Fifteen patients indicated for bilateral maxillary premolar extraction were included. The defects were randomly assigned to one of the treatments: Mucosal grafts along with G-bone Substitutes or mucosal grafts along with modified G-bone Substitutes. After extraction and debridement, sockets were filled with bone substitutes to level of the alveolar bone crest. Autogenous mucosal graft was obtained from maxillary tuberosity or palatal area and placed so as to seal the sockets. Mucosal grafts were stabilized and secured by sutures and inspected weekly for a month to assess the vitality of the graft.

Results: Amongst 30 grafts placed, 19 grafts were partially vital, during the course of follow up, at end of four weeks follow up 17 grafts were vital and 13 grafts were non-vital. Improved vitality was noticed with sockets filled with Modified G-bone substitutes. It was also observed that grafts from maxillary tuberosity region survived better than the palatal grafts.

Conclusions: Based on the present observation, it seems that Autogenous mucosal grafts sealing fresh extraction sites are mainly dependent on underlying tissue vascularization and that sealing grafted fresh extraction sockets with bone substitutes may be beneficial in preventing the alveolar ridge collapse.

Keywords: Autogenous mucosal graft; Ridge augmentation; G-bone substitutes; Modified G-bone substitutes.

INTRODUCTION

Successful preservation of edentulous ridges after extractions may eliminate or reduce the need for ridge augmentation procedures. It has been claimed that grafting fresh extraction sockets and sealing them with autogenous soft tissue grafts promote ridge preservation after tooth extraction [1]. The oral hygiene maintenance of edentulous patients with fixed prostheses could be irritative and even harmful in the absence of attached masticatory mucosa. A sufficient zone of attached gingiva is

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recommended around teeth planned for full crown restoration.

This pre-requisite may also be valid in new era of esthetic restoration with osseointegrated implants, "every free gingival graft becomes important in conjunction with fixed restorative dentistry". Soft tissue management is the initial step in maintaining a clean peri-implant area. Lack of masticatory mucosa and presence of alveolar mucosa embracing the implant are often associated with plaque, which can induce inflammation resulting in subsequent peri-implant destruction. To facilitate proper mechanical oral hygiene maintenance transplantation of autogenous masticatory mucosal graft at implant site is important [2].

Mucosal grafts from hard palate or tuberosity are used for surgical correction of localized alveolar ridge defects by different ridge augmentation procedure, as it is autogenous graft and being a keratinized in nature serves as a good donor site [3, 4].

Tooth extraction generally leads to resorption of the bone at the extraction site. 40 to 60% of bone height and width are lost within 2 to 3 years after extraction. Because of ongoing bone loss many patients have inadequate bone height and width when they are considered for prosthodontic rehabilitation [5].

Bone being a dynamic organ that can regenerate, as seen after tooth extraction, the socket becomes filled with bone to a variable degree. In addition, a portion of the bone may resorb or be absent after healing. In an effort to enhance the bone healing of the extraction socket to allow for optimal implant placement, various materials have been advocated to be placed into the extraction socket.4 Hydroxyapatite is an attractive material for bone and tooth implants being compatible, non-toxic and stimulates little inflammation, because of the impressive results of the clinical trials particulate Hydroxyapatite was tried to augment deficient ridges to improve its physical property [6].

Hence, the aim of this investigation was to evaluate and compare the survival rate of autogenous masticatory mucosal grafts in extraction socket filled with g-bone and modified g-bone substitutes. This study also focuses on evaluation of the efficacy of g-bone and modified g-bone substitutes in maintaining alveolar ridge after tooth extraction.

MATERIAL AND METHODS

Fifteen patients reporting to the Department of Oral and Maxillofacial Surgery, indicated for extraction of bilateral maxillary premolars were selected for the study. The ethical clearance was obtained from the institutional ethical committee. Patients were selected irrespective of their age and sex.

Patients excluded were patients suffering from diabetes mellitus, emotional disturbances and epilepsy. Also, HIV positive subjects, patients with oral cancer and ongoing radiation therapy, patients with poor oral hygiene maintenance and those with teeth having active periapical infection were excluded from the study.

Materials

Bone Graft Material -

The bone graft material used in this study was G-Bone and Modified G-Bone. It is a bovine derived hydroxyapetite material, supplied by Surgiwear Ltd. It is marketed in a sterile airtight pack, sterilized by Gamma irradiation.

G-bone - (Hydroxyapatite)

Hydroxyapatite is apatite calcium phosphate Ca10(Po4)6(OH)2

G-bone substitutes are derived from natural sources i.e. bovine origin. It refills the gap in bone and augments bony structures. It is biocompatible, nontoxic to hard and soft tissues.It is porous; hence soft tissues grow into and mingle with natural tissues. Also it can be sterilized easily by autoclaving and dry heat.

Because of its similarity to human bone G-bone is revitalized by new blood vessels due to its natural porous and trabecular structure. It is Osseo-integrated rapidly due to its excellent guide rail function based on the high porosity and large internal surface. Resorbs slowly and integrates in the natural remodeling process due to its natural crystalline structure. However, being fragile in nature, these bone substitutes can't be used in load bearing areas.

Modified G-bone: (Hydroxyapatite with added PO4 - ions)

Like G-bone substitutes these are of bovine origin and biocompatible to the hard and soft tissues. It is porous; hence soft tissues grow into and mingle with natural tissues. However, Modified G-bone substitutes show increased strength owing to the added PO4 – ions, as compared to Hydroxyapatite and hence can be used in load bearing areas.

Surgical Procedure

The surgical procedure was carried out in an operating room under strict aseptic conditions. This includes a preoperative mouthwash of the patient's oral cavity with Chlorhexidine Digluconate 0.2% (1 minute) and extra- oral skin scrub. The surgeries were performed under local anesthesia (Lignocaine 2% with epinephrine 1:1,00,000). Furthermore, patients were given an antibiotic coverage for five days (Amoxicillin 500mg every 8 hours post-operatively). The surgical procedure was performed with a standard instrument set used for minor oral surgical procedures.

Tooth extraction was done carefully, while preserving the alveolar bone plates around the teeth.

Site Preparation

Thorough debridement of the extraction socket was accomplished with fine curettes. All visible granulation tissue was curetted from the socket. The socket was then gently flushed with sterile saline. To avoid contamination of the bone graft material, the debridement instruments were removed from the surgical field. Hemostasis was achieved.

Harvesting of Palatal mucosa :

A partial thickness palatal graft was harvested from either the edentulous maxillary tuberosity or from the palatal tissue adjacent to molar region, a free masticatory mucosal graft, elliptical in shape measuring approximately about 3mm in thickness and 12mm in diameter was obtained after measuring the socket size and divided into two pieces, then preserved in normal saline until it was secured over the extraction sockets. Hemostasis was achieved.

Bone Graft Placement :

The G-Bone and Modified G-Bone graft material was dispensed from its container separately in two separate sterile stainless-steel bowl. Using a suitable instrument, the graft was placed into the sockets and packed until it filled the socket space. The material outside the socket was carefully retrieved & discarded.

Free Masticatory Mucosal Graft Placement:

The free masticatory mucosal graft was trimmed to the appropriate size with scissors and was placed over the extracted sockets filled with bone graft thus sealing the socket (Fig 1b & 2b).

Site Closure:

The masticatory mucosal graft was secured onto the extracted pre-molar sockets by 2-3 cross horizontal mattress sutures which do not penetrate the grafts (Fig 1b & 2b).

Post-Operative Instructions And Follow-Up :

Patients were instructed to apply gentle pressure on the gauze pack over the operated site. After achieving haemostasis a pre-fabricated biostar splint was placed covering the operated site Ice application externally was advised in the first 24 hours. The patients were instructed not to chew in the area for approximately 2 weeks. Antibiotic coverage for five days (Amoxicillin 500mg every 8 hours post-operatively) was given. Chemical plaque control with Chlorhexidine digluconate solution (0.2% 1 minute, Tid) was instituted for the first postoperative week. Patients were instructed to brush their teeth with soft paediatric toothbrush from the second postoperative day. The patients were prescribed a non-steroidal anti-inflammatory medication on an as needed basis for pain control.

The patients were recalled on the third and tenth days following surgery. At 10 days, the sutures were removed. Subsequently, patient was seen every week for a month to examine the soft tissue status. Results were evaluated using Fisher exact test.

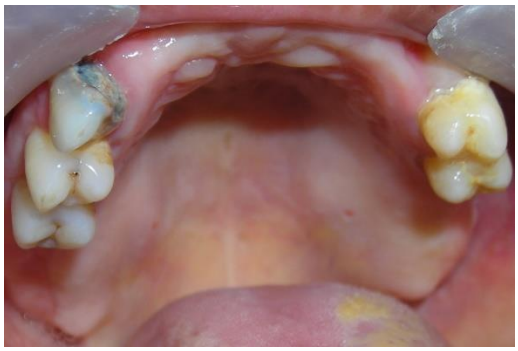


Fig 1a: Pre-op picture for case treated with free masticatory mucosal graft harvested from the Maxillary tuberosity.

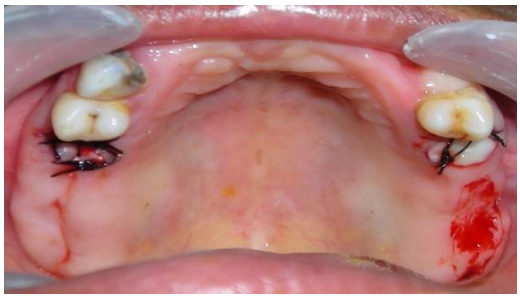


Fig 1b: Intra-op picture for case treated with free masticatory mucosal graft harvested from the Maxillary tuberosity.

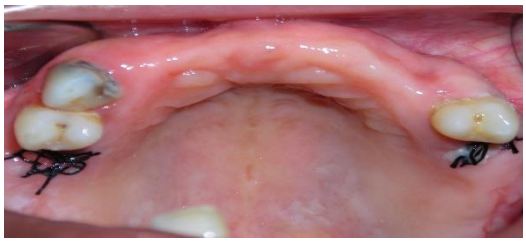


Fig 1c: 1 week Post-op picture for case treated with free masticatory mucosal graft harvested from the Maxillary tuberosity.

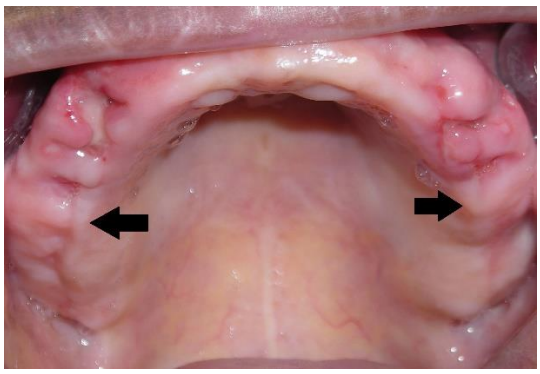


Fig 1d: 2 weeks Post-op picture for case treated with free masticatory mucosal graft harvested from the Maxillary tuberosity. Black arrows showing areas of interest.

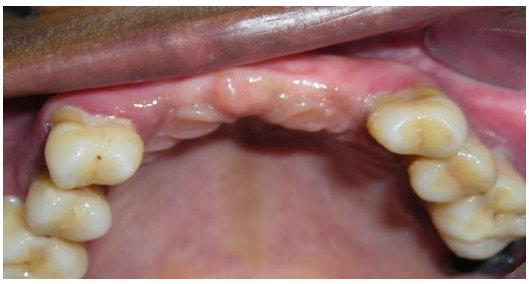


Fig 2a: Pre-op picture for case treated with free masticatory mucosal graft harvested from the Palate.

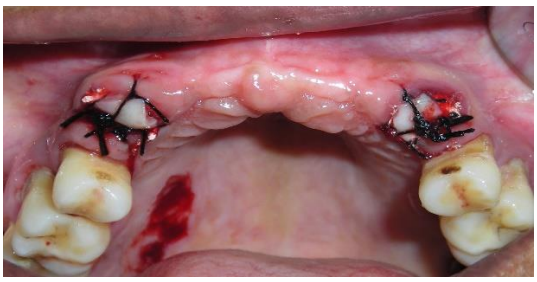


Fig 2b: Intra-op picture for case treated with free masticatory mucosal graft harvested from the Palate.

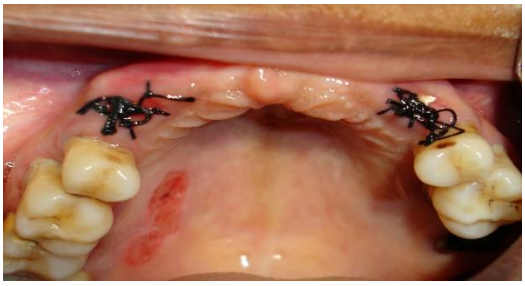


Fig 2c: 1 week Post-op picture for case treated with free masticatory mucosal graft harvested from the Palate.

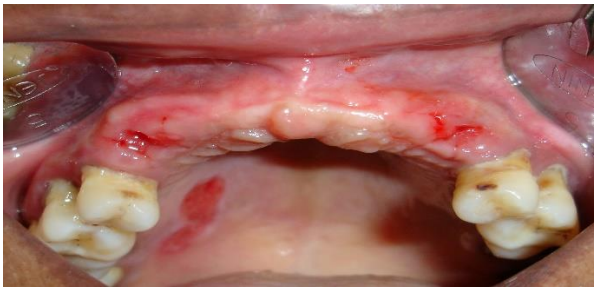


Fig 2d: 2 weeks Post-op picture for case treated with free masticatory mucosal graft harvested from the Palate.

RESULTS

This study was conducted on 15 patients (7 males and 8 females) reporting to the Department of Oral and Maxillofacial Surgery presenting with the need for extraction of bilateral maxillary premolars. 9 Mucosal grafts were harvested from the maxillary tuberosity region and 6 grafts were harvested form the palatal region. The graft vitality was categorized according to the following criteria:

Vital: Graft was attached to the underlying tissue and surrounding gingiva and responded by bleeding to removal of the necrotic epithelium.

Partially vital: Part of the graft presented signs of vitality and part showed signs of necrosis, amorphous white material which could be detached and removed leaving no signs of bleeding at detachment site.

Non-vital: Graft could easily be detached and removed from the recipient sites and did not show signs of vitality.

Of the 30 grafts, 13(43%) failed exposing the white amorphous graft material. 19(63%) grafts were partially vital which had some signs of vitality with a part of that showed signs of necrosis during the 1st week of follow up (Graph 1) and subsequent weeks these partially vital grafts were taken up. 17(57%) graft were vital which had no signs of necrosis at 4 weeks post surgery (Graph 4).

Amongst the vital grafts more number of vitality was observed in grafts placed over modified G-bone graft material (n=10) and less in number over G-bone material (n=7). However, the difference was not statistically significant (P = 0.034) (Table 1). Non-vitality of the grafts were more seen in grafts placed over G-bone graft (n=8) when compared to grafts placed over modified G-bone graft (n=5). But, the difference was not statistically significant (P = 0.67) (Table 1).

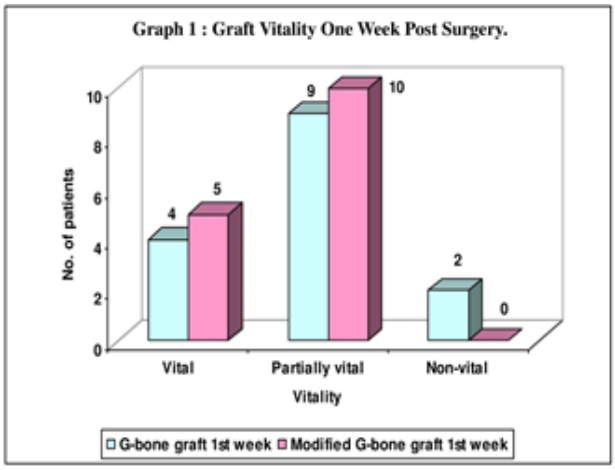
Mucosal graft in accordance to donor site showed more vitality with grafts harvested from maxillary tuberosity as compared to grafts harvested from the palatal region (Table 2).

Table 1: Distribution of recipient sites by graft material and healing response

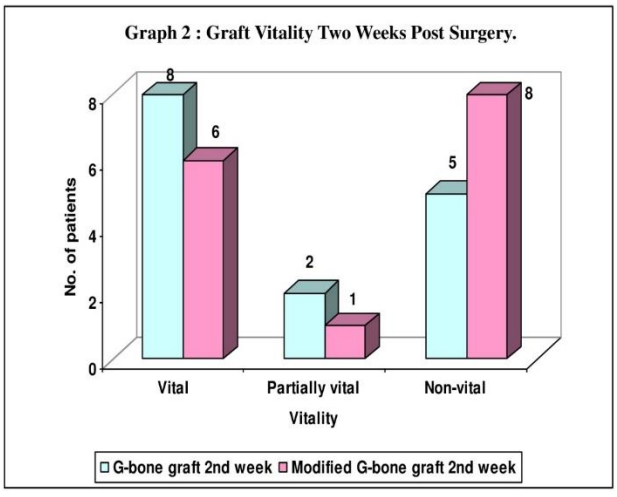
Distribution of recipient sites by graft material and healing response			
Sites (n=30)	Grafting material		Total
	G-Bone	Modified G-Bone	
Vital	7	10	17
Partially vital	9	10	19
Non-vital	8	5	13

Table 2: Graft vitality in accordance to donor site.

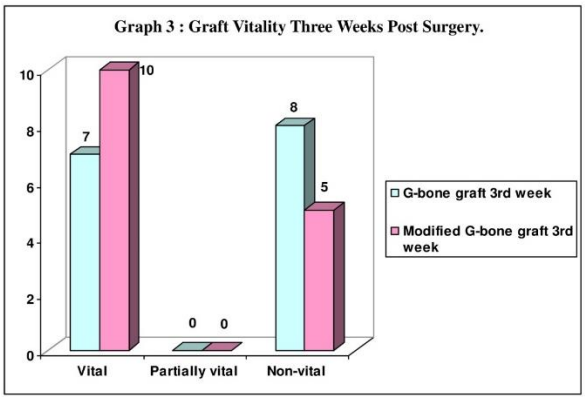
Graft vitality in accordance to donor site				
	Maxillary tuberosity	Percentage	Palatal region	Percentage
Vital	9	50%	8	66.66%
Non-vital	9	50%	4	33.33%



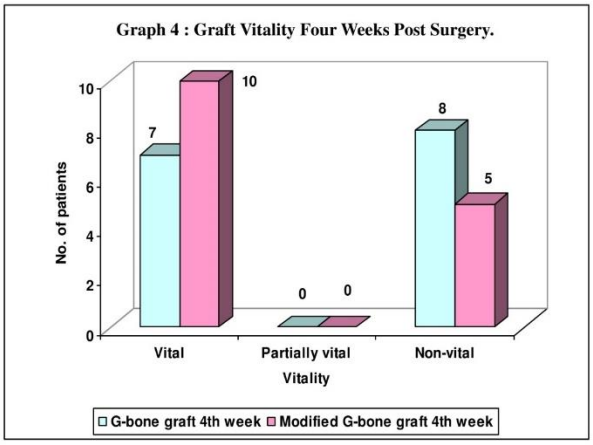
Graph 1: Graft vitality one week post-surgery



Graph 2: Graft vitality one week post-surgery.



Graph 3: Graft vitality three weeks post surgery.



Graph 4: Graft vitality three weeks post surgery.

DISCUSSION

In the speciality of oral and maxillofacial surgery, defects with tissue loss or deformities are always encountered due to developmental disorders, pathologies and surgical resection. These defects frequently require grafting to achieve normal function and esthetics [7-10].

Patients who are scheduled to have a tooth extraction may want to replace the tooth, the traditional method has been a fixed partial denture taking support from adjacent teeth. With success of endosseous implants, a single tooth implant restoration is now a viable option for the patient [5].

When confronted with a tooth extraction site with significant pre-existing bone loss, use of a graft material that will preserve bone in the planned implant site is advantageous [10].

Preservation of edentulous ridges after extractions may eliminate or reduce the need for ridge augmentation procedures. Porous hydroxylapatite particle is a osteoconductive, porous in nature allows in growth of bone demonstrates good stability, biocompatibility, good handling properties and more accurate placement of material resulting in predictable ridge shape [4]. It has been claimed that grafting fresh extraction sockets and sealing them with autogenous soft tissue grafts promote ridge preservation after tooth extraction [1].

The masticatory mucosa harvested from the hard palate or maxillary tuberosity serve as a good donor site as it is autogenous graft and is keratinised in nature, grafts obtained from tuberosity have more thickness and dimensions as compared to grafts from the hard palate [3]. In our study we found grafts harvested from maxillary tuberosity had more dimension compared to palatal region and risk of damage to neurovascular bundle was minimised. Lack of masticatory mucosa and presence of alveolar mucosa embracing the implant are often associated with plaque, which can induce inflammation resulting in subsequent peri-implant destruction [11]. To facilitate proper mechanical oral hygiene maintenance, transplantation of autogenous masticatory mucosal graft at implant site is important [12]. The rationale behind this therapy being autogenous grafts can exclude epithelial cells and allow cells of periodontal ligament to selectively repopulate a wound area. In addition the masticatory mucosa can physically maintain an osseous graft in place [13,14].

Autogenous gingival grafts pose no antigenic problems and if the tissue can be retained for 2-4 weeks it will allow tissue from socket to surround the implant without the epithelium intervening between the implant and bone, it also will prevent accumulation of food debris surrounding bone from attaching to the implant thereby preventing bacteria from invading into implant site [7].

Initially survival of free connective tissue graft depends on nourishment from plasma elements originating from organizing blood clot and granulation tissue beneath the graft, from the socket gingival walls from which it receives additional blood supply or from combination of two [1]. By the 3rd post operative day recirculation to the graft

commences by the anastomoses of the existing vessels in the graft and the vessels in the recipient bed via new sinusoidal vessels. After 5th post operative day these vessels gradually increase their continuity forming a vascular layer in the graft-bed junction.

By 7th postoperative day these new vessels connect the existing vessels of the graft with the vessels in the recipient bed by horizontal anastomoses thus promoting formation and distribution of a vascular plexus throughout the junction bed [15].

Of the 30 grafts, 13(43%) failed exposing the white amorphous graft material which could be detached easily from the recipient bed at 1st week of follow up (Graph 1), indicating that graft nourishment was jeopardized at the initial healing phase. 19(63%) grafts were partially vital which had some signs of vitality with a part of that showed signs of necrosis during the 1st week of follow up and subsequent weeks these partially vital grafts were taken up (Graph 1). 17(57%) graft were vital which had no signs of necrosis and were attached to the underlying tissue and surrounding gingiva responded to bleeding indicating that graft nourishment primarily originated from the organizing clot and granulation tissue within the healing socket (Graph 1). In a similar study the author found 11 (26%) grafts to be non-vital, 13 (31%) grafts to be partially vital and 18 (43%) grafts to be vital of total 42 grafts that were placed over extracted sockets filled with demineralised freeze – dried bone and deproteinised bovine bone mineral at the end of one month [1].

Amongst the vital grafts more number of vitality was observed in grafts placed over modified G-bone graft material (n=10) and less in number over G-bone material (n=7) (Table 1).

It may be assumed that blood clot and granulation tissue organised and developed more effectively at modified G-Bone graft thus supplied better nourishment during initial healing phase of the graft. Non-vitality of the grafts were more seen in grafts placed over G-bone graft (n=8) when compared to grafts placed over modified G-bone graft (n=5) (Table 1). Mucosal graft in accordance to donor site showed more vitality with grafts harvested from maxillary tuberosity (n=9) compared to grafts harvested from palatal region (n=8) (Table 2). Although more number of grafts were harvested from maxillary tuberosity region (n=9) compared to palatal region (n=6) were vital, it was not statistically significant.

Statistically evaluated results by Fisher exact test showed P=0.161 between vital grafts of modified G-bone to vital grafts of G-bone and P=0.210 between non vital grafts of modified G-bone to non vital grafts of G-bone making them statistically not so significant.

Although the study by Haim Tal et al showed 18 of the grafts were vital, 13 were partially vital, 11 were non-vital of the total 42 grafts that were placed over extracted sockets filled with demineralised freeze-dried bone and deproteinised bovine bone mineral, with more number of grafts showing vitality with demineralised freeze-dried bone compared to deproteinised bovine bone mineral with P = 0.034 for vital grafts demineralised freeze-dried bone to vital grafts of deproteinised bovine bone mineral, P = 0.67 for non-vital grafts placed over demineralised freeze-dried bone to vital grafts of deproteinised bovine bone mineral, making them statistically insignificant [1].

Since this part of study was undertaken to compare free graft survival over G-bone and Modified G-bone showing more survival rate of grafts, making them statistically not so significant thus requiring large number of variables and long time results, the information provided is a very promising technique that may benefit the patients.

CONCLUSION

This study was attempted to determine the survival of free autogenous connective graft sealing the extracted maxillary premolars socket with G-bone and Modified G-bone indicating that more survival rate was observed in grafts placed over sockets filled with Modified G-bone than with G-bone conclusive of grafts showing better adaptability with Modified G-bone making it superior to G-bone. It was also found that grafts obtained from maxillary tuberosity region survived more in number compared to grafts from palatal region indicating that more thickness and dimension of graft is required for its survival.

Although this study requires more number of variables for statistically significant value and long term results, the need for sealing the sockets with autogenous connective tissue graft may become inevitable procedure in future as it is "an era of implants".

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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