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The effect of socket preservation techniques on bone healing at the sites planned for implant placement-a cohort study.

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ABSTRACT

Background: A cohort study was conducted to compare and evaluate the effect of two different socket preservation techniques with normal healing of sites planned for implant placement.Objectives of the study were to compare and assess the bone fill achieved and the density of newly formed bone in extraction sockets after healing following three techniques.

Methods: Eighteen fresh extraction sites indicated for delayed implant placements were randomly divided into 3 groups of six each. Group A consisted of sockets left for normal healing, Group B were preserved with bone graft and PRF (Platelet Rich Fibrin) and Group C using PRF alone. Bone level was recorded using Radiovisiography (RVG) at day 0 and at the end of third month and bone density assessment was done using Computed Tomography Reformation (Dentascan).

Results: Comparative assessment at the end of 3 months among the study groups using simple ANOVA test showed Group C exhibiting highest average bone fill (p =0.064), whereas average bone density assessed using Dentascan showed highest values for Group B (p =0.1).

Conclusion: Within the limitations of present study it has been inferred that, there was no significant quantitative or qualitative benefit in using socket preservation procedures in extraction sockets compared to normal healing in preparation of placing implants.

KEYWORDS: bone graft, platelet rich fibrin, bone matrix, bone density.

I. INTRODUCTION

Healing of an extraction site is dependent upon the nature of extraction, pathologically altered bone and soft tissue and patient's systemic condition influencing its healing. An extended objective of tooth extraction should be directed at preserving the surrounding bone and soft tissue and to incorporate any augmentation procedure if required, that will benefit its rehabilitation.

Replacement and rehabilitation following tooth extraction is on the basis of clinical diagnosis, patient preferences and available replacement modalities. Ideally adequate ridge height, width, form and periodontally stable adjacent teeth, are required for removable, fixed and implant prosthesis. The alveolar crest undergoes resorption and remodelling in first 3 months following extraction. These findings indicate importance of preserving alveolar ridge in its native state.

Soft and hard tissue augmentation to compensate for socket resorption primarily includes a judicious management of blood clot inside the bony socket and the right approximation of flap around it. It often incorporates invasive techniques including bone substitutes, soft tissue grafts and platelet rich blood products.

Studies conducted to compare the outcome of natural healing versus induced healing of extraction sockets could furnish clinicians a proper guideline in deciding whether the extraction sockets should be augmented or left for normal healing. The ideal requisite for an appropriate prosthetic rehabilitation would be a stable ridge dimension preserving or enhancing the existing bone height and width whereas, an option of

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implant would also seek for the density of the newly formed bone.

The widely accepted socket preservation techniques incorporates bone substitutes and platelet rich fibrin. Usage of bone grafts involve an additional expenditure and usage of PRF involve surgical intervention at an extra oral site. Considering these factors, these techniques should be critically evaluated for its potential benefit of enhancing the healing process facilitating an earlier implant placement over the normal socket healing process.

Thus, a study was planned with objectives to compare and assess density of newly formed bone and quantity of bone fill achieved in extraction sockets with and without preservation techniques at end of 3rd month.

II. MATERIALS AND METHODS

A prospective cohort study was planned to compare bone fill achieved in extraction sockets following normal healing and socket preservation using either PRF alone or PRF mixed with bone graft. Selection of patients for study followed principles outlined in Declaration of Helsinki on clinical research involving human subjects. The informed consent to participate in study was obtained from each patient prior to study.

Sample size for the study was determined using G power software and the total sample size was calculated to be 18 distributed as 6 per group, based upon the reference key article.[1] Thus, 18 fresh extraction sites were selected from 12 patients and were randomly divided to fit into one of the 3 groups. Group A consisted of 6 socket sites left to heal normally, Group B were sockets preserved with PRF and Demineralised Bone Matrix (DMBM) bone graftand Group C were sockets preserved with PRF alone.

Subjects systemically and physically fit to undergo tooth extraction, PRF related surgical procedure and replacement with implants following healing were selected for the study. The teeth with active periodontal lesions and/or with grade III mobility and without atleast one adjacent neighbouring tooth were excluded from the study. Subjects with history of periimplantitis and implant failure, possessing any risk factors adversely affecting the healing of extraction sockets and extraction sites with less than 60% residual bone height were also excluded from the study.

Teeth were atraumatically extracted and socket preservation techniques as per requirement of group involved was performed by an expert surgeon. Each of the extraction socket areas of all 3 groups was subjected to radiographic assessment to measure the depth of socket from a reference line created in the RVG. The reference line is a line drawn in the RVG perpendicular to the line assessing the socket depth connecting a fixed point on each nearby tooth (Figure 1). In case of multi rooted teeth in mandibular sites, these values were calculated as the average depth of multiple sockets and in case of maxillary molars, only the palatal root were considered as the sample site (Figure 2).

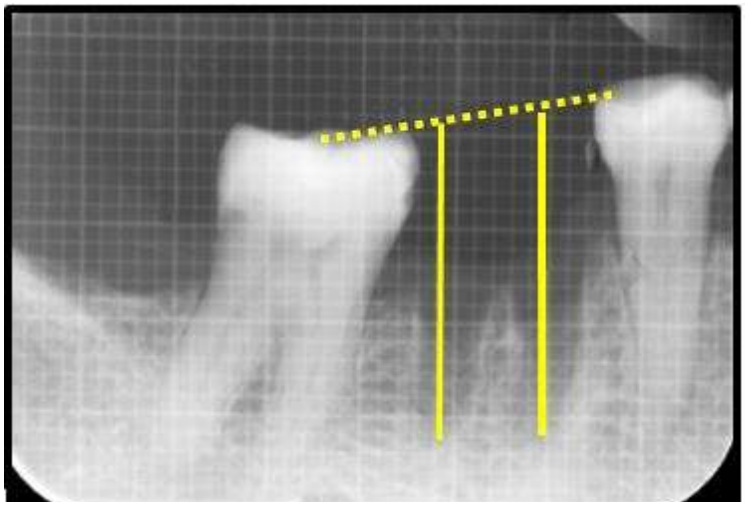

Figure 1: Assessment of extraction socket depth immediately after extraction using RVG in mandibular molar

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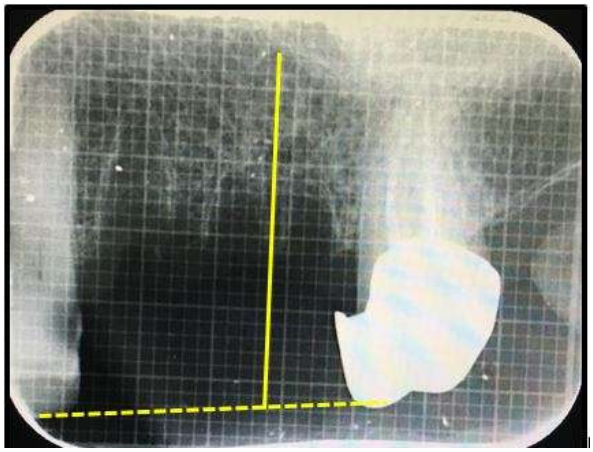

Figure 2: Assessment of extraction socket depth immediately after extraction using RVG in maxillary molar

The radiographic assessment was repeated after 3 months to measure the level of bone achieved in the socket area from the same reference line created in the RVG (Figure 3, 4). The measuring of the bone level at both intervals were made more precise and errorless using millimetre grid (X-ray Mesh Meyer, Haake, Germany) attached to the RVG sensor.

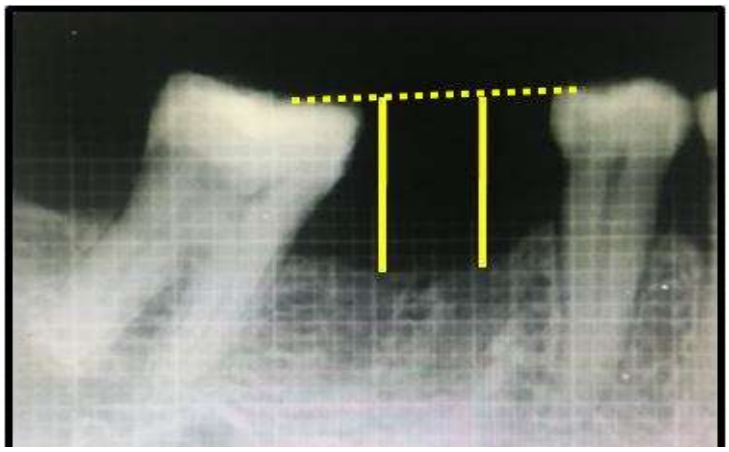

Figure 3: Assessment of bone fill in mandibular extraction socket after 3 months using RVG

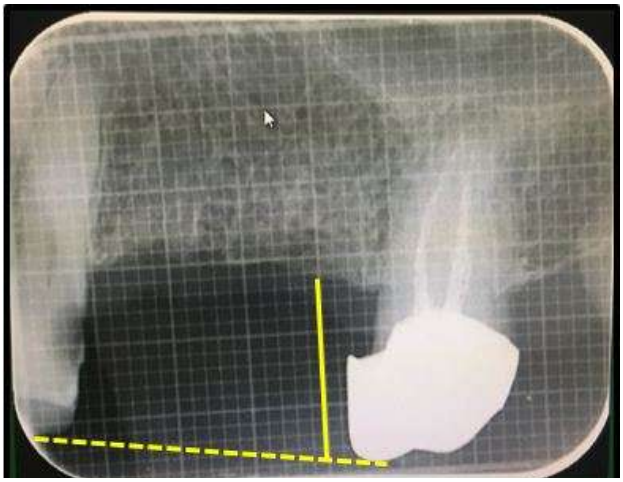

Figure 4: Assessment of bone fill in maxillary extraction socket after 3 months using RVG

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Bone density of newly formed bone was assessed using CT reformation Dentascanat the end of three months using GE Revolution Act 16 slice CT machine. Patients were subjected to CT scan procedure and images reformatted into sagittal, coronal and panoramic images using Dentascan (Figures 5, 6).

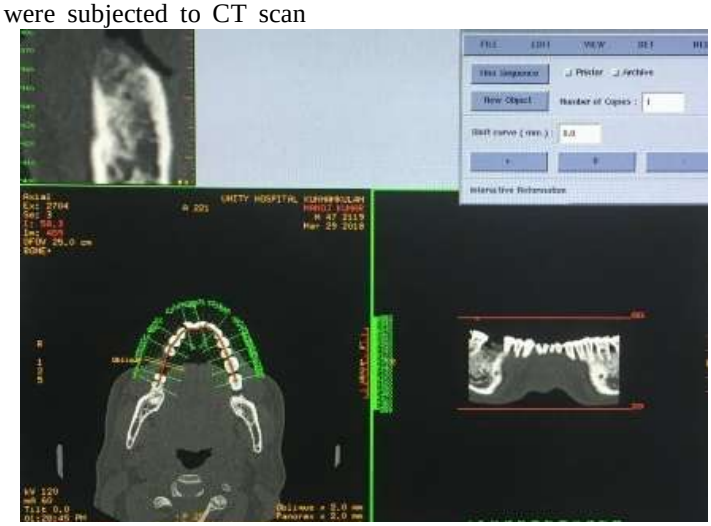

Figure 5: Images reformatted into paraxial and panoramic images using Dentascan.

Figure 6: Axial, transverse, occlusal and cross sectional views

Available bone density at implant site was assessed using reformatted images on computer with pixels tools present in software.[2] Most critical region of bone density was base of extraction socket within buccal and lingual/palatal cortical plates to detect density of newly filled bone. Intercomparison of data were to be done to assess the technique that achieved maximum bone fill and maximum bone density at end of 3 months.

Software of a CT Dentascan has the ability to measure density of a "region of interest" (ROI), electronically overlaid on the images. CT numbers are density assigned to a voxel of tissue/image expressed as Hounsfield Unit (HU). It is a dimensionless unit universally used in CT to characterize tissue or its chemical composition and determination of bone mineral content. Arbitrarily water is given 0 HU, air -1000 and bone +1000.[3]

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ROI was represented by a circular histogram in the present study (Figure 7).

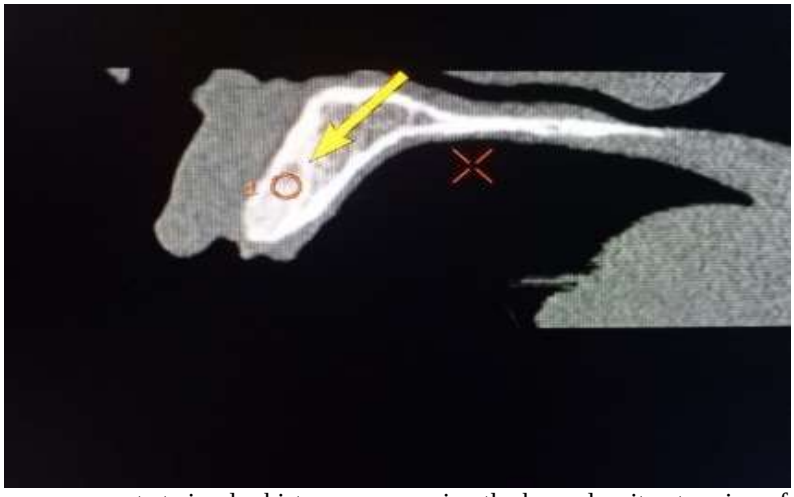


Figure 7: Dentascan assessment at circular histogram assessing the bone density at region of interest (ROI) of extraction socket (3rd month)

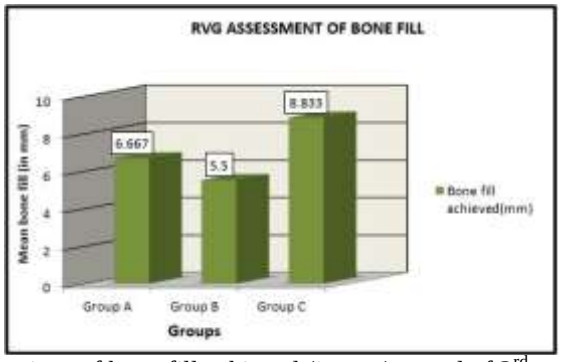
The bone density was assessed under two indices of maximum and average bone density of newly formed bone in HU units and standard deviation values. Maximum density is the point of maximum HU value within the selected ROI and average density is the overall density of the given ROI (Figure 7).

III. RESULTS

All 18 sites considered for the study were assessed for bone level at baseline (day 0) and end of 3rd month (90 days) in mm scale using RVG. Thereafter, mean score of 6 samples in 3 Groups - A (normal healing), B (sockets preserved with PRF and bone graft) and C (sockets preserved with PRF) was obtained and compared. Comparative analysis was carried out in personal computer through SPSS windows (Statistical Presentation System Software, Version 18, IBM USA).

Density assessment of newly formed bone by Dentascan used HU value keeping density of water (0) as baseline. Maximum density, average density and standard deviation of samples were recorded using Dentascan and tabulated. Average score of 6 samples in 3 Groups were calculated and recorded. Intercomparison assessed the best bone fill achieved technique and group to achieve maximum and average bone density at end of 90 days.

The bone fill was calculated by subtracting the later value obtained at third month from the baseline value. The mean bone fill values of each groups were intercompared using simple ANOVA test and the p value less than 0.05 was considered statistically significant. The mean bone fill value obtained for Group A was 6.667mm, Group B was 5.5mm and Group C was 8.833mm. Bone fill in Group C showed the highest value which was clinically significant. The p value of bone fill achieved among groups was 0.064 which has to be considered statistically insignificant (Graph 1).



Graph 1: Comparison of bone fill achieved (in mm) at end of 3rd month using RVG

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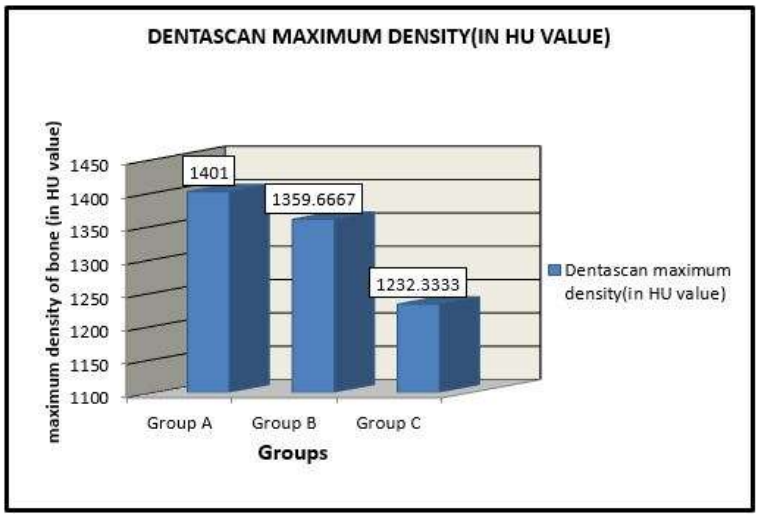
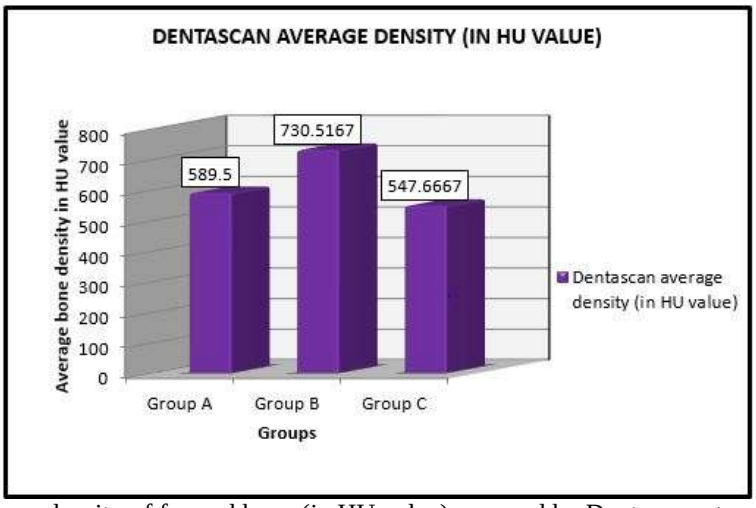
Comparison of maximum density value of formed bone between study groups showed Group A having 1401 HU, Group B with 1359.6667 HU and Group C having 1232.3333 HU. Highest maximum density value of Group A with 1401 HU showed a marginal difference compared to other groups, thus rated statistically insignificant for having a p value of 0.699 (Graph 2).



Graph 2: Comparison of maximum density of formed bone (in HU value) assessed by Dentascan at end of 3rd month

Mean values of average density obtained for Group A was 589.5 HU, Group B was 730.5167 HU and Group C had 547.6667 HU. Group B exhibited highest HU value but was again statistically insignificant with p value of 0.1 (Graph 3).



Graph 3: Average density of formed bone (in HU value) assessed by Dentascan at end of 3rd month.

IV. DISCUSSION

In the present study, both the study parameters that assessed quantity and the density of bone fill achieved following 3 different socket managing techniques failed to achieve any supremacy of one technique over the other.

A study conducted in 2013 by S.Girish Rao et al. considering only PRF and a control group had results in accordance with present study, showing PRF group better compared to control group failing to achieve any statistical significance.[4]

A similar study conducted by Thakkar DJ et al. in 2016, where bone fill assessment was done using intra oral periapical radiographs. Groups assessed were sockets filled with bone graft alone and bone graft along with PRF.[1] In contradiction to the present study, statistically significant results were obtained in group using PRF with bone graft than bone graft alone.

Tomlin EM et al. in 2014 explored evidences behind different techniques of socket preservation and emphasised benefits of ridge preservation to reduce resorption and no material can be regarded as key element to successful ridge preservation.[5] The statistical comparison results are in compliance with present study.

V. CONCLUSION

Substantial evidence was lacking to prove any difference in bone formation in extraction sockets with an additional augmentation with PRF or bone graft compared to its normal healing process with regards to the two parameters used. None of the groups under the study could exhibit a supremacy over others in terms of bone fill achieved and density within study period of 3 months. However, the review of literature in this regards strongly support use of socket preservation techniques though it involves additional expenditure and even an interventional procedure at an extra oral site. Hence, such a technique can be limited to cases which is of its absolute necessity like conditions where immediate implant placement is not possible or in situations that cannot afford even the minimal bone loss that happens with normal crestal bone remodeling during the healing process.

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Conflicts of interest
There are no conflicts of interest.

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