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**Research Article**

# SOCKET PRESERVATION FOR IMPLANTS WITH COLLAGEN SPONGE AND PRF MEMBRANE VERSUS NATURAL HEALING:A COMPARATIVE STUDY

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**A R T I C L E I N F O**

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Socket preservation, collagen sponge, PRF, implants, natural healing

**A B S T R A C T**

***Aim & Objectives***: To evaluate whether bone resorption around tooth sockets after extraction can be reduced by socket preservation techniques. Evaluation of efficacy of collagen sponge and platelet rich fibrin (PRF) membrane as a socket preservation material.
***Materials and Methods***: Ethical approval was taken from the institution and informed consent from all patients was taken before the commencement of the study. Collagen sponge and PRF membrane were used in test group in our study. 20 human extraction sockets were assigned alternatively in test and control groups (10 in each group). Test groups were preserved with collagen sponge and PRF membrane, control groups were allowed to heal naturally (without any graft for preservation). Bone width was measured immediately after extraction (baseline), and at the implant placement procedure along with implant insertion torque. Bone core was harvested from the implant osteotomy site and send for histological analysis in both the groups. Radiographic analysis included bone density measured with inverse gray scale method at baseline and again at duration of minimum 3 months. Bone resorption was measured at
baseline and after 3 months.
***Results:*** Our study showed that although bone width was better preserved inthe test group (mean bone resorption after 3 months in test was 1.2mm and in the control was 1.65mm), it was statistically insignificant(p value 0.063).Test group biopsies had an average of 50.62% and control group had average of 31.59% bone surface mineralization. Radio density with grey scale value showed mean values of 7.5 8 for test & control respectively. Radiographic height showed mean group resorption, which was mean of 1.4 and 1.5 mm for test and control respectively. Torque was 28 Newton per square meter (N/Sqm) for test group and 30 N/sqm for control group difference being non significant statistically. (p value=.0795)
***Conclusion*** : The combination of a platelet concentrate like PRF membrane with a simple space filler like collagen sponge is not statistically better in preserving the dimensions compared to natural healing of a socket. The authors concluded that socket preservation is better achieved with traditional bone substitutes rather than the economical option of collagen sponge and PRF membrane.



## INTRODUCTION

Socket preservation for implant placement have gained a lot of popularity in the past decade[1]. But, only a handful of studies have compared socket preservation techniques to the natural healing process in extraction sockets for implants.Varying degrees of success have been reported with the different materials[2 ] Darby *et al*[2] also states that the superior results obtained by Serino *et al*[3] could be due to the slower rate of resorption of PGA/PLA(polylactide and polyglycolide). The fastest resorbing PGA/PLA sponge also persists for a minimum of 50-60 days.[3] However, without supportive bone, the buccal and labial soft tissue in the socket collapses. The formation of new bone in the socket cannot compensate for the loss of volume. A collagen sponge or plug alone cannot maintain the volume. So we carried out this study whether, addition of growth factors to a healing extraction socket from the PRF membrane along with collagen sponge would be of any benefit. This study attempts to compare whether platelet rich fibrin can induce bone formation and thereby reducing bone resorption with a nothing but a space filler like a collagen sponge, and not any traditional bone graft.

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***Aims and Objectives of The Study***
***Aim***

- To compare bone resorption rate after tooth extraction in naturally healing sockets and socket preservation with PRF membrane and collagen sponge for implant placement

***Objectives***

Evaluation of Efficacy of combination of a space filler like collagen sponge and PRF membrane as a socket preservation material.

## MATERIALS AND METHODS

***Method of Collection of Data***

Each extraction site was allotted in alternate fashion to the Test and Control groups(10 each in 2 groups) Figure1.

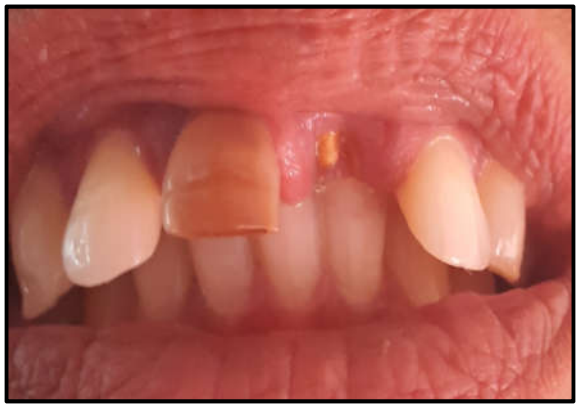


**Fig 1** Teeth indicated for extraction/AT BASELINE: 11(TEST GROUP) &21 (CONTROL GROUP)

***Test Group(Group 1):*** Following atraumatic extraction the socket were grafted with collagen sponge and PRF membrane. Figure 2 shows PRF gel, Figure 3 shows collagen sponge

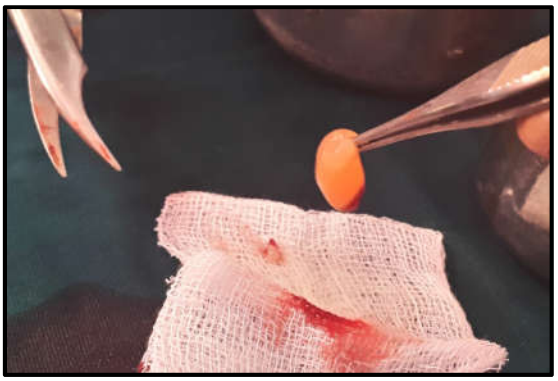


**Fig 2** preparation of PRF membrane

***Control Group (Group 2):*** The teeth were extracted and the sockets were allowed to heal by natural phenomenon of clot formation.

***Study Design***

20 extraction sockets were assigned to the test and control groups in alternate order.Sockets were compared with respect to clinical and radiographic parameters immediately at the time of extraction and a minimum of 3 months after it via a

**Fig 3** Collagen Sponge Of Dimension 8 X 20mm

radiovisiograph (RVG).Bone width was measured clinically immediately after extraction and, at the time of implant placement procedure with a sterile measuring calliper. Along with that a bone sample was harvested via a trephine drill from the osteotomy site at the time of implant placement and wassend for histological analysis. Sockets were compared with respect to various clinical and radiographic parameters as described below.

***Evaluation Parameters***
***Clinical parameters***

A. Bone width
B. Torque required at the time of placement of implants.

***Radiographic parameters***

1. Bone density through indirect Gray scale technique.

***Histologic parameters***

1. Nature of bone formed at the test and control sites
2. Graft material left at the Test site, if any.

***Inclusion Criteria***

1. Patients willing to give their consent for the procedure.
2. Patients fit to undergo procedure under local anaesthetic on a dental chair.
3. Patients in which Maxillary anteriors and premolars are indicated for extraction.
4. Patients who are co-operative well motivated.
5. Patients who are able to maintain good oral hygiene.

***Exclusion Criteria***

1. Patients who do not wish to give informed consent
2. Patients with systemic diseases that can interfere with implant therapy.
3. Patients who are Heavy smokers (>10 cigarettes per day).
4. Patients presenting with history of bruxism, para-functional habits and/lack of stable occlusion.
5. Patients with presence of active infections or chronic sinus tracts at the site of implant placement.
6. Patients on bis-phosphonate, or have undergone bisphosphonate therapy in past.
7. Patients who have undergone chemotherapy /radiotherapy, steroid therapy.
8. Patients with Coagulation disorders.

9. Patients who have had surgical Extraction in the region of interest.
10. Patients with immunocompromised state.
11. Patients who are unable to maintain good oral hygiene.

***Prf Membrane Preparation***

10 ml of blood was collected from the patient under aseptic precautions in 2 separate vacutainers containing no anticoagulants and were subjected to centrifugation at 3600 rpm for 12-15 minutes.The PRF gel was placed in between sterile gauze and compressed with digital pressure to form a thin membrane which was then used to place inside the freshly extracted sockets.

***Procedure***

After atraumatic extraction of indicated teeth in maxillary anterior/premolars region, the test socket was grafted with collagen sponge and Platelet Rich Fibrin membrane. In test group 10 ml of blood from the antecubital vein was withdawn under aseptic conditions to prepare the PRF membrane. In the control group, the socket will be left to heal without any graft by natural clot formation process. The bone width was measured labiopalatally in its maximum dimension with the measuring caliper, & interdental sutures were placed in both the sockets (Figure 4). Standardized intraoralperiapical radiograph with a paralleling technique and a radiopaque marker were taken after extraction. After 3 months the healed extraction sockets will be evaluated IOPARs and bone width were measured clinically. Along with that a bone sample was harvested via a trephine drill from the osteotomy site at the time of implant placement and send for histological analysis. Sockets were compared with respect to various clinical and radiographic parameters as described above. (Figure 5-9)

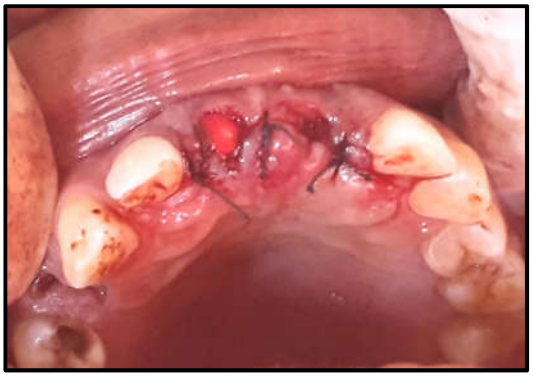


**Fig 4** Test &Control Sockets Both Sutured With 3-0 Bbs Without Primary Closure

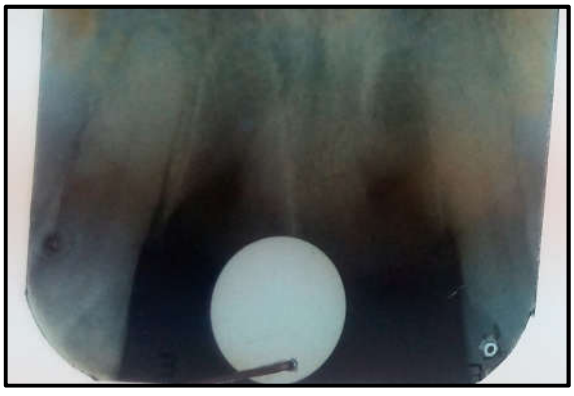


**Fig 5** Radiographic Height At Baseline

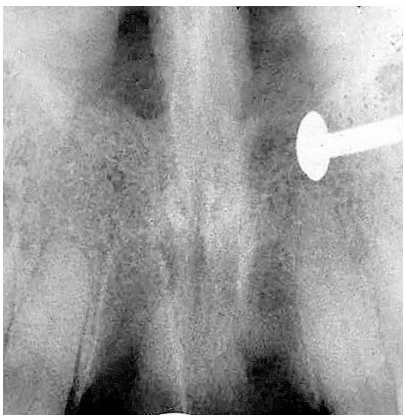


**Fig 6** Grayscale Value Immediately At Baseline

**After 3 Months**

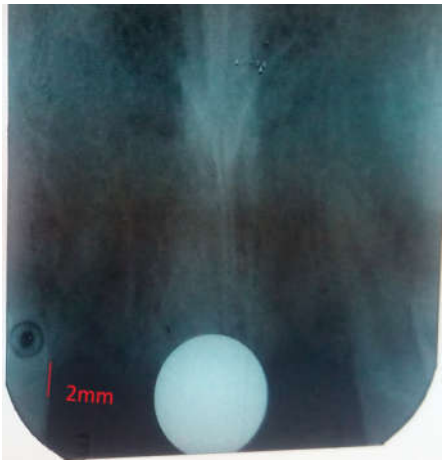



**Fig 7** Radiographic Height At 3 Months

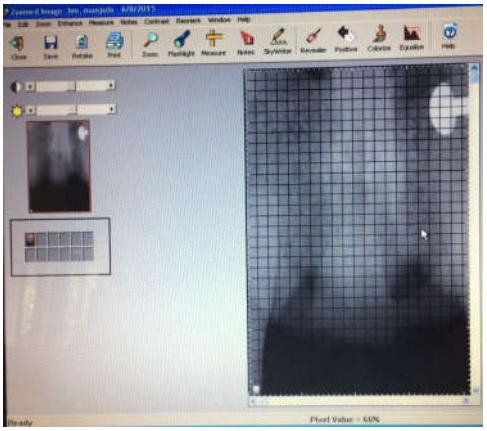


**Fig 8** Gray scale at 3 months

**Fig 9** biopsy harvested from the implant osteotomy site and send for histomorphometry

## RESULTS

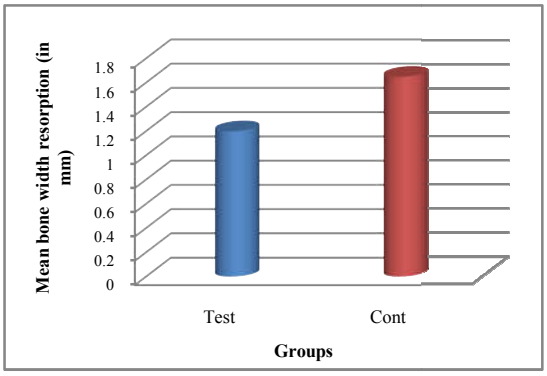
**Table 1** Bone width (in mm)

| Test | | Control | |
|---|---|---|---|
| Baseline | After 3 months | Baseline | After 3 months |
| 7 | 6 | 6 | 5 |
| 7 | 6 | 6 | 5 |
| 6 | 5 | 6.5 | 4 |
| 7 | 6 | 5 | 4 |
| 7 | 5 | 6 | 4 |
| 6 | 5 | 6 | 4 |
| 6 | 5 | 7 | 5.5 |
| 6 | 5 | 6 | 5 |
| 6 | 5 | 7 | 5 |
| 7 | 5 | 7 | 5 |

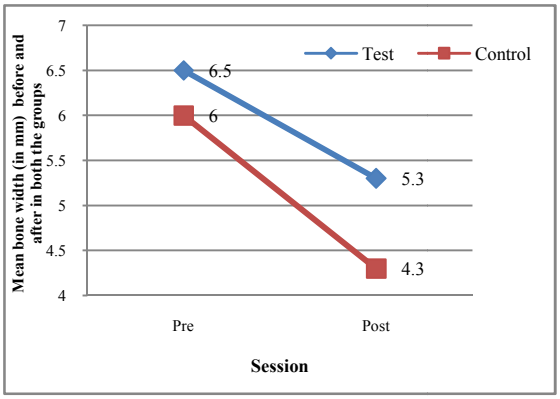
### T-Test

**Group Statistics**

| | GRP | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Mean Bone Width difference within the groups at baseline &after 3 months | Test | 10 | 1.2000 | .42164 | .13333 |
| | Cont | 10 | 1.6500 | .57975 | .18333 |




**Graph 1** Mean diff in bone width at baseline and after 3 months within the 2 groups




**Graph 2** Mean bone width (in mm) before and after in both the groups

**Table 2** Radiodensity in inverted grayscale

| Test | | Control | |
|---|---|---|---|
| Before | After | Before | After |
| 85.6 | 79 | 73.3 | 68.3 |
| 86.6 | 78.6 | 76 | 71.6 |
| 90 | 86 | 87.3 | 82 |
| 88.3 | 78.6 | 93.6 | 80.3 |
| 88.8 | 79.6 | 79.6 | 68.6 |
| 87.6 | 81 | 75.6 | 70.2 |
| 90 | 82 | 90 | 89 |
| 76 | 72 | 75 | 73 |
| 89.8 | 80.1 | 71 | 69 |
| 79.5 | 70.3 | 73.3 | 68.3 |

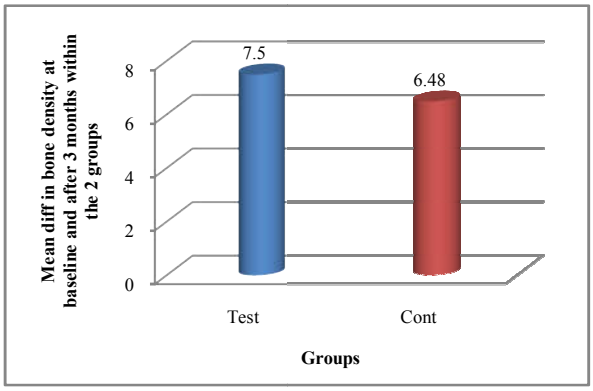
### T-Test

**Group Statistics**

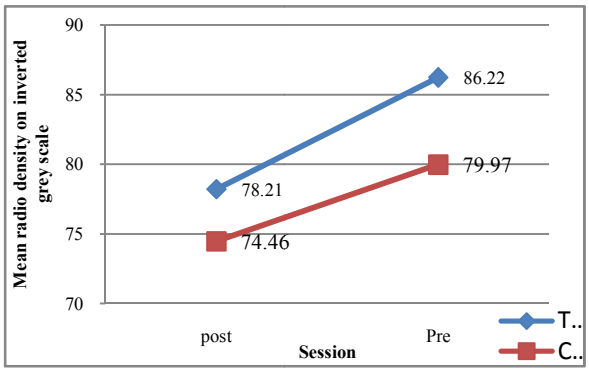
| | GRP | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Bone density difference at baseline and after 3 months within the groups | Test | 10 | 7.5000 | 2.16230 | .68378 |
| | Cont | 10 | 6.4800 | 3.06478 | .96917 |

**Indep Test**

| | | t-test for Equality... | | | |
|---|---|---|---|---|---|
| | | t | df | Sig(2-tailed)... | Mean Difference |
| Bone density | Equal variances ... | .860 | 18 | .401 | 1.0200 |




**Graph 3** Mean diff in bone density at baseline and after 3 months within the 2 groups




**Graph 4** Mean diff in bone density at baseline and after 3 months within the 2 groups

**Table 3** Torque

| Test | Control |
|---|---|
| 25 | 30 |
| 25 | 30 |
| 35 | 30 |
| 30 | 30 |
| 25 | 25 |
| 25 | 30 |
| 25 | 35 |
| 35 | 30 |
| 30 | 35 |
| 25 | 25 |

### Group Statistics

| | GRP | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| TORQUE | Test | 10 | 28.0000 | 4.21637 | 1.33333 |
| | Cont | 10 | 30.0000 | 4.51753 | 1.05409 |

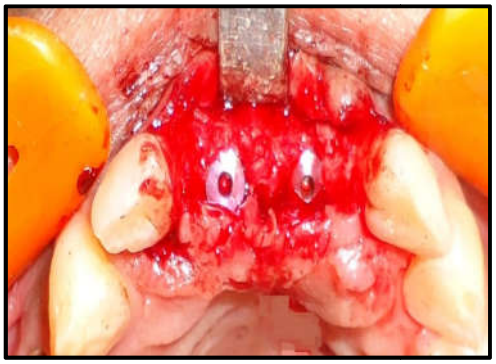


**Fig 10** Implant Placement After 4 Months Of Healing In Test Andcontrol Group

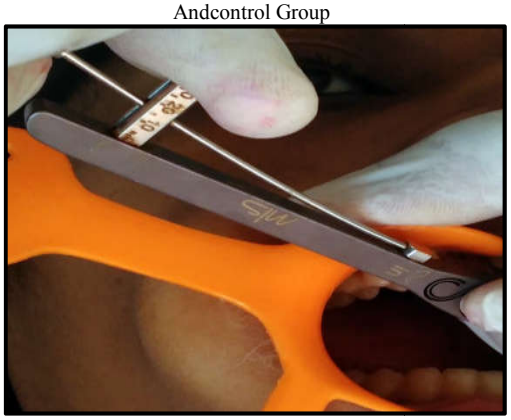
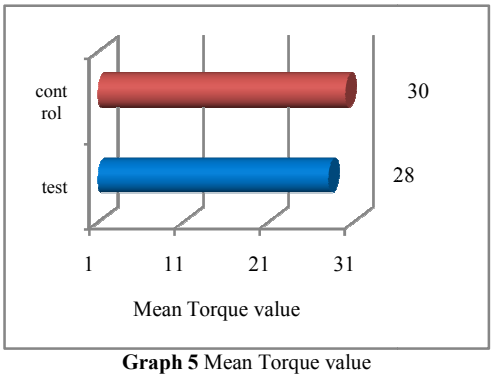


**Fig 11** Measurement Of Final Torque During Implant Placement (25N/SqM Test site & 30N/SqM,on control site)

| Indep Test | | | | | |
|---|---|---|---|---|---|
| | | t-test for Equality... | | | |
| | | t | df | Sig(2tailed)... | Mean Difference |
| Torque | Equal variances ... | 0.264 | 18 | 0.795 | 0.5 |




**Graph 5** Mean Torque value

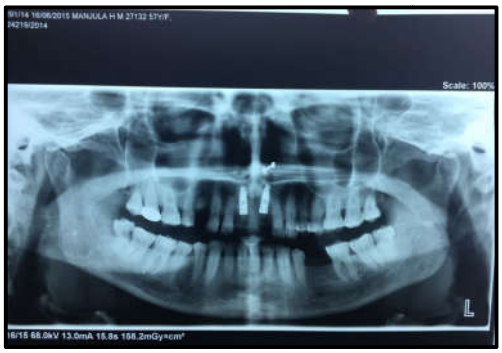


**Fig 12** postop opg to evaluate implant placement

**Table 4** Histomorphometry

| Test | Control |
|---|---|
| 25.3 | 20.33 |
| 13.97 | 19.49 |
| 83.21 | 59 |
| 50.63 | 19.49 |
| 80 | 59 |
| 25.3 | 20.33 |
| 13.97 | 19.49 |
| 83.21 | 59 |
| 50.63 | 20.33 |
| 80 | 19.49 |

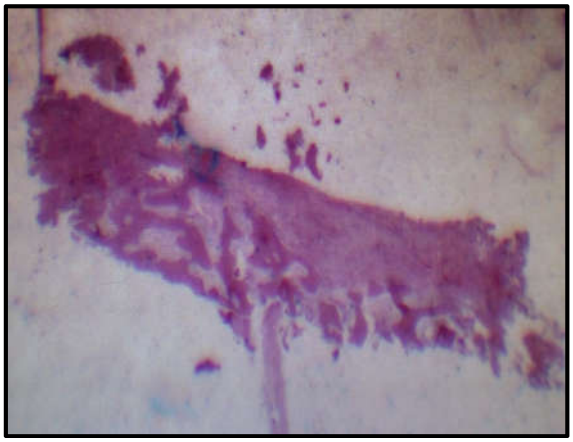


**Fig 13** biopsy of test group (at 10x)

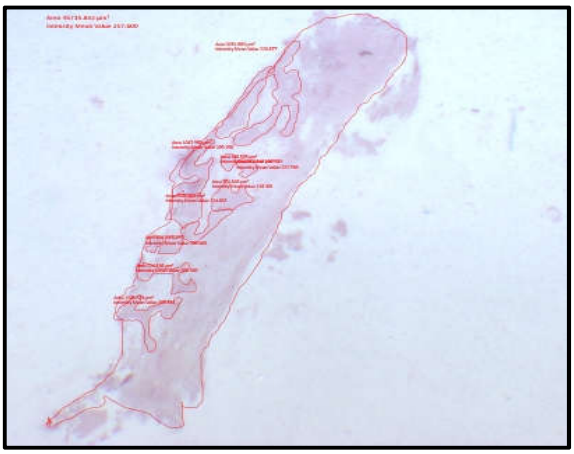


**Fig 14** Histomorphometry of test group

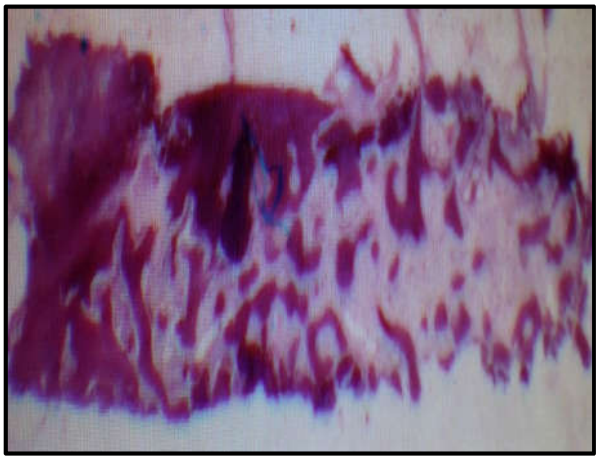


**Fig 15** biopsy of control group (at 10 x) showing few areas of remodelling

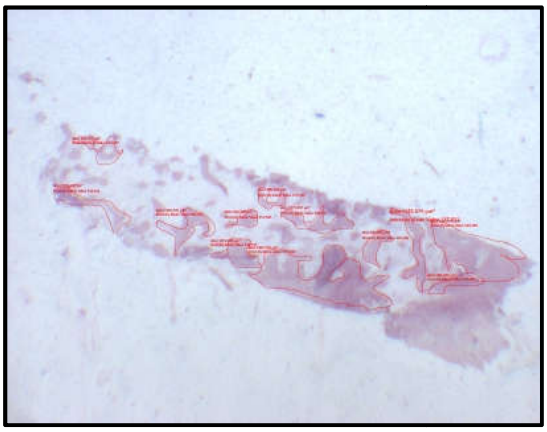


**Fig 16** Histomorphometry of control group

**T-Test**

**Group Statistics**

| | GRP | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Histomorphometry | Test | 10 | 50.6220 | 29.47548 | 9.32096 |
| | Cont | 10 | 31.5950 | 18.91480 | 5.98138 |

**Indep Test ...**

| | | t-test for Equality... | | | |
|---|---|---|---|---|---|
| | | t | df | Sig (2-tailed)... | Mean Difference |
| Histomorphometry | Equal variances . | 1.718 | 18 | .103 | 19.0270 |

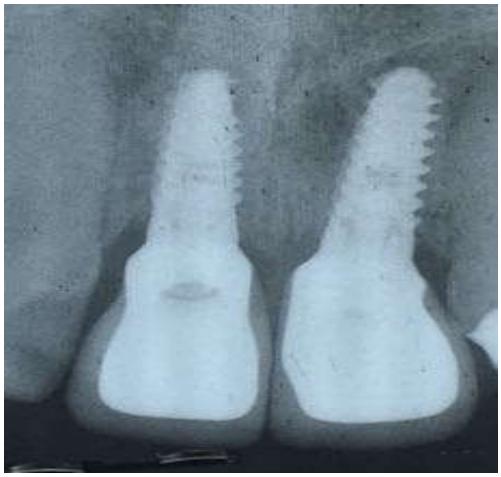


**Fig 17** IOPA of the final prosthesis

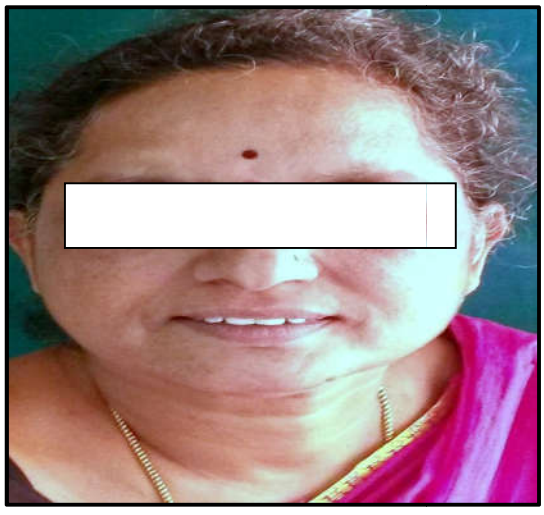
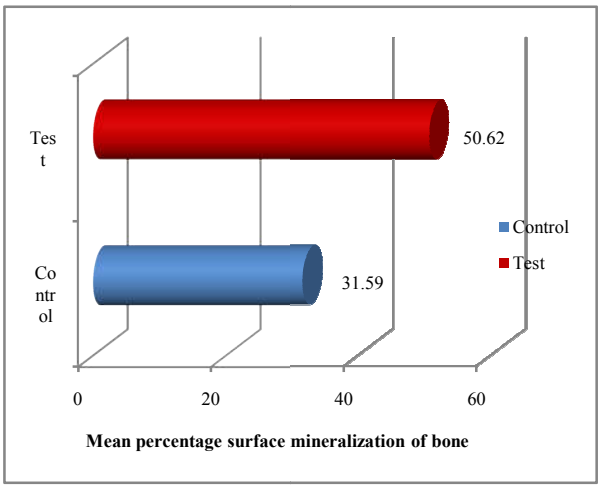


**Fig 18** final prosthesis

## DISCUSSION

In our study we found that the mean post-extraction resorption within the test group was 1.2mm only, while in the control group it was 1.6 mm. This was statistically insignificant (p value 0.063). The mean % resorption after 3 months was 25.6% of its initial width in the control group while in test group it was 18.46 %.This is similar to the study by **Serino *et al*[3]**. The reason behind this was stated that the collagen sponge forms a physical support system in the socket after extraction, and prevents the collapse of the socket walls onto each other and thus helps to preserve the natural dimension of the socket. It acts as a scaffold in the initial




**Graph 6** Histomorphometry showing mean percentage mineralization in two groups

phase of healing, absorbs blood and expands to achieve hemostasis. **Darby *et al*[2]** in his review of materials used for socket preservation states that these collagen space fillers only acts to stabilize the clot and not preserve the ridge per se. But as he also mentions that most of the resorption takes place within the first 3 months after extraction, the utmost importance of preserving the socket dimension in this period cannot be stressed enough. And since the collagen sponge dissolves in way too before this timeline, it is doubtful how much of the ridge can it actually preserve once it resorbs. Bone graft, by itself, should be able to promote bone ingrowth. However, because of the nature of the extraction socket, the majority of bonegrafts may be lost if no protection is provided. Therefore, the use of collagen wound dressing material was suggested not only to protect the graft materials but also induce blood clot formation and stabilize the wound. Our results about the bone width showed that the bone width was better preserved in the socket preservation group than the control, it was although statistically insignificant.(p value=0.063). The difference of results in our study with collagen sponge is different from the one carried out with PGA/PLA as the former is faster resorbing than the latter. **Collagen sponge itself resorbs within 10-14 days[4]**, thus may not be available to prevent any future loss in the ridge width. This could be the reason as to why the difference in the final widths of the test and control is not significant. The literature on the effectiveness of collagen sponge is much needed, as there is little consensus on issues whether:-

1. Does a space filler work, or which space filler works better than the other, and

2. Does adding a platelet derived concentrate make any difference to it?

In the same article **Darby *et al*[2] have described a protocol** with series of questions one must answer to arrive at a decision whether or not socket preservation is warranted in a particular case, and if yes, which material to use. He states that if the implant placement procedure is considered within 6 to 8 weeks of extraction, and if one or more walls of the socket have been lost, then one can use a rapidly resorbing material like collagen sponge or others like calcium sulphate.
If implant placement procedure is later than the 8 week duration, then we can use anorganic bovine bone or bioactive glass.
Results of our study indicate that the final torque while placement of implants is higher in the (control) natural healing group than the socket preservation (test) group. This suggests that the quality of bone in the natural group is superior to the one in test group. Average torque for test group is 28N/sqm, and for control it was 30N/sqm, but however, it was statistically insignificant. Radiodensity measured in both the groups with grey scale value immediately after extraction and at an interval of a minimum 3 months after extraction and socket preservation. The difference in final radio densities however, was not significant. Here, the mean increase within test group (7.6) may be more than the difference within the control group(5.483) again, leading to the fact that test sockets had more bone formation than the control group.

***Link Between Radiodensities And Torque***

was described by **Johansson *et al*[5]** in his study compared radio densities of grafted and non graftedmaxillas after sinus lifts with natural healing and resorbable membrane with computed tomography. No significant differences were found between the 2 groups in terms of new bone density preoperatively, neither at 1 week or 3 months postoperatively. However, the density of bone in the nongrafted group was higher than that in the grafted group 6 months after surgery. This could be one of the reasons as we had measured the radiodensities not more than a gap of 4 months where the differences in test and control group radiodensities seem to be insignificant in the initial stages of healing.(p value =0.401) Our findings in HISTOMORPHOMETRY are similar to those described in a study done by **Serino *et al*[3]** for socket preservation with polylactide and polyglycolide space filler. The test site showed an average of 50.42% of bone formation with maximum of 83.21% and minimum of 13.97%, while the control group showed an average of 31.59%, maximum being 20.33%. This difference was not statistically significant though (p value 0.103). The test sites showed numerous osteoblasts with interposing connective tissue. Quality of bone was woven in 50% of the biopsies and lamellar in remaining 50 %. The control group on the other hand, showed less number of osteoblasts and narrow marrow spaces. Quality of bone was lamellar in all of the control biopsies. Degree of remodelling was found to be more in the test group than the control group, probably because the bone was still actively forming whereas the control has already completed bone formation. No graft material residue was found in the biopsies.

The result that the final implant torque value is less in test group despite having more surface area mineralisation than the control group is supported by many studies. The authors measured torque in grafted versus non-grafted maxillary sites and reported higher torque values in non-grafted maxillas than in the grafted maxillas. This could be explained by the fact that collapsed bone walls increase the density of bone within, and the result is denser bone with higher torque value. While on the other hand the socket preservation prevents this collapse. Another study[6] had compared collagen sponge and xenogenic bone graft combination with natural healing for socket preservation.They measured resorption rate of the width of alveolar bone 3 mm below the alveolar ridge of the control group and they observed it to be 20.74% and of the experimental group was an mean of 14.26%, approximately a difference of 6% was observed, which was statistically significant. New bone formation in the vicinity of bone graft materials was achieved well, and inflammation findings were not observed. The authors concluded that in ridge preservation using collagen sponge and xenograft, xenograft prevents the horizontal resorption of the alveolar ridge, and the upper collagen sponge blocks the infiltration of soft tissues to the lower area, and thus it has the advantage of the enhancement of bone fill.

One more similar study[7] to ours was found comparing rhBMP-2 in varying concentrations with collagen sponge for socket augmentation. They compared two different concentrations of the rhBMP-2 (0.75mg/ml and 1.5mg/ml) with absorbable collagen sponge, another group with collagen sponge alone (placebo) and another co as natural healing sockets without any preservation as control group. The results showed that augmentation was significantly greater in the test group with a higher concentration of rhBMP-2.No differences in bone density measured by a CT scan and histology were found between newly formed and native bone.The stated that only partial healing was seen in the placebo group

## CONCLUSION

From our study, we concluded the combination of a platelet concentrate like PRF membrane with a simple space filler like collagen sponge is not statistically better in preserving the dimensions compared to natural healing of a socket. However it cannot be denied that the individual bone width values in sockets that have undergone preservation procedure are still more than that obtained without any preservation, though statistically non significant. This could be clinically important while placing an implant and varies from case to case.. Addition of PRF membrane to a space filler does not help ridge preservation after a limited 3-4 months of waiting period which was done in our study. Our study was limited by its small sample size, and more studies in future would be necessary to improve our understanding of how socket preservation works. The hypothesis that PRF membrane induced growth factors would stimulate enough bone formation alongside a simple space filler like collagen sponge doesn't appear to give statistically significant bone preservation. To effectively preserve the socket dimension one needs to have materials with osteoinductive or osteoconductive properties inside the socket while which lasts long enough to be replaced by the de novo osteoid matrix.

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