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RESEARCH ARTICLE

COMPARISON BETWEEN HYDROXYAPATITE BONE GRAFT AND PLATELET-RICH FIBRIN IN THE PREVENTION OF PERIODONTAL DEFECTS ON THE DISTAL ASPECT OF MANDIBULAR SECOND MOLARS AFTER SURGICAL REMOVAL OF IMPACTED MANDIBULAR THIRD MOLAR: A SPLIT MOUTH STUDY

Asish Kumar Das[1], Subhasish Burman[2], Abhijit Maji[3], Inam Uddin[3], Purbalee Barman[4], Swagatam Samanta[4] and Moumita Ghosh[4]

1. Prof and Head, Dept. of Oral and Maxillofacial Surgery, Dr. R. Ahmed Dental College and Hospital.
2. Profressor Department of Oral and Maxillofacial Surgery, Dr. R. Ahmed Dental College and Hospital.
3. Assistant Professor, Department of Oral and Maxillofacial Surgery, Dr. R. Ahmed Dental College and Hospital.
4. PGT,Department of Oral And Maxillofacial Surgery, Dr R Ahmed Dental College and Hospital,Kolkata.

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Abstract

Background: Surgical removal of impacted mandibular third molars often results in periodontal defects on the distal surface of the adjacent second molar. These defects may lead to deep periodontal pockets, bone loss, pain, and inflammation. Different graft materials have been used to prevent such complications. Among them, hydroxyapatite (HA) and platelet-rich fibrin (PRF) are commonly employed.

Aim: To compare the effectiveness of hydroxyapatite bone graft and platelet-rich fibrin in preventing periodontal defects on the distal aspect of mandibular second molars following surgical extraction of impacted mandibular third molars.

Materials and Methods: This prospective comparative study included patients requiring surgical removal of impacted mandibular third molar s. After extraction, one of the sockets were managed with hydroxyapati te graft and another one with platelet-rich fibrin. Clinical parameters such as pain, swelling and periodontal pocket depth distal to the second molar were assessed postoperatively. Radiographic evaluation was carried out to assess bone healing.

Results: Sites treated with PRF showed reduced postoperative pain and swelling, faster soft tissue healing, and better periodontal health on the distal aspect of the second molar and also radiographic bone formation.

Conclusion: PRF is more effective in reduction of pain and swelling and hydroxyapatite was better in preventing periodontal defects distal to mandibular second molars after third molar surgery.

Corresponding Author:-Asish Kumar Das
Address:-Prof and Head, Dept. of Oral and Maxillofacial Surgery, Dr. R. Ahmed Dental College and Hospital.

Introduction:-

Impacted mandibular third molars are frequently encountered in oral and maxillofacial practice and often require surgical removal [1]. Although the procedure is routine, it is commonly associated with postoperative complications such as pain, swelling, and periodontal defects on the distal surface of the mandibular second molar[2,3,4]. The bone defect created after third molar removal can lead to periodontal pocket formation, plaque accumulation, and long-term periodontal breakdown if left untreated[4].Various techniques have been proposed to prevent these defects, including socket grafting and guided tissue regeneration [5]. The use of graft materials helps preserve the extraction socket, supports bone regeneration, and reduces soft tissue collapse. Hydroxyapatite is a synthetic bone substitute that closely resembles the mineral phase of bone and is widely used due to its osteoconductive properties [6].Platelet-rich fibrin is an autologous biomaterial obtained from the patient‘s blood. It contains a fibrin matrix rich in platelets, leukocytes, and growth factors, which are gradually released and enhance wound healing and tissue regeneration. PRF has gained popularity due to its biocompatibility, and positive influence on both soft tissue and periodontal healing.[7]The present study aims to compare hydroxyapatite and platelet-rich fibrin in preventing periodontal defects on the distal aspect of mandibular second molars following surgical extraction of impacted mandibular third molars.

Materials and Methods:-

This study was conducted on 20 patients indicated for surgical removal of impacted mandibular third molars bilaterally. Patients were selected based on predefined inclusion and exclusion criteria and provided informed consent prior to participation.The procedure was carried out after thorough clinical and radiological assessment using OPG (orthopantomogram) [Fig. 1]. Standard aseptic procedures was followed for all patients and the third molars of both the sides were extracted. Haemostasis was achieved and the sockets were thoroughly debrided and irrigated with normal saline solution following removal of follicular remnants.

After extraction and thorough irrigation of both the sockets, one socket was filled with hydroxyapatite, which was considered as Group A and another socket was filled with PRF, which was considered as Group B:

• Group A (HA group): One side of the extraction socket was filled with hydroxyapatite granules,covered with collagen membrane andsutured. [Fig. 2,3]

• Group B (PRF group): Another side of the extraction sockets were filled with autologous platelet-rich fibrin, covered with collagen membrane and sutured. [Fig. 4,5]

Graft material:

The graft material which will be used in this study will be G-bone, a synthetic hydroxyapatite crystals in the form of granules of 1cc pack and particle size of 0.4-0.9mm in average.

Preparation of PRF:

Collection of blood- Under all aseptic condition, 20 ml of blood will be withdrawn from patient‘s vein. The blood will be placed in plastic vacutainers. Preparation of Platelet Rich Fibrin- The vacutainers then will be placed in a centrifuge machine and counterbalanced. Then it will be centrifuged at 3000 rpm for 10 minutes. A Buffy coat will be obtained in the middle of the tube, just between the red corpuscles at the bottom and acellular plasma at the top. Then the buffy coat or the fibrin clot will be picked up with a sterile tweezer or sinus forcep and will be separated from the red bottom part with a sterile scissor and this is the Platelet Rich Fibrin we will obtain.Postoperative evaluation included assessment of pain, swelling, soft tissue healing, and periodontal probing depth on the distal aspect of the second molar at different follow-up intervals. Radiographic examination was carried out to assess bone healing in CBCT(cone beam computed tomography) [Fig 6] measuring bone density unit.

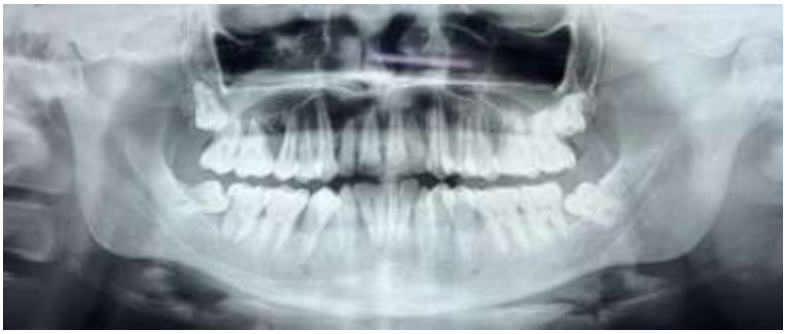

Fig. 1: pre-operative orthopantomogram of patient

Fig. 2: Hydroxyapatite Boone graft placed in the extraction socket of left lower molar

Fig. 3: Collagen membrane placed over bone graft

Fig. 4: PRF placed in the extraction socket of right lower molar

Fig. 5: Collagen membrane placed over PRF

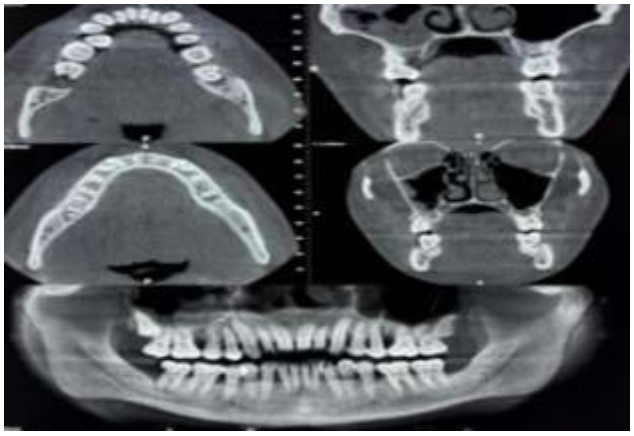

Fig. 6: post-operative cone beam computed tomography of patient at 6th month

Postoperative swelling and edemameasured with measuring tape based on the modification of three line measurement using five fixed points on surgical side of the face [Fig. 7]:-

1: Horizontal line joining the outer corner of the mouth to the midline of the tragus of the ear lobe (a)
2: Horizontal line joining the pogonium to the midline of the tragus of the ear lobe (b)
3: Vertical line joining the outer canthus of the eye and point on mandibular angle (c).

Fig. 7: swelling measurement was done using 3 lines

Results:-

Patients treated with platelet-rich fibrin showed reduced postoperative pain and swelling compared to those treated with hydroxyapatite. Soft tissue healing was faster and more satisfactory in the PRF group, with healthier gingival margins and minimal inflammation.Periodontal probing depth on the distal surface of the second molar was significantly lower in the hydroxyapatite group, indicating better prevention of periodontal pocket formation. Radiographic evaluation showed that hydroxyapatite sites demonstrated higher bone density, particularly at later follow-up periods.The collected data was tabulated in a spreadsheet using Microsoft Excel 2024 and then statistical analysis was carried out using the GraphPad Prism for Windows, Version 10.1.2 (GraphPad Software, La Jolla California USA). A Shapiro-Wilk's test and a visual inspection of the histograms, standard Q-Q plots, and box plots showed that the collected data were approximately normally distributed for all the outcome variables except Wound Healing scores, due to ordinal nature of the scores. Descriptive statistics were used to report the quantitative variables in terms of mean/median (central tendency) and Standard deviation/inter-quartile range (measures of dispersion) and the categorical variables in terms of Frequencies and percentages. Both Parametric and non-parametric tests were carried out for inferential statistics. Two-way Repeated Measures Analysis of Variance (ANOVA) with post hoc Fishers 'LSD test or Wilcoxon's test were employed for both intra and inter-group comparisons, owing to a split-mouth study design.

Pain:

Time Points	n	Hydroxyapatite	PRF
3rd Day	20	3.4±0.99	3.1±1.25
7th Day	20	1.1±1.33	1.1±1.17
14th Day	20	0.1±0.31	0.05±0.22

Table 1: Mean(±standard deviation) and comparative analysis of VAS pain scores: intragroup time point changes and intergroup differences

At the 3rd day, the mean VAS pain score was 3.40 ±0.99 in the Hydroxyapatite group and 3.10 ±1.25 in the PRF group. The inter-group comparison at this time point showed no statistically significant difference between the two groups (P= 0.52).By the 7th day, pain scores had markedly reduced in both groups, with mean values of 1.10 ±1.33 in the Hydroxyapatite group and 1.10 ±1.17 in the PRF group. The inter-group difference remained non-significant, indicating comparable pain reduction patterns between the treatment modalities.On the 14th day, further reduction in pain was observed, with mean VAS scores of 0.10 ±0.31 in the Hydroxyapatite group and 0.05 ±0.22 in the PRF group. The minimal difference between the groups continued to be statistically non-significant, confirming similar late-phase pain outcomes.

Swelling:

Time Points	n	Hydroxyapatite	PRF
3rd Day	20	11.41±0.57	11.3±0.57
7th Day	20	10.95±0.61	10.89±0.6
14th Day	20	10.85±0.58	10.84±0.59

Table 2: Descriptive statistics and comparative analysis of swelling (tragus–mouth corner distance) [cm]: intra-group time point changes and inter-group differences

Time Points	n	Hydroxyapatite	PRF
3rd Day	20	14.46±0.41	14.38±0.45
7th Day	20	14.02±0.52	13.97±0.51
14th Day	20	13.94±0.52	13.93±0.52

Table 3: Descriptive statistics and comparative analysis of swelling (tragus– pogonion distance) [cm]: intra-group time point changes and inter-group differences

Time Points	n	Hydroxyapatite	PRF
3rd Day	20	10.61±0.5	10.51±0.51
7th Day	20	10.21±0.52	10.14±0.53
14th Day	20	10.12±0.51	10.08±0.53

Table 4: Descriptive statistics and comparative analysis of swelling (Outer canthus of eye–mandibular angle distance) [cm]: intra-group time point changes and inter-group differences

Within-group comparisons demonstrated a significant decline in swelling over time for both study groups. Pairwise analysis showed that swelling at the 3rd day was significantly higher than at the 7th day and the 14th day in the Hydroxyapatite group (mean differences: 0.465 and 0.560, respectively; P= 0.0136 and 0.0031). Similarly, in the PRF group, swelling at the 3rd day was significantly higher than at both the 7th day and the 14th day (mean differences: 0.410 and 0.465, respectively; P= 0.0291 and 0.0136). The reduction in swelling between the 7th day and 14th day was minimal and did not reach statistical significance in either the Hydroxyapatite group (mean difference: 0.095; P= 0.6096) or the PRF group (mean difference: 0.055; P= 0.7674).

Time Points	n	PRF	Hydroxyapatite
2nd month	20	166.6±49.45	187.2±53.9
4th month	20	407.4±52.51	438.5±59.99
6th month	20	562.3±51.17	628.25±63.94

Table 5:Descriptive statistics and comparative analysis of Bone formation (Bone density units): intra-group time point changes and inter-group differences

At the 2nd month, the mean bone density was 166.6 ±49.45 units in the PRF group and 187.2 ±53.9 units in the PRF group. Although higher mean values were observed in the Hydroxyapatite group, the inter-group difference at this time point was not statistically significant (P= 0.2421).By the 4th month, a marked increase in bone density was noted in both groups, with mean values of 407.4 ±52.51 units in the PRF group and 438.5 ±59.99 units in the Hydroxyapatite group. The inter-group comparison at this follow-up also did not reach statistical significance (P= 0.0785).At the 6th month, further bone formation was evident in both groups, with the PRF group showing a mean bone density of 562.3 ±51.17 units and the Hydroxyapatite group demonstrating a higher mean value of 628.25 ± 63.94 units. At this time point, the inter-group difference was statistically significant (P= 0.0003), indicating greater bone formation in the PRF group.

Time Points	n	Hydroxyapatite	PRF
3rd month	20	2.17±0.2	2.26±0.22
6th month	20	1.94±0.21	1.97±0.18
P value‡		0.0008*	<0.0001*

Table 6: Mean(±standard deviation) and comparative analysis of Probing depth (mm): intragroup time point changes and intergroup differences

At the 3rd month, the mean probing depth was 2.17 ±0.20 mm in the Hydroxyapatite group and 2.26 ±0.22 mm in the PRF group. The inter-group comparison at this time point showed no statistically significant difference between the two groups (P= 0.17).By the 6th month, a reduction in probing depth was observed in both groups, with mean values of 1.94 ±0.21 mm in the Hydroxyapatite group and 1.97 ±0.18 mm in the PRF group. The inter-group difference at this follow-up remained non-significant.Two-way repeated measures analysis demonstrated a

statistically significant time effect (P<0.0001), indicating a significant reduction in probing depth over time in both treatment groups. However, the treatment effect was not statistically significant (P= 0.17), suggesting comparable probing depth outcomes between the Hydroxyapatite and PRF groups.

Discussion:-

Periodontal defects distal to mandibular second molars are a well-documented complication following impacted third molar removal. Socket grafting plays a crucial role in preventing these defects by maintaining space and supporting tissue regeneration [8,9].Hydroxyapatite is known for its osteoconductive nature and ability to support bone formation. However, it is biologically inert and does not actively promote soft tissue healing.Porous hydroxyapatite granules permits the growth of osteogenic cells from existing bone surfaces into adjacent bone graft material and showed a tendency to maintain socket width better, reflecting its structural role as a space-maintaining graft[10,11].Platelet-rich fibrin, on the other hand, releases growth factors such as platelet-derived growth factor and transforming growth factor-β over a prolonged period. These factors enhance angiogenesis, fibroblast proliferation, and epithelial regeneration, resulting in improved soft tissue healing and reduced inflammation. The fibrin matrix also acts as a natural scaffold, stabilizing the blood clot and protecting the extraction site [12,13].The findings of this study suggest that sites treated with PRF showed reduced postoperative pain and swelling, faster soft tissue healing, and better periodontal health on the distal aspect of the second molar and also radiographic bone formation.

Conclusion:-

In this study, hydroxyapatite was found to be more effective in preventing periodontal defects on the distal aspect of mandibular second molars following surgical removal of impacted third molars. PRF offers better soft tissue healing, reduced postoperative discomfort, pain and swelling. Both hydroxyapatite and PRF is good choice for preventing pocket formation distal to second molar after surgical removal of third molar.

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