POP : BINDER FOR RECONSTRUCTION

Dr. Jinendra Jain
Reader
Dr. Gokkulakrishnan
Reader
Department of OMFS, Kothiwal Dental College & Research Centre, Moradabad.

Dr. Sridhar Kannan
Reader
Department of Orthodontics, Kothiwal Dental College & Research Centre, Moradabad.

Dr. Ashish Kumar Shahi
PG Student
Department of OMFS, Kothiwal Dental College & Research Centre, Moradabad

Introduction

Jaw defect can develop as result of surgery, trauma, infection or congenital malformation. The aim of replacing osseous structure are preservation of morphologic contour, restoration of mechanical strength function, & elimination of dead space and thus promote healing and prevent in-growth of soft tissue. The surgical removal of impacted mandibular third molar is one of the most frequently performed minor oral surgical procedure. The defect caused by such surgery often results in dry socket, infection and periodontal problems. The wound also undergoes secondary healing. To overcome these adverse effect, various implant material like antibiotics supplemented bone allografts (ASBA), and antibiotics with hydroxyapatite (drug delivery system) have been used to fill the above defect, with encouraging result. In the present study, natural hydroxyapatite in granular form was mixed with plaster of paris to fill in bony defects resulting from surgical removal of impacted third molar.. The plaster serves as a binder that holds the hydroxyapatite granules together and provides an effective delivery system. The aim of study is to :

Materials and Methods

This study was done to evaluate post-operative wound healing of sockets in 40 patients with bilateral symmetrically impacted mandibular third molar teeth which were extracted and on one side the bony socket was filled with Hydroxyapatite mixed with plaster of paris and the other side served as a control. The aim of the study- To assess the efficacy of the material in regeneration of bone by osteoconduction, Compatibility of the material with the host tissue, Decreasing the intrabony defect distal to second molar, To achieve primary healing.

The graft material used was.

Calcium hydroxyapatite NATGRAFT

Calcium sulphate hemihydrates (plaster of paris)

Material selected had-

No antigenicity or antibody reaction, Bio-resorbable, Cleared by American society for testing material F1185-88; confirm to ASTM specification.

In this study the Natural hydroxyapatite (Natgraft) has been used in its granular form. The hydroxyapatite granules are white in colour, measuring 1-2 mm in size with porosity of 300-500 microns. It is packed in 500mg capsule and sterilized by gamma radiation of 2.5 mega rads for 60 hours. Its chemical and physical parameters are identical to that of human bone. It is elastic just as natural bone and as it resorbs it acts as a mineral reservoir which induces new bone formation via osteoconduction mechanism. Gypsum is a common mineral consisting of calcium sulphate dyhydrate. Plaster of paris is a hemihydrate of Gypsum. It is manufactured by heating gypsum at temperature of 110-130 degree centigrade in such a way it loses three quarters of water to form calcium sulphate hemihydrates which solidifies when mixed with water. This material was packed into small sachets of 250mg which was gas sterilized with ethylene oxide for 48 hours.

In the present study 40 cases of both sexes with symmetrical bilateral impacted mandibular third in molar the age group of 20-35 years was selected. Clinically all cases were free of any infection and radiographs were taken to assess the type of impaction, position, depth and presence or absence bony defect distal to second molar. Oral prophylaxis was done before carrying out surgical procedure. Half an hour before surgery the patient was asked to rinse the mouth with 0.2% chlorhexidine mouth wash. Surgical procedure was planned for removal of bilaterally impacted third molar in a single sitting. After part preparation and local anaesthesia a modified ward incision was placed and mucoperiosteal flap was gently reflected away from the tooth. Using a straight fissure bur gutter was created with minimal amount of bone removal on mesial and distal aspect of the tooth. Odentectomy was done where required and the tooth was elevated from the socket. The socket was carefully examined and any remanant follicular tissue was curreted out of the socket. Following wound toilet the wound was primarely closed with 3-0 mersilk on the control side and hydroxyapatite granules mixed with Palster of Paris(2:1) using saline was placed into the extracted socket in contact with surrounding bone till the level of alveolar creast without any compression of the mixture. The flap was then approximated and suture with 3-0 silk.

Figure 1. Natgraft Granules placed in the 3rd molar socket

Figure 2.Mucoperiosteal flap approximated and sutures placed

Routine post operative instruction was given. Patient was covered with antibiotics and analgesic for period of 5 days. Post operatively the wound site was clinically examined on the 1st day and then every week, for period of 4 weeks. The pressure of edema and any sign of wound dehiscence or extrusion of material was observed. The sutures were removed after 1 week. Intra-oral periapical radiograph were taken immediate post operatively, and then on, at the end of 1st week, 2nd week. 4th week and 8th week of surgery. The radiographs were taken under standardized condition to obtain an optimal film density and contrast.

Results

The Post-operative evaluation of all the patients was done for a period of 8 weeks starting from the day of operation. Out of 40 patients 34 patients came for regular follow-up, with a dropout of 6 patients, who failed to come for regular check-up. The evaluation was done under two categories, Clinical Evaluation and Radiogra phic Evaluation. Clinical Evaluation consisted of (a) Edema and post-operative pain (b) infection (c) Gaping of wound.

Edema: In all the 34 patients mild to moderate swelling was observed on the implant side, first day post operatively, while on the control side, moderate swelling to no swelling was observed. After 1 week mild swelling was observed in 12 patients on the implant side and 4 patients on the control side. At the end of 2nd week mild swelling still persisted in 2 patients on the implant side while in 4 patients on the control side. By the end of 3rdweek no swelling was seen on implant as well as control side in all the patients.

Pain: On the first post-operative day pain on the implant side, varied ftom 1 to 8, while on the control side, it ranged ftom 0 to 4, as measured on visual analogue scale. In all the patients, the pain reduced to the score ranging ftom 0 to 2 in the first post-operative week. At the end of 2nd week, on the implant side pain score of 1 was present in 2 patients, while on control side, same score was present in 4 patients. In the following weeks the pain reduced to '0' on both sides.

Gaping of wound: After 1 week gaping of wound was observed in 10 patients at implant side as compared,to 30 patients on the control side.

Infection: Name of the patients had any infection

Radiographic Evaluation: Post-operative I.O.P.A. radiographs of implant and control sides were taken at regular intervals:-

Immediate post-operative - 1stweek - 2ndweek - 4th week - 8th week

Immediate post-operative radiographs of the implant side showed radiopaque material within the socket. Whereas a large radiolucent area, were seen on control side indicative of empty socket. The first and second week radiographs of the implant side showed decrease in the density of the material indicating resorption of graft material. However on control side it was radiolucent area of the empty socket. The fourth and the eighth week radiographs showed a diffused radiopaque area in the socket with reduction in the volume of the material, indicating progressive resorption of the graft material. The control side showed mixed radiopaque and radiolucent areas within the socket. All the radiographs were superimposed with a millimeter grid and quantitative/volumetric analysis was carried out. The "Mean Difference" and "Standard Deviation" was calculated to determine the range and amount of variation in the study conducted. The "Paired t test" was done for the comparison of two different groups (the implant side and the control side) at different stages and to test its significance under the guidance of statistician.

Bone heights mearusements were made to assess

intrabony defects distal to second molar by drawing a parallel line distally from the occlusal surface of the second molar (occlusal line). A second line was drawn perpendicular to the occlusal line, inferior and adjacent to the second molar, in contact with socket bone height next to the distal root surface of 2nd molar (PL). The length of PL represented from the occlusal line to the height of socket bone, adjacent to the distal root surface of the second molar.(Fig. 8)

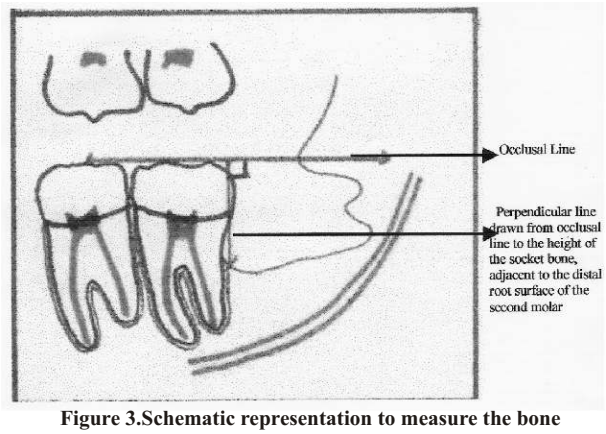


Figure 3.Schematic representation to measure the bone height distal to 2nd molar tooth

On the implant side, the amount of material degradation at 1st week, 2nd week, 4th week and 8th week was found to be 15.941±12.59, 24.647±13.72, 38.471±17.82, 51.765±21.95 mm respectively and all were found to be significant (p 0.05).

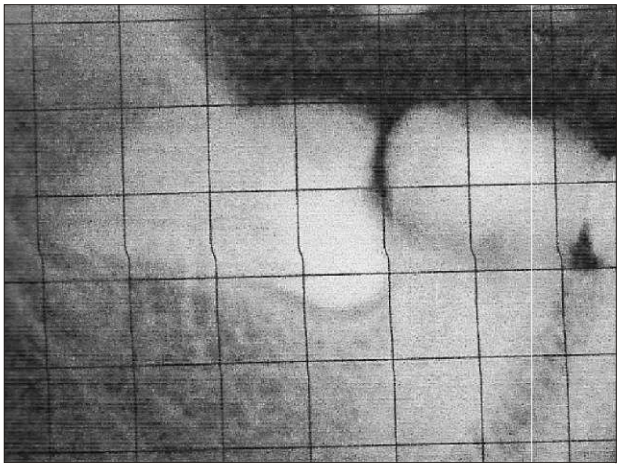


Figure 4. Preoperative Horizontal Impaction

On the control side, the amount of bone formation at the end of 1st week and 2nd week was 3.471±2.154 and 8.882±6.143mm respectively and was found to be significant. At the end of 4th and 8th week there was gradual increase in the amount of bone formation by 29.111±9.08, 41.000±12.247 mm and both were significant(p0.05).

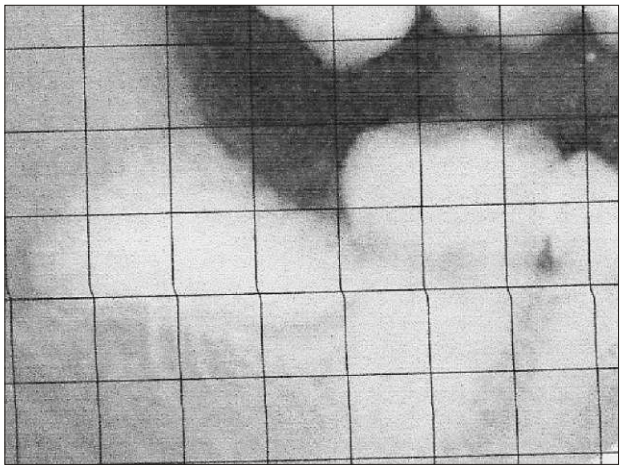


Figure 5. Immediate postoperative after graft placement

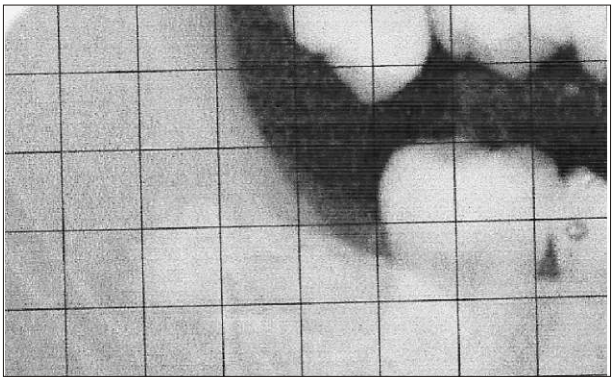


Figure 6. Postoperative 8th week

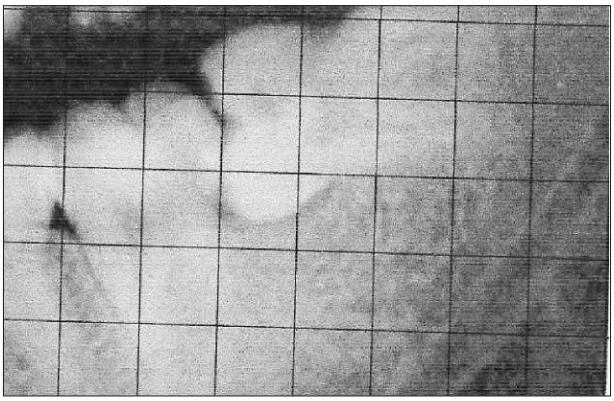


Figure 7. Preoperative Horizontal Impaction

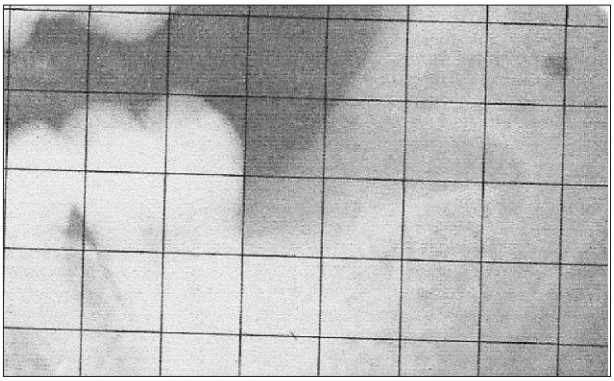


Figure 8. Immediate postoperative

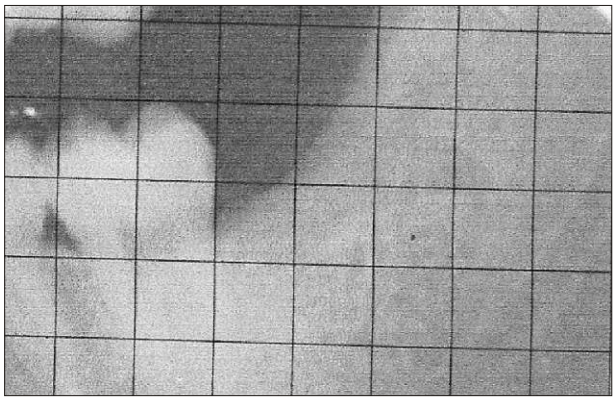


Figure 9. Postoperative 8th week

The amount of material degradation following bone formation on the implant side was compared with amount of bone formation on the control side at 1st week,2nd week ,4th week and 8th week. At all 4 points of time, the bone formation on implant side was more when compared to control side and this difference was statistically significant.

The height of the alveolar crest distal to second molar from occlusal line (PL) was 5.529 mm on the implant side and 7.353 mm on the control side indicating an increase in height of alveolar crest by 2.294mm(PL difference) on the implant side. Similarly after 8 weeks the height of alveolar crest was found to be 1.941mm more on the implant side and the difference was ststistically significant (p<O.O5).

Discussion

Experimental and clinical studies using Hydroxy-apatite derived from various sources and Plaster of paris in reconstructive procedures in Oral and Maxillofacial defects have been carried out previously. But Natural Hydroxyapatite and Plaster of Paris combination have not been used much and its application in extracted third molar sockets has not been previously studied.Hydroxyapatite implant materials are biocompatible, bioresorbable and osteoconductive, when placed next to viable bone, an advancing front of new bone grows into the porous matrix as concluded by Michael Jarcho [1] in 1986. Plaster of Paris is rapidly resorbable and biocompatible material. Previous studies where Hydroxyapatite granules were used to treat various bony defects and alveolar ridge augmentation have shown migration of graft material in the absence of a binder. The plaster serves as a matrix that holds ,the Hydroxyapatite granules together when mixed with saline. This is one of the rationales for employing Plaster of Paris in this study. On the first postoperative day, the swelling and pain on the implant side was more as compared to the control side. At the end of two weeks, mild swelling still persisted in 2 patients on the implant side. The pain score was also more on the implant side. The initial increased in swelling on the implant side could be because calcium sulfate when mixed with 0.09% NaCI has a pH of 6.8 as compared to normal extracellular fluid which has a pH of 7.4 . This is the acid phase which lasts upto 10 days. At about 10thday this acid phase is replaced by alkaline phase with rapid absorption of calcium sulfate and simultaneous formation of homogenous osteoid matrix as explained by Andries.S.Coetzee [2] in 1980. In another study, Bahn.S.L.[3] in 1966, concluded that during the early stages of bone repair, healing was inhibited by the presence of solidified plaster against the margins of the defects. After the initial period of 4 to 6 days, the tissue fluid in the area begun marginal resorption of the plaster mass and then osseous regeneration was accelerated. Moller and Peterson [4] in 1988, carried out a study where impacted sockets were filled with fibrin sealant and the other side was conventionally treated. They did not find any difference in pain and swellipg between the two groups. We also found that the degree of pain and swelling was dependent on the difficulty of impaction which is in correlation with the findings by Abel Garcia [5] in 1991 after removal of impacted third molar teeth. In an earlier experimental study, carried out by Geist C.E. [6] in 1991 who performed orbital augmentation with Hydroxyapatite and Plaster of Paris composite in rabbits, found minimal inflammatory reaction in early period which resolved in 2 months. Patients were assessed for the presence of infection as seen in the form of edematous swelling and discharge of exudate. In our study, none of the patients had infection in the follow up period either on the implant or the control side. On the contrary, study by Nicholas.G.Georgiade [7] (1993) showed that the use of this composite in 5 of 24 patients with facial"defects had infection and 1 patient had to have a portion of the implant removed because of persistent drainage. In another study carried out by Su-Gwan and Kim [8] in 1999, this composite graft material used in 10 patients with jaw defects of odontogenic cyst & they found that 2 patients had an intraoral perforation of the wound and I patient had infection which was treated with incision and drainage.

Gaping of wound was noted in 10 patients on the implant side and 30 patients on the control side. This

gaping on the implant side was seen in cases of horizontal and mesioangular impactions. Su-Gwan and Kim [8] (1999), in their study where cystic defects of the jaw were treated with this composite material noted gaping of wound in 3 patients In earlier studies carried out by Arnold.B. (9) in 1993 to augment alveolar ridge had problems with displacement of the Hydoxyapatite particles into the sulcus. But in our study we did not have migration of Hydroxyapatite particles because of Plaster of Paris which was used as a binder. The fourth and eighth week radiographs revealed increased radiodensity on the Implanted socket side which was attributed to the known osteoconductive capability of Hydroxyapatite (anorganic bone) and stimulatory effect of Plaster of Paris on bone regeneration`. The particulate Xenogenic Hydroxyapatite and Plaster of Paris combination serves as a passive scaffold which gets slowly resorbed in the bony cavity. With the I.O.P.A. radiographs, statistical analysis over the area of implant material within the defect showed 38.47 +_17.82mm of reduction in the material at the end of 4thweek and 51.765+_21.959mmat the end of 8thweek, thus suggesting the absorption of the graft material. Our results corresponds with the results of Su-Gwan and Kim (8)in 1999 which showed complete absorption of the graft material trom the cystic cavities of the jaws in 10 patients, 3 to 4 months post operatively We found statistically that at any given point, the amount of bone formation on the implant side was more compared to the control side. In a study by Talib.A.Najjar(10) 1991, which comparing Hydroxyapatite and Hydroxyapatite composite material found increased degree of bone formation in the latter.which was similar of this study where the use of Hydroxyapatite and Plaster of Paris in the extracted third molar socket appears to be beneficial to the patient. This combination can be used routinely in the third molar sockets, as it gives a good primary closure because Hydroxyapatite and Plaster of Paris forms a firm base so that the collapse of the oral mucosa is prevented and allows for primary epithelization,. In cases, requiring surgical removal of deep, complete bony impactions, use of this material in the extracted sockets would possibly ayoid periodontal pockets, intrabony defects, food accumulation and infection post surgically.

Summary and conclusion

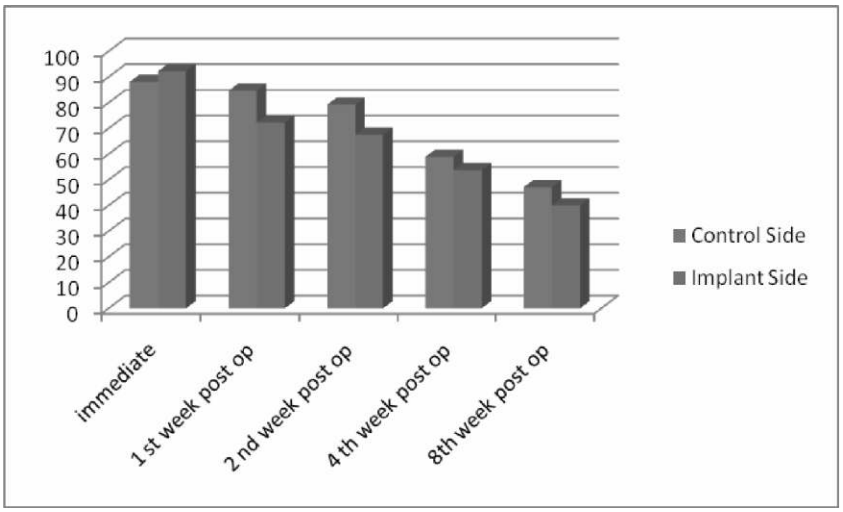
In this study. the Natural Hydroxyapatite implant material (Natgraft) mixed with Plaster of Paris was employed as a filler and scaffold to facilitate bone formation and to promote wound healing of the socket following surgical removal of impacted third molar. This study was done in 40 patients having bilateral symmetrically impacted third molar teeth where one side socket served as control. Clinical evaluation showed primary closure and good signs of wound healing on the implant side indicating that the composite material is biocompatible and non - allergic while the control side underwent secondary healing. Radiographic analysis showed that there was progressive resorbtion of the material in the socket and decreased infrabony defect distal to second molar on the implant side as compared to control side. The use of this material is advantageous over other alloplastic materials because Hydroxyapatite is osteoconductive and combining with Plaster of Paris as a binder not only improves the application of Hydroxyapatite but also enhances the degree of new bone formation. However, sthe fate of this composite implant material and its role in bone formation needs to be investigated histologically and in the form of isotope study of bone activity with long term follow

References

1. Michael Jarcho, Biomaterial aspect of Calcium phosphates, J - Dental Clinics ofN.America; Vol. -30(1);]986.
2. Andries S.Coetzee, Regeneration of Bone in tbe presence qfCalcium sulfate Arch Otolaryngg..l; Vol. - 106 : 405-409 ; July 1980.
3. Bahn S.L, Plaster -",A bone substitute J - OJ-alSurgery, Oral Med, Oral Path; Vol. - 21 : 5: 672-681 ; May 1966.
4. Moller & Peterson, Efficacy offibrin sealant on healing of extraction wound, Int J - Oral & Maxillofacial surg. ; Vol. - 70 : 142-]44 ; 1988.
5. Abel-Garcia, Trismus and l!ainafier removal of impacted lower third molar J - Oral & Maxillofacial surgery; Vol. - 56:1223-1226; 1997.
6. Geist C.E. , Stracher M.A. & Grove, Orbital augmentation by Hydroxyapatite - based composites. A Rabbit study and comparative analysis, Opthal Plast Reconstruct surg. ; Vol. - 7(1) : 8-22 ; 1991
7. Nicholas G. & Hanker, The use of particulate Hydroxyapatite and Plaster of Paris in aesthetic and reconstructive surgery,Asesth. P]astSurg. ; Vol. -17 : 85-92; 1993.
8. Su-Gwan Kim, Hwan-Ho Yeo & Kim Grafting of large defects of thejaw with a particulate Dentin - Plaster of Paris Combination,J - Oral surg., Oral Med. , Oral Rad. & Endod. ; 88 : 22-25 ; 1999.
9. Talib A. Najjar, Enhanced osseointegration of Hydroxyapatite implant material, J -Oral surg., Oral Med & Oral Path. ; Vol. 71 : 9-15; 1991

Evaluation difference in Volumetric Analysis of the Study Group between the Control Side and the Implant Side

Time Point	Control Side	Implant Side	tcal, 32	p-value
immediate	88.12	92.235	1.24	>0.05
1 st week post op	84.647	72.294	5.022	<0.05
2 nd week post op	79.235	67.588	4.678	<0.05
4 th week post op	58.941	53.765	2.513	<0.05
8th week post op	47.118	40.059	3.46	<0.05



Time Point	Study Side	Mean	Std.Dev
IstWeek Post-operative	Control	7.353	±1.367
	Implant	5.529	±I.700
8thWeek Post-operative	Contra I	6.412	±1.278
	Implant	4.588	±1.372