Original Article

Clinical Evaluation of Hydroxyapatite with Polyglactin-910 Membrane in the Management of Intraosseous Periodontal Defects

Vivek Kumar Bains [1], Vipin Bharti [2], Daljit Kapoor[3], Roshan Lal Sharma[4]

ABSTRACT

Purpose: To evaluate and compare clinically the efficacy of BONE-GLASS® with and without VICRYL-MESH® (Polyglactin-910) in the management of intrabony defects in humans suffering from periodontal disease. **Material & Method:** Ten patients with comparable bilateral periodontal intrabony defects in relation to the posterior teeth, as determined by clinical and radiological evaluation were selected for the study and divided on basis of split mouth design. In Group I, BONE-GLASS® and in Group II, BONE-GLASS® with VICRYL-MESH® were given. Each patient received initial phase I therapy scaling root planing and occlusal adjustments etc as required. Soft tissue parameters viz, the probing depth, the attachment levels and gingival recession were recorded clinically from fixed point on acrylic occusal stent at baseline and 6 months. Hard tissue measurements were made on radiographs exposed using paralleing technique at baseline and 6 months. **Results:** Both groups showed statistically highly significant ($p<0.01$) probing pocket depth (PPD) reduction, clinical attachment (CAL) gain, and defect fill from baseline to 6 months. In comparison to Group I, highly significant ($p<0.01$) pocket depth reduction and defect fill was detected for Group II after 6 months.

KEY-WORDS: Intraosseous defects, Hydroxyapatite, GTR membrane

INTRODUCTION

Most serious consequence of the periodontal disease, which is one of the most prevalent afflictions worldwide, is the destruction of the tooth supporting structures. Various types of osseous defects produced by the periodontal disease are horizontal, vertical, osseous craters, bulbous bone contours, inconsistent margins, ledges etc.[1] Vertical or angular or intrabony defects are those that occur in an oblique direction leaving a hollowed out trough in the base alongside the root. Goldman and Cohen[2] classified angular defects according to the location and number of osseous walls remaining around the defect. The morphology of osseous defect will largely determine the treatment technique to be used. One-walled angular defects (Hemiseptum) usually have to be surgically resected. Three-walled defects (intrabony) can be successfully treated with techniques that aim at new attachment and bone regeneration. Two-walled angular defects can be treated with either method depending on their depth, width and general configuration.

The challenge of periodontal regeneration has come to the forefront of periodontal research and practice and thus regenerative approaches have enhanced the long term prognosis of the teeth that have advanced periodontal destruction. One of first synthetic implant material used in periodontics was Plaster of Paris, but later report showed that this material had no osteogenic potential.[3] The calcium phosphate system and in particular Hydroxyapatite (HA) has been the

Department of Periodontology, [1]Saraswati Dental College, Lucknow, [2]Government Dental College & Hospital, Patiala, [3]Gyan Sagar Dental College and Hospital, [4]Surendra Dental College and Research Institute, Sriganganagar, India.
Address for Correspondence:
Dr. Vivek K Bains, #16/1317, Indiranagar, Lucknow-226016, India. doc_vivek76@yahoo.co.in
+91 9935023439.
Date of Submission: February 10, 2017
Review Completed: April 12, 2017
Date of Acceptance: April 18, 2017

subject of intensive investigation because it is from this system that vertebrate tooth and bone mineral is derived. The most widely investigated calcium phosphate biomaterials are composed of either hydroxyapatite [Ca_{10} $(PO_4)_6$ $(OH)_2$] or tricalcium phosphate [Ca_3 $(PO_4)_2$].[4]

BONE-GLASS® (Rushkin Innovative Group, Ahemdabad) is a synthetic graft material consisting of bioceramic hydroxyapatite granules of 300 to 355 microns. It consists of calcium and phosphate ions which are common constituents of vertebrate hard tissue systems. BONE-GLASS® exhibits mechanical properties similar to cortical bone and has a calcium/ phosphate ratio of 1.67 equivalent to living bone.

The use of physical barriers (GTR membrane) to promote new attachment has been an area of intense interest since its inception in 1980's.The initial membranes developed were non-resorbable that required a second operation, and therefore resorbable membranes were developed. The search for resorbable membranes include tests with rat collogen, bovine collagen, cargile membrane derived from the cecum of ox, polylactic acid, VICRYL-MESH® (Polyglactin 910), synthetic skin (Biobrane), and freeze-dried dura mater.[1] Resorbable knitted polyglactin 910 membrane (VICRYL MESH®, Ethicon Lab, Johnson and Johnson) has been reported to be economical, easily available, easy to manipulate with no abnormal immunological response and requires single surgical procedure with resorption time of 3-12 weeks. The purpose of this clinical study was to evaluate the efficacy of BONE-GLASS® (alloplastic material) with and without VICRYL MESH® (Polyglactin-910 membrane) in management of intraosseus periodontal defects.

MATERIALS AND METHOD

Patient selection: A general assessment of subjects was made through their history, clinical examination and routine investigations. Intraoral periapical radiographs of regions of interest were taken. All subjects were treated with initial Phase-I therapy involving oral hygiene instructions, scaling and root planing and occlusal adjustment, if needed. After clearance from local ethical committee, ten systemic healthy, non-smoker, co-operative patients, showing acceptable oral hygiene during pre-surgical (Phase-I) therapy in the age group of 35-45 years, suffering from moderate to advanced chronic periodontitis were selected amongst the patients visiting the department of periodontics. Based on radiographic observations along with clinical probing depth of at least 6 mm, selected patients had two almost identical intrabony defects, one on the either side of the mandibular arch, having 3-walled or combined defects when viewed on surgical exposure. Teeth with furcation defects were excluded from the study. Selected sites were randomly divided into two groups and were treated according to split mouth design technique as Group-I sites received BONE-GLASS® (bioceramic hydroxyapatite granules of 300 to 355 microns, Rushkin Innovative Group, Ahemdabad) and Group II sites received BONE-GLASS® and VICRYL-MESH® (resorbable polyglactin 910 knitted mesh, Ethicon Lab, Johnson and Johnson).

All instruments and linen to be used in the surgery were sterlised by autoclaving (temperature 121ºC, at 15 psi pressure for 15 minutes). The facial skin all around the oral cavity was scrubbed with 5% povidone-iodine solution (betadine) and intraoral surgical site was painted with 5% povidone-iodine solution.

Local anesthesia was administered by either nerve block (inferior alveolar nerve, lingual nerve, mental nerve and buccal nerve) or local infiltration to adequately anaesthetize the surgical site.

Surgical technique: Conventional flap surgery with crevicular incision was performed. The defect was debrided of all the granulation tissue and root surface was scaled and planed with the help of scalers and curettes. As per manufracture's instruction, the BONE-GLASS® (graft material) stored in sterile vials was taken out in the sterile dappen dish, mixed with saline and with the help of an amalgam carrier, packed into the defect (Figure-1 to Figure-3). In group II site, VICRYL-MESH® (stored in a vacuum dessicator) was cut to fit and sutured in place with 5/0 Vicryl sutures over the BONE-GLASS® (graft material) which was already placed in the defect. The flaps of both sites were then approximated as close as possible and sutured

with 4-0 black silk. The surgical areas were covered with periodontal dressing (COE-PAK®) on both the sites. Written post-operative instructions were given and analgesic (Ibuprofen 400 mg twice daily) was prescribed for 3 days. Doxycycline (Orobiotic® 100 mg b.d.) and 0.2% chlorhexidine (Hexidine®, ICPA) mouthrinse was instructed for 2 weeks after surgery. Sutures retaining the flap were removed 2 weeks after the surgical procedure and patients were asked to maintain meticulous oral hygiene. The areas were kept covered with periodontal dressing for 4 weeks where possible, and the patients were instructed to avoid the area if the pack came off. The mesh retaining sutures were absorbed.

Clinical and Radiographic Parameters: All the clinical measurements were standardized using customized acrylic occlusal stents (Fixed reference point) with grooves which were prepared on the study model of the patients. The recordings were made using a silver cone and then transferred to the 0.5 mm scale. The occlusal stent for vertical grooving was made using self-cured pink acrylic which was made to cover the occlusal as well as coronal 1/3rd of the buccal and lingual surfaces of the tooth involved and one tooth mesial and distal of the involve tooth. Vertical grooves were made to guide the silver cone penetration vertically in the same plane every time; it was inserted for recording measurements. The upper limit of the vertical grooves was made as the fixed reference point (FRP) for the vertical probing depth. Clinical parameters were recorded at the baseline (at and before surgery) and 6 months after the surgical procedure. Vertical measurements for determination of Probing Pocket Depth (PPD),

Clinical Attachment Level (CAL) and Gingival Recession (gingival margin position-GR) were measured from; fixed reference point (FRP) to the base of the pocket (BOP), fixed reference point (FRP) to the cementoenamel junction (CEJ), and fixed reference point (FRP) to gingival margin.

Intraoral periapical radiographs of each defects was exposed at baseline and 6 months, using extension cone paralleling (XCP) instrument (paralleling technique) with a calibrated grid (Person Dental Company, Los Angeles, USA) of 1x1 mm^2 copper wire, keeping mandibular arch parallel to the floor, concurrent with the studies of Gager and Schultz.[13] All surgical procedures were performed by the same clinician and both pre-operative and post-operative measurements were recorded by identical individual.

The recorded measurements were statistically analyzed using ANOVA and Student-'t' test.

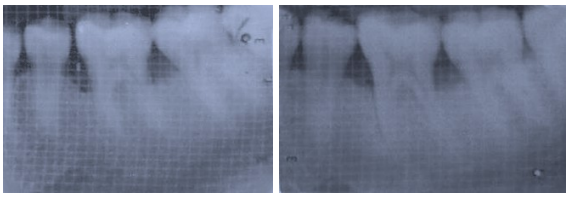

Figure 1 (a): Radiograph showing intrabony defect in group 1: baseline (b): in group 1: at 6 months

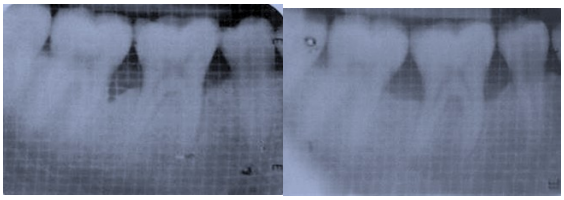

Figure 2 (a): Radiograph showing intrabony defect in group 2: baseline (b) in group 2: at 6 months

RESULTS

Both the materials were well tolerated by all the patients with no adverse reaction, infection or delayed healing during the course of study. A mean probing pocket depth (PPD) reduction in Group I between baseline and 6 months as 2.40 ± 0.65 mm (highly significant, $p<0.001$), and that in clinical attachment gain (CAL) as 2.25 ± 1.08 mm (highly significant, $p<0.001$).

Mean value change for gingival recession (GR) of approximately 0.70 ± 0.75 mm (significant, $p<0.05$) with hydroxyapatite after 6 months was observed. Mean defect fill in Group I between baseline and 6 months was 1.64 ± 0.40 mm (highly significant, $p<0.001$), but mean change in alveolar crest was not significant.

In Group II mean PPD reduction and CAL gain between base line to 6 months was 3.45 ± 0.69 mm (highly significant, $p<0.001$) and 2.60 ± 0.65 mm (highly significant, $p<0.001$) respectively. For Group II mean change in gingival margin position (gingival recession) after 6 months was 0.95 ± 1.09 mm (significant, $p<0.05$).

Mean defect fill in Group II after 6 month was 2.60 ± 0.80 mm (highly significant). Comparison of mean change in clinical and radiographic parameters are summarized in Table 1

Table 1: Mean change in various parameters of group I and II (in millimeters)

Parameters	Time Interval	Group	No.	Mean change	Mean difference	T	P	S
Probing pocket depth	Baseline and 6 months	I	10	2.40 ± 0.65	1.14 ± 0.04	3.76	<0.01	HS
		II	10	3.54 ± 0.69				
Gingival position from fixed reference point	Baseline and 6 months	I	10	0.70 ± 0.75	0.25 ± 0.34	0.95	>0.05	NS
		II	10	0.95 ± 1.09				
Clinical attachment loss		I	10	2.25 ± 1.08	0.35±0.57	0.87	>0.05	NS
		II	10	2.60 ± 0.65				
Mean distance from CEJ to alveolar crest	Baseline and 6 months	I	10	0.00 ± 0.00	0.05 ± 0.15	0.16	>0.05	NS
		II	10	0.05 ± 0.15				
Mean defect fill	Baseline and 6 months	I	10	1.64 ± 0.40	0.56±0.40	3.34	<0.01	HS
		II	10	2.60 ± 0.80				

DISCUSSION

Regeneration of lost periodontium remains the ultimate goal and to achieve this objective, bone grafts/ substitutes alone or in combination have been tried and studied. Van Meekran in 1668 was first to make an attempt to repair a cranial defect in a Russian soldier with a dog's skull bone but later was forced to remove the bone graft or else suffer excommunication,[14] later Merrem in 1809 reported the first successful autogenous bone graft.[15] Macewen in 1878 transplanted allogenic bone successfully in clinic patients[15] and Hegedus in 1923 was credited with the first use of bone grafts in periodontal therapy.[16] Hiatt *et al*[17] in a retrospective study based on histologic evaluation of 100 human block sections and extracted teeth from sites treated via bone and marrow autograft and non-graft regenerative procedures and revealed new cementum and bone formation.

Calcium phosphate system are alloplastic grafts materials which are available in different forms viz. hydroxyapatite, fluorapatite and tricalcium phosphate.[5] In the present study selected sites were randomly divided into two groups and were treated according to split mouth design. In Group I BONEGLASS® alone and in Group II BONEGLASS® with VICRYLMESH® was used. BONE-GLASS® is bioceramic hydroxyapatite granules of 300 to 355 microns. Hydroxyapatite (HA) also referred to as hydroxylapatite is a calcium phosphate bioceramic. It is generally recognized as the natural mineral component of vertebrate hard tissue composing of 60-70% of bone and 98% of dental enamel.[6] It's chemical formula is $Ca_{10}(PO_4)_6(OH_2)_2$ and has Ca/P ratio of 1.67 which is identical to that of bone mineral.[7]

Probing depth, clinical attachment level and position of gingival margin were measured from fixed point on occlusal stent, which appear to be more reliable than subgingival CEJ readings.[18]

The evaluation of the hard tissue changes after regeneration therapy can be done either by clinical or by radiographic assessment. Clinical measurements require a second surgical intervention which is usually not acceptable to the patient. Furthermore it may cause a disturbance of the new connective tissue attachments which is then replaced by long junctional epithelium.[19] Radiographic assessment provides the non-invasive method for evaluating the changes in hard tissue.

It was observed that both the materials were well tolerated by the patients as no unusual findings with regard to the post-operative healing as well as no sign or symptom of any other allergic manifestation was elicited.[3,4,13,20,21] Our results showed a highly significant ($p<0.001$) mean PPD reduction and CAL gain in Group I between baseline and 6 months similar to other

studies.[3,20,22-24] Brown *et al.*[22] shows mean value change for GR of approximately similar to the present study (significant, $p<0.05$) with hydroxyapatite after 6 months. Highly significant ($p<0.001$) mean defect fill in Group I was observed, but mean change in alveolar crest was not significant.[4,20,24-26] Hydroxyapatite is remarkably biocompatible. The substance has ability to adhere to connective tissues in general and to the bone in particular. Hydroxyapatite provokes little inflammatory responses when implanted within a tissue.[8] Hydroxyapatite biomaterials are generally non-bioresobable over periods of many years and they dissolve far less readily in a variety of fluids. Cultured human fibroblasts have been demonstrated to attach readily to the surface of calcium phosphate ceramics. Although devoid of any demonstrable osteogenic effects, the chemical nature of calcium phosphate materials is believed to facilitate osseous integration.[9,10] Jahn[11] has suggested that hydroxyapatite acts as an amphoteric ion exchanger. Selective accumulation of calcium and phosphate ions occurs as a consequence of the negative charges on the hydroxyapatite surface. This leads to the formation of more apatite and stimulates the formation of new bone. The excellent bonding between new bone and calcium phosphate implants has been characterized in detail by various investigators.[10,12]

In Group II mean PPD reduction and clinical attachment gain between base line to 6 months was highly significant, ($p<0.001$). Mean PPD reduction and clinical attachment gain was more for group II as compared to Group I and although, the difference for PPD between the two groups was highly significant after 6 months, but insignificant for CAL. Added advantage of GTR and bone graft for pocket reduction and clinical attachment gain was shown by other studies also.[13,27-34]

Decrease in pocket depth may be attributed to gingival shrinkage alone, gingival shrinkage along with coronal movement of junctional epithelium or gingival shrinkage with closed adaptation of gingival epithelium. Gain in clinical attachment may be due to new attachment and/or formation of long junctional epithelium. Although various studies are available that shows GTR membrane results in new attachment,[35] however the exact nature of attachment gain and there by probing depth reduction could not be ascertained due to lack of histological findings. Similar to present study, Schallhorn and McClain,[32] Gouldin *et al*.[33] also shows decrease in recession while using GTR membrane alone or GTR membrane along with bone graft. VICRYL-MESH® is resorbable polyglactin 910 knitted mesh which is prepared from a copolyomer of glycolide and lactide. Woven mesh is difficult to handle as it has tendency to "fray" whereas knitted mesh is easier to work with and has property of adaptation. Also placing a double layer of the knitted material approximates the smaller pore dimension of the woven material. Since Vicryl is absorbable there is no need for any subgingival irrigation to remove it, as occurs with removal of non-resorbable membranes.[13]

Similar to Bowen *et al.*[36] present study also reported bone repair of 2.1 mm after 6 month. Mean defect fill in Group II cases was more in comparison to Group I and the difference between highly significant ($p<0.01$). In the present study radiographs taken at 6 months after surgery had shown decrease in depth of defect due to defect fill and this radiographic defect fill was more when both graft and GTR membrane are used. Gager and Schultz[33] in their study also reported increased radiopacity indicative of radiographic fill at 3 and 6 months after surgery. Mean change in alveolar crest in Group I and Group II was 0 ± 0 and 0.5 ± 0.15 mm respectively, which was not significant. Concurrent results which show either resorption or no significant change in alveolar crest by others also.[29,30]

The combination of barrier techniques with bone graft and other methods has been suggested and procedures following these ideas are proposed by several authors.[25,27,28,37] The function of a grafting material in association with GTR is to act as a scaffold to provide and maintain space whenever the membrane may have the possibility to collapse and therefore reducing the chances for periodontal ligament cells to repopulate the previously exposed root surface.[38] Hence, no collapse of vicryl mesh occurs when it is supported by bone graft material.

CONCLUSION

Within the limits of the study both BONE-GLASS® alone and BONE-GLASS® with VICRYL-MESH® proved to be beneficial in the management of intraosseous defects but more pocket reduction, gain in clinical attachment and defect fill are observed when both materials are used in combination. It is important to emphasize that the data generated by this study derive from 6 months observations only. Hence, the long term studies are suggested to evaluate the efficacy of materials and techniques.

Source of support : Nil
Conflict of interest : None reported

REFERENCES

1. Carranza FA, Jr. Bone loss and pattern of bone destruction. In. Clinical Periodontology by Carranza FA, Newman MG, 8th edition, p 308. Prism Books (Pvt.) Ltd., Bangalore, India; 1996.
2. Goldman HM, Cohen DW. The intrabony pocket: classification and treatment. J Periodontol 1958; 29: 272.
3. Kenney EB, Lekovic V, Han T, Carranza FA Jr., Dimitrijevic B. The use of porous hydoxylapatite implant in periodontal defects. J Periodontol 1985; 56: 82-88.
4. Meffert RM, Thomes JR, Hamilton KM, Brownstein CN. Hydroxylapatite of an alloplastic graft in the treatment of human periodontal osseous defects. J Periodontol 1985; 56: 63-73.
5. Becker W, Becker BE. Periodontal regeneration updated. J Am Dent Assoc 1993: 124: 37-43.
6. Jarcho M. Biomaterial aspects of calcium phosphates. Dent Clin N Am 1986; 30: 25.
7. Caton J, Nyman S, Zender H. Histomeric evaluation of periodontal surgery. II. Connective tissue attachment level after four regenerative procedures. J Clin Periodntol 1980; 7: 224-231.
8. Moscow BS, Lubarr A. Histological assessment of human periodontal defect after durapatite ceramic implant. J Periodontol 1983; 54: 455-457
9. Jarcho M. Calcium phosphate ceramics as hard tissue prosthetics. Clin Orthop 1981; 157: 259–78
10. Shetty V, Han T. Alloplastic materials in reconstructive periodontal surgery. Dent Clin North Am 1991; 35: 521-30.
11. Jahn TL. A possible mechanism for the effect of electrical potentials on apatite formation in bone. Clin Orthop 1968; 56: 261.
12. Ogiso M. Formation and calcification of bone tissue on the surface of apatite ceramics. J Oral Disease 1983; 50: 1.
13. Gager AH, Schultz AJ. Treatment of periodontal defects with an absorbable membrane (polyglactin 910) with and without osseous grafting; case reports. J Periodontol 1991; 62: 276-283.
14. Longacre JJ, Converse JM, Kinze M. Tranplantation of Bone, Reconstructive Plastic Surgery. Converse vol I (ed. 2) p 317-323. WB Saunders Company 1977.
15. Boyne PJ. Tissue transplantation. Text of Oral and Maxiofacial Surgery. Krugger, ed 6th, 298-299. Jaypee Brothers, New Delhi, 1990.
16. Shetty J, Sood M, Mehta DS. Clinical evaluation of HTR polymer (a synthetic bone replacement alloplast), in treatment of periodontal osseous defects. J Ind Soc Periodontol 2001, 4: 28-35.
17. Hiatt, WH, Schallhorn RG, Aaranian AJ. The induction of new bone and cementum formation. J Periodontol 1978; 49: 495-577.
18. Clark DC, Chin Quee T, Bergeron MJ, Chan EC, Lautar-Lemay C, de Gruchy K.. Reliability of attachment level measurement using the cementoenamel junction and plastic stent. J Periodontol 1987; 58: 115-118.
19. Parashis A, Andromikaki FA, Taklekis K. Comparison of two regenerative procedures – guided tissue regeneration and demineralised freeze-dried bone allografts – in the treatment of intrabony defects: A clinical and radiographic study. J Periodontol 1998; 69: 751-758.
20. Krejci CB, Bissuda NF, Farah C, Greenwell H. Clinical evaluation of porous and non-porous hydroxyapatite in the treatment of human periodontol bony defects. J Periodontol 1987; 58: 521-528.
21. Lin CJ, Ishikawa I. Effect of porous and dense hydroxyapatite implantation or periodontal tissue regeneration in monkeys. Abstract. Bulletin Tokyo Med Dent Univ 1989; 36: 1-11.
22. Brown CD, Mealey BL, Nummikoski PV, Bifano SL, Waldrop TC. Hydroxyapatite cement implant for regeneration of periodontal osseous defects in humans. J Periodontol 1998; 69: 146-157.
23. Minegishi D, Lin C, Noguchi T, Ishikawa I. Porous hydroxyapatite granules implants in periodontal osseous defects in monkeys. Int J Periodont Restor Dent 1988: 51-63.
24. Mora F, Ouhayoun JP. Clinical evaluation of natural coral and porous hydroxyapatite implants in periodontal bone lesions; results of a 1 year follow up. J Clin Periodontol 1995; 22: 877-884.
25. Mellado JR, Salkin IM, Freedom AL, Stein MD. A comparative study of ePTFE, periodontal membranes with and without decalcifed freeze dried bone allograft for the regeneration of interproximal intraosseous defects. J Periodontol 1995; 66: 751-755.
26. Barnett JD, Melloning JT, Gray JL, Towle HJ. Comparison of freeze-dried bone allograft and

porous hydroxyapatite in human periodontol defects. J Periodontol 1989; 60: 231-237.
27. Lekovic V, Kenney EB, Carranza FA Jr, Danilovic V. Treatment of class II furcation defects using porous hydroxylapatite in conjunction with a polytetrafluroethylene membrane. J Periodontol 1990; 61: 575-578.
28. McClain PK, Schallhorn RG. Long term assessment of combined osseous composite grafting, root conditioning and guided tissue regeneration. Int J Periodont Restor Dent 1993; 13: 9-27.
29. Batista EL Jr, Novas AB Jr, Simonpietrii JJ C, Batista FC. Use of Bovine derived anorganic bone associated with guided tissue regeneration in intrabony defects. Six month evaluation at re-entry. J Periodontol 1999, 70: 1000-1007.
30. Camargo PM, Lekovic V, Weinlaender M, Nedic M, Vasilic N, Wolinsky LE, Kenney EB. A controlled re-entry study on the effectiveness of bovine porous bone mineral used in combination with a collagen membrane of porcine origin in the treatment of intrabony defects in humans. J Clin Periodontol 2000; 27: 889-896.
31. Chen CC, Wang HL, Smith F, Glickman GN, Shyr Yu, O'Neal RB. Evaluation of a Collagen membrane with and without bone grafts in treating periodontal intrabony defects. J Periodontol 1995; 66: 838-847.
32. Schallhorn RG, McClain PK. Combined osseous composite grafting, root conditioning and guided tissue regeneration. Int J Periodont Restor Dent 1988; 4: 9-31.
33. Gouldin AG, Fayed S, Mellonig JT. Evaluation of guided tissue regeneration in interproximal defects (II) Membrane and bone versus membrane alone. J Clin Periodontol 1996; 23: 485-491.
34. Joly JC, Palioto DB, de Lima AF, Mota LF, Caffesse R. Clinical and radiographic evaluation of periodontal intrabony defects treated with guided tissue regeneration. A pilot study. J Periodontol 2002; 73: 353-359.
35. Gottow J. Guided tissue regeneration using bioresorbable and non-resorbable devices. Initial healing and long-term results. J Periodontol 1993; 64: 1157.
36. Bowen JA, Mellonig JT, Gray JL, Towle HT. Comparison of decalcified freeze-dried bone allograft and porous particulate hydroxyapatite in human peridontal osseous defects. J Periodontol 1989; 60: 647-654.
37. Anderegg CR, Martin SJ, Gray JL, Mellonig JT, Gher ME. Clinical evaluation of the use of decalcified freeze-dried bone allograft with guided tissue regeneration in the treatment of molar furcation invasions. J Periodontol 1991; 62: 264-268
38. Caffesse RG, Nasjleti CE, Plotzke AE, Anderson GB, Morrison EC. Guided tissue regeneration and bone grafts in the treatment of furcation defects. J Periodontol 1993; 64: 1145-1153.

To cite: Bains VK, Bharti V. Kapoor D, Sharma RL. Clinical Evaluation of Hydroxyapatite with Polyglactin-910 Membrane in the Management of Intraosseous Periodontal Defects. Asian J Oral Health Allied Sc 2017;7(1):2-8.