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Application of glass reinforced hydroxyapatite composite in the treatment of human intrabony periodontal angular defects – Two case reports

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Abstract

Bony defects caused by periodontitis are often treated by regenerative therapy using autografts and/or allografts. Alloplasts such as hydroxyapatite or ceramics and bioactive glasses are used as osteoconductive materials that serve as scaffold for new bony ingrowth. The purpose of this study was to ascertain the possible regenerative capability of glass reinforced hydroxyapatite (Bonelike®) an osteoconductive synthetic graft in the treatment of human periodontal intrabony angular defects. The material was placed in 2 defects in 2 individual patients and clinical parameters such as probing depth (PD) and clinical attachment level (CAL) have been included. Bone fill was determined using an intra oral periapical radiograph (IOPA) and Autocad Software. After 3 months implantation period, there was an improvement in CAL and reduction in PD along with bone fill was observed.

Introduction

Periodontitis is defined as inflammation of the gingival tissues together with a measurable loss of attachment of the periodontal ligament and bony support[1]. The main objective of any regenerative periodontal therapy is to cure and control the infection and ultimately regenerate the lost supporting apparatus of the tooth[2]. The regenerated tissue should ideally consist of new bone, cementum and attached periodontal ligament to replace that which was lost due to periodontitis. To achieve this goal, a variety of materials and various regenerative procedures have been tried with varying results[3]. Although the use of intraoral autogenous bone grafts is well accepted in the periodontal community, drawbacks such as limited availability of donor site, requirement for an additional surgical procedure are few of the drawbacks with this material. Furthermore, although allografts obtained from an approved bone bank have been shown to be free of HIV Virus[4], it's osteogenic potential has been questioned[5]. This has led to the evolution of alloplasts as bone replacement grafts in treatment of intraosseous defects. A number of alloplastic materials have been utilized for periodontal regeneration[6]. Alloplasts such as porous HA[7], calcium coated polymer alloplastic material[8] and tricalcium phosphate[9, 10] when placed in human periodontal defects have demonstrated osseous fill and PD reduction, but show limited evidence of connective tissue attachment. Bioactive glass has the ability to bond to both hard and soft tissues[11]. Bioactive glass exhibits osteoconductive and osteostimulatory effects. It's pore size provides an optimal space for vascularization and hemostasis. It's biocompatibility and easy manipulation has been well documented[12-15].

The osteoconductivity and bioactivity of Bonelike® in repairing surgical cystic bone defects[16], Sinus lift procedures and dental implants was confirmed by successful clinical applications. It's use in treatment of periodontal intrabony defects is yet to be ascertained, hence the present study was reported.

Materials and Methods

Bonelike® is a glass reinforced – HA whose chemical composition resembles that of inorganic bone tissue[17]. It contains small percentage of TCP (alpha and beta forms) and ionic species of glass prepared by innovative liquid phase sintering process[18,19]. This system allows incorporation of several ions, such as magnesium, sodium and fluoride resulting in a bone graft with a chemical composition similar to bone mineral phase and it's microstructure presented improved mechanical properties and enhanced bio activity than the actual commercial HA[20, 21].

In the present clinical trial, the patients selected for the study satisfied the following criteria. No medical problems that would contraindicate routine periodontal surgery, PD $\geq$ 6 mm, radiographic evidence of angular bone loss, previous invasive procedures within 6 months and patients who had not taken antibiotics within 6 months of initial examination.

Exclusion Criteria: Patients having unacceptable oral hygiene during pre surgical phase (Phase I), pregnant women and uncooperative patients. Informed consent was taken from both the patients.

Initial therapy: Prior to Surgery, scaling, root planing and oral hygiene reinforcement was done. A customized acrylic stent was fabricated and stored on the study cast to minimize distortion. The stent was grooved to standardize the point of entry of a probe while making clinical measurements.

Two female patients reported to the Dept. of Periodontics and Oral Implantology, SSCDS, A.P, India, with an intrabony angular defect in relation to 16 (patient 1) and 26 (patient 2). Initial therapy was performed and clinical measurements recorded as mentioned in Fig 1(A). The presence of the defect was confirmed by an intra oral periapical (IOPA) radiograph. Following infiltration using a local anesthetic solution (2% Lignocaine with 1:80,000 Adrenaline), full thickness mucoperiosteal flaps were raised and the defect exposed (Fig. 1B). The area was debrided and curetted using hand instruments (Hu-friedy Gracey curettes). The intra osseous defect was filled with Bonelike® mixed with patient's blood (Fig 1C) and direct sutures placed using non resorbable

silk (Fig. 1D). Periodontal dressing was placed on the buccal and palatal aspect of the operatory site (Coepak®). Post operative analgesics were prescribed and patient was advised to use 0.2 % chlorhexidine mouth wash for two weeks. Patient was recalled on 8th postoperative day for suture and pack removal. A radiograph was taken to confirm the presence of the graft material.

Results and Discussion

There was no pain postoperatively and both the patients presented with uneventful healing. Three months post operatively there was marked improvement in PD reduction and CAL gain (Table 1). The amount of bone fill was determined by comparing the pre (Fig. 2 A and Fig. 3A) and post operative radiographs (Fig. 2B and Fig. 3B) using an Autocad software (2006 Version). Both the patients showed considerable amount of bone fill at three months post operatively (Table 1, Fig. 4A and B).

The present study showed an average PD reduction of 4 mm and CAL gain of 4mm. There was an average linear defect depth (LDD) of 6.4mm, which reduced to 2.4mm indicating an average linear bone fill (LBF) of 4.0mm. The average percentage bone fill was 70%. The PD reduction in this study is similar to the one performed by Park et al [22] but that study was of 6 months duration. The CAL gain was similar to results reported by Froum et al[23]. The amount of bone fill was greater than that reported by Zamet et al [24]. This difference could be attributed to liquid phase sintering process of the material and presence of bioactive glass and TCP in it's composition which favours rapid resorption.

Green et al [25] showed that osteoblastic tissue responses are directly related to pore dimensions. Pore dimensions between 15 and 50 micrometers induce fibro vascular growth, whereas those between 50 and 150 micrometers stimulate osteoid formation. Our reports support those of Green et al [25] where pore diameters ranging from 150-500 micro meters led directly to mineralized bone. The optimal particle size for alloplastic material is 300-500 micrometers, a range that provided adequate inter particular space for vascular invasion to occur. [26] The greater bone fill

in our study might be because of bioactive glass which produces ion exchange in the interface between glass particles and surrounding tissue fluids building silica gel to produce a layer rich in calcium and phosphorous; macrophages permeates the layer through apertures to partly absorb the gel; the absorption leads to previously indifferent cells to make protective vesica that assume the same phenotype as osteoblasts with the minimum fluid flow; and the final mutation occurs when those affected cells become affixed to the bone like surface of the calcium-phosphorous layer. [27,28] Since the vesica functions as a nucleus of osteogenesis, the islands of newborn bone tissues come into being without any change in the surroundings.[14, 29]

Conclusion

The study although restricted to two patients is a preliminary investigation and indicates the tolerance of the grafted material and absence of any untoward adverse effects. The extent of bone fill in both cases is promising and given a longer observational period, may consolidate or even improve the bone fill. Further studies using larger sample size and longer follow up period would provide more information and wider applications of this material.

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Table 1: Post operative probing depth (PD), clinical attachment level (CAL), linear bone fill (LBF) bone fill after three months.

	Base line			**3 months post op**			**Results**		
	PD	**CAL**	**LBD(mm)**	**PD**	**CAL**	**LBD(mm)**	**PD reduction**	**CAL gain**	**LBF**
Patient 1	7	8	6.2	3	4	2.2	4	4	4.0
Patient 2	8	9	6.5	4	5	2.1	4	4	4.4

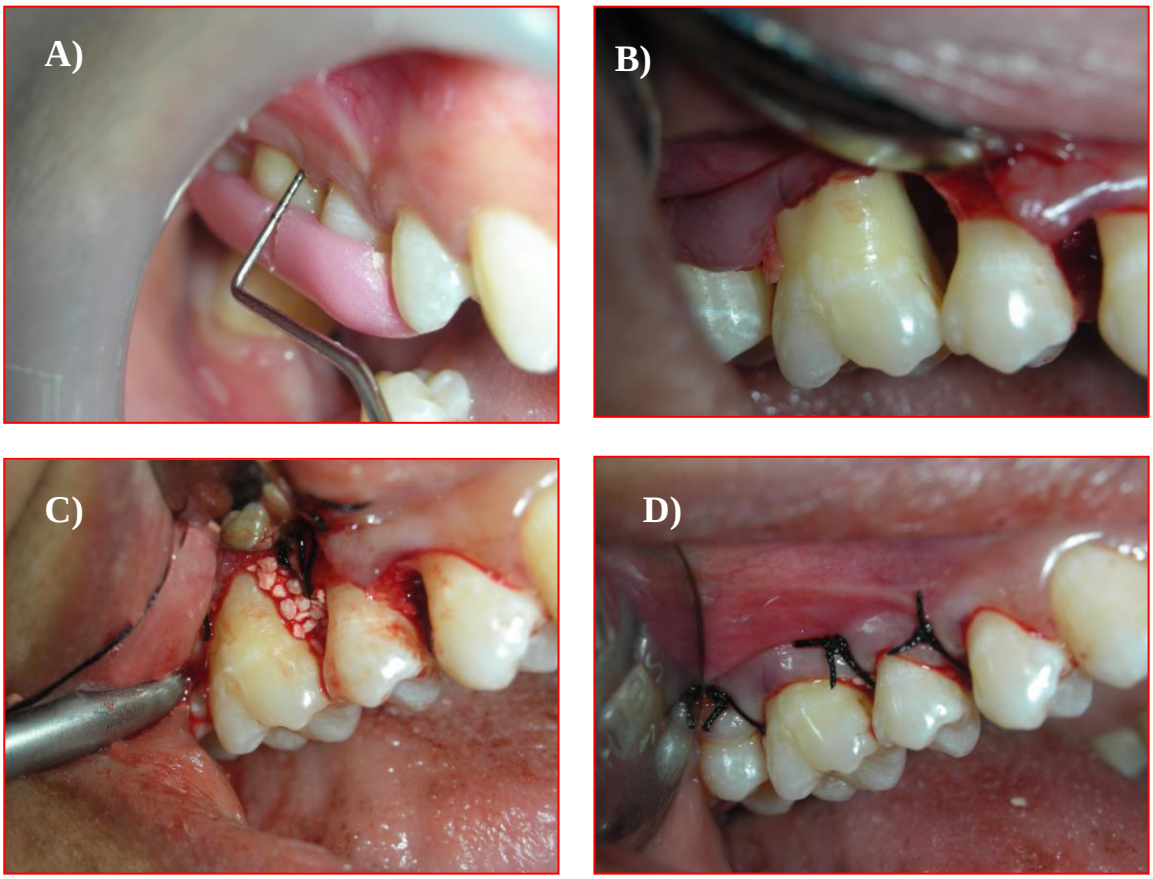

Figure 1: Clinical procedure - Patient's initial therapy (A), defect exposed (B),defect filled with Bonelike® granules (C), and direct sutures placed using non restorable silk (D).

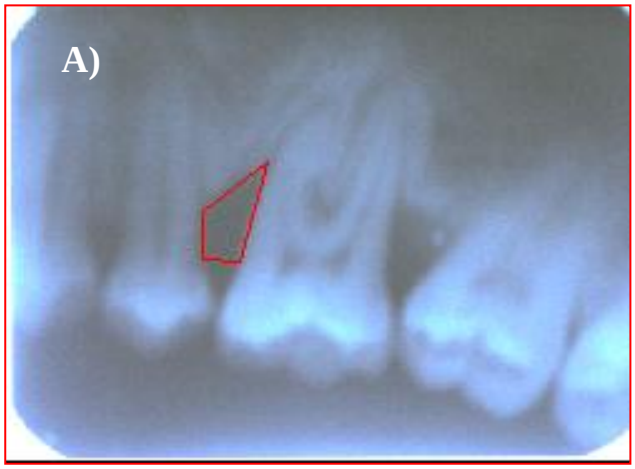

Figure – A

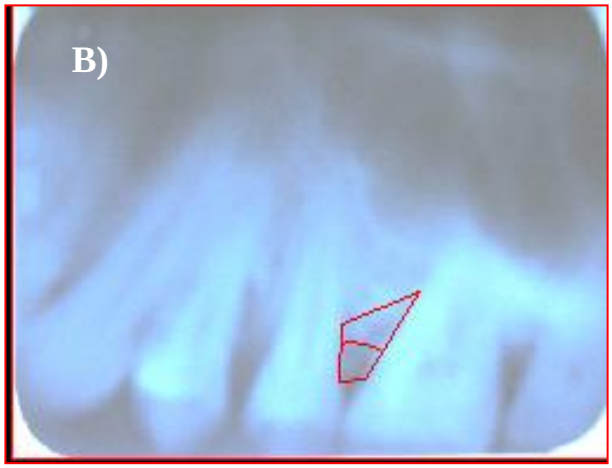

Figure – B

Figure 2: The presence of defect confirmed by an intro oral periapical (IOPA) radiograph, preoperative (A) and post operative (B) for patient one.

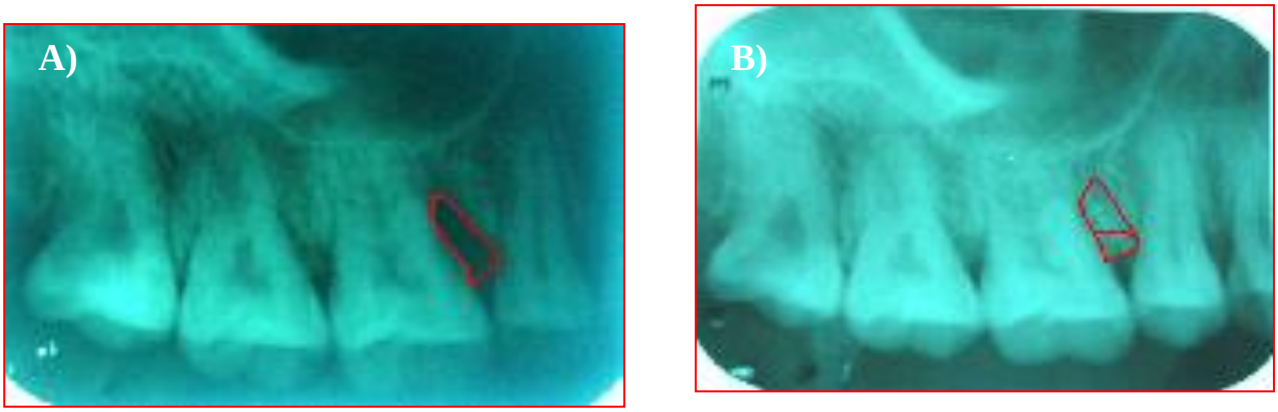

Figure 3: The presence of defect confirmed by an intro oral periapical (IOPA) radiograph, preoperative (A) and post operative (B) for patient two.

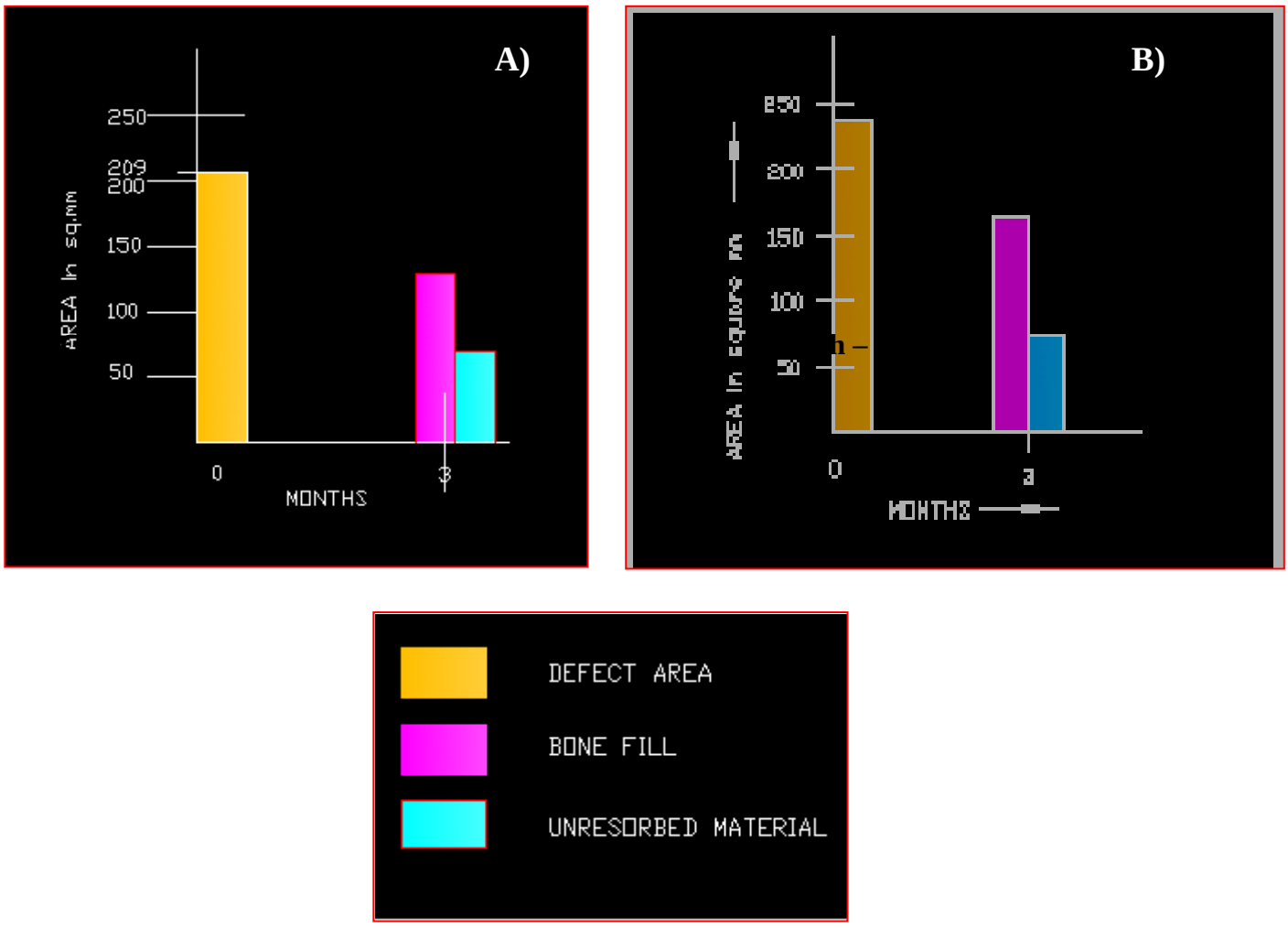

Figure 4: Graph shows Bone defect area and bone filled data for patient one (A), and patient two (B).

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