Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/13045
DOI URL: http://dx.doi.org/10.21474/IJAR01/13045

RESEARCH ARTICLE

CONE BEAM COMPUTED TOMOGRAPHY AS A TOOL FOR THE ANALYSIS OF BONE FILL IN INTRABONY DEFECTS WITH USE OF NANOGEN™ BONE GRAFT

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Manuscript Info

Manuscript History
Received: 20 April 2021
Final Accepted: 18 May 2021
Published: June 2021

Key words:-
Intrabony Defect, Periodontal Regeneration, Bone Graft

Abstract

Aims and Objectives-The aim of the present study was to evaluate the regenerative potential of synthetic nanocrystalline calcium sulphate bone graft (NANOGEN™) in treatment of intrabony defect both clinically and radiographically.

Materials and Methods- Study was conducted in 10 patients with 10 defect sites with probing pocket depth >5mm with radiographs at base line were selected. All the sites with intrabony defects treated with Nanogen™ bone graft and follow up was done for 3 months and 6 months respectively. Clinical parameters included in the study are of plaque index, probing depth (PD), clinical attachment level (CAL), Sulcus bleeding index (SBI). Radiographic parameters include bone fill.

Results-In the present study, the mean clinical attachment loss, plaque index, probing depth index, sulcus bleeding index at baseline was 9.11±1.054, 1.5278±1.9543, 8.44±1.130, 3.7222±.77504 respectively, reduced to 5.7±1.093,.6389±.37731,3.67±.500,1.2222±.75462 respectively at the end of the 3 months.5.00±.707, .4167±.39528, 2.78±.667, .4167±.46771 respectively at the end of the 6 months. The mean bone fill baseline was 9.11 ± 1.054 mm which was reduced to 5.78 ± 1.093 mm at 3 months and reduced to 5.00 ± 0.707 mm at 6 months, showing a bone fill of 3.933 ± 0.3640 mm by the end of three months and 4.256 ± 0.3678 by the end of six months which were statistically significant (P=0.002).

Conclusion- Present study, evidenced that reduction in probing depths, gain in clinical attachment level and bone fill. Improvement of clinical and radiographic parameters at sites treated with Nanogen™.

Introduction:-

Periodontitis is a bacterially induced inflammatory disease that is characterized by the destruction of periodontal tissues,[1] alveolar bone with pocket formation, recession or both[2].Conventional periodontal treatments such as scaling and root planning are effective in repairing defects but result in the development of long junctional epithelium between the gingival connective tissue and root surface rather than regrowth of tissue that restores the architecture and function.

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Open flap debridement results in the formation of junctional epithelium which is susceptible to microbial invasion and is thought to be less stable attachment; hence, bone grafting is the most common form of regenerative therapy.[2]

Periodontal disease approaches to diagnose periodontal disease include probing of gingival tissues and radiographs.[3]Imaging includes bitewings and periapical (PA) radiographs,[4] with the most radiographic technique used for diagnosis being the paralleling extension cone technique.[5,6]

Intraoral radiograph has limited due to inherent overlay of anatomic structures.There is ample analysis demonstrating that funnel-shaped or lingually placed defects cannot be detected[7]where destruction of the buccal plate may be undiagnosed or unnoticeable from lingual defects.

Periodontal identification depends heavily on ancient two-dimensional image. Despite efforts in rising responsibility, current strategies of detection bone level changes over time or determinative three-dimensional architecture of animal material defects area unit was inadequate. To address these problems, computerized axial tomography (CT) has been explored owing to its ability to supply correct three-dimensional imaging; however limitations like radiation, machine size and value have created this approach impractical. Recently, cone beam computerized tomography (CBCT) has turned this concept into potential reality as a result of these lower-cost machines manufacture has high quality information. Nonetheless there's very little analysis to establish bone measurement exploitation with CBCT as a valid technique.[8]

Calcium sulfate (CS) and calcium phosphate compounds are used alternatives to autografts because of their chemical and physical resemblance to bone mineral .They have ability to induce release of growth factors also inhibition of epithelial migration, biocompatibility, handling characteristics, porosity, and different rates of dissolution, and modest cost.[9]

Calcium sulphate is an osteoconductive but not osteoinductive, whereas in the presence of periosteum or bone it appears to become osteogenic [10].When sufficient organic matrix and functioning osteoblasts are present, these ions are utilized in bone formation. Calcium sulphate facilitates in cell attachment and spreading, migration of gingival fibroblasts and also has the angiogenic potential and anti-inflammatory property by dissolving rapidly and washed away before infection can occur.[11-13].Calcium sulphate degrades quickly over a period of 4–6 weeks and its success is limited as a bone graft for large defects. To label this difficulty controlled release calcium sulphate and later on Nanocrystalline version of Calcium sulphate was introduced.

The present study was done to evaluate the regenerative potential of synthetic nanocrystalline calcium sulphate bone graft (NANOGEN^{TM}) in treatment of intrabony defect both clinically and radiographically.

Materials And Methods:-

The ethical committee of Army College of dental sciences approved with letter number: ACDS/IEC/34/OCT 2018. All the selected patients in the subject group were subjected to clinical and radiographic interpretation. A total of 10 sites were selected in patients for the study in which flap debridement was done followed by the placement of Nanogen^{TM}. All patients with age limit of 20-50 years of both genders, systemically healthy patients, probing depth greater than 5mm as assessed by UNC-15 periodontal probe and patients with chronic periodontitis were included in this study.

The exclusion criteria included with patients having short or long term drug therapies, any systemic diseases, drug allergies, lactating women, pregnant women and smokers.

Informed consent was signed those fulfilled the inclusion criteria. All participants received instructions in proper oral hygiene performance. Supra-gingival and sub-gingival scaling and root planning were performed, and potential participants were re-evaluated. Stent preparation was done on the study model of the patients. The recordings were made using University of North Carolina 15 probe (Hu-Friedy).

In the present prospective study, patients were asked to rinse their mouth with 10 ml of 0.2% chlorhexidinedigluconate solution. The extra oral surface of the patient was swabbed with 5% povidine iodine solution. The operative site was anaesthetized with 2% Lignocaine HCL with adrenaline (1:80,000) using block and infiltration techniques on the sites. The crevicular and interdental incisions were given using the Bard Parker handle

with Swan Martin blade No. 15. A full thickness mucoperiosteal flap was reflected using the periosteal elevator. After reflection of the flap and exposure of the osseous defect, a thorough surgical debridement of the soft and hard tissues was done using the curettes. Following the completion of defect debridement, intra-operative measurement was taken with the UNC-15 probe.

The defect was grafted with the Nanogen^{TM} bone graft and then mucoperiosteal flap were repositioned and secured in place using a 3/8 Circle, reverse cutting and 3-0 black braided silk with interrupted sutures. The primary closure of the area was protected with a non-eugenol (CoE-pak) dressing. Postoperative instructions were given, antibiotics and analgesics were prescribed. The patient was recalled for suture removal after 7 days and follow up. The following variables were measured at baseline, 3 months and 6 months post-surgery, probing pocket depth. (PPD), clinical attachment level (CAL), full mouth plaque scores (Plaque index (PI), Silness and Loe), sulcus bleeding score and amount of bone fill. Radiographic parameters were measured by cone beam computed tomography of each defect site was exposed at baseline, 3 months and 6 months. Cone beam computed tomography images were obtained and bone defect were measured with CS 3D Imaging software package.

Statistical Analysis

Statistical analysis was carried out using SPSS (Statistical Package for Social Sciences) version 26 software. Means and standard deviations for all parameters were calculated. Results were expressed as Mean ± SD. Changes in the clinical and radiographic parameters in study group was analyzed by students unpaired t-test, ANOVA test for within a group (intra- group).

Results:-

NANOGEN^{TM} - The mean CAL score at baseline was 9.11 ± 1.054 mm which was reduced to 5.78 ± 1.093 mm at 3 months and reduced to 5.00 ± 0.707 mm at 6 months, which was statistically not significant initially at three months follow up but was statistically significant at six months follow up as shown in table 1 and graph 1.

The mean plaque index score at baseline was 1.5278 ± 0.19543 which was reduced to 0.6389 ± 0.37731 at 3 months and reduced to .4167 ± 0.39528 at 6 months, which was statistically not significant as shown in table 2 and graph 2.

The mean Probing pocket depth score at baseline was 8.44 ± 1.130 mm which was reduced to 3.67 ± 0.500 mm at 3 months and reduced to 2.78 ± 0.667 mm at 6 months, which was statistically significant at both 3 and 6 months as shown in table 3 and graph 3.

The mean SBI score at baseline was 3.722 ± 0.77504 which was reduced to 1.2222 ± 0.75462 at 3 months and reduced to 0.4167 ± 0.46771 at 6 months, which was statistically significant initially at three months follow up but was statistically not significant at six months follow up as shown in table 4 and graph 4.

Radiographic Evaluation

The mean distance from CEJ to the base of the defect at baseline was 9.11 ± 1.054 mm which was reduced to 5.78 ± 1.093 mm at 3 months and reduced to 5.00 ± 0.707 mm at 6 months, showing a bone fill of 3.933 ± 0.3640 mm by the end of three months and 4.256 ± 0.3678 by the end of six months which were statistically significant (P=0.002).

The mean distance from CEJ to the base of the defect at baseline was 9.11 ± 1.054 mm which was reduced to 5.78 ± 1.093 mm at 3 months and reduced to 5.00 ± 0.707 mm at 6 months, showing a bone fill of 3.933 ± 0.3640 mm by the end of three months and 4.256 ± 0.3678 by the end of six months which were statistically significant (P=0.002).

Discussion:-

Traditional methods used in the treatment of periodontal diseases may result in healing by the formation of long junctional epithelium. Hence regenerative procedures have focused on the regeneration of new attachment apparatus including periodontal ligament, alveolar bone and cementum. In the present study Nanogen^{TM} bone graft was compared clinically and radiographically in the treatment of intrabony periodontal defects.[14]

So far there has been little research to support the use of recent CT methods for potential diagnosis of periodontal bone level. Within the limits of the present study, results showed that CBCT is as accurate as direct measurements

using a periodontal probe and as reliable as radiographs for interproximal areas, because of lingual and buccal defects could not be diagnosed with radiography, CBCT is a superior technique.[8]

In the present study, the mean clinical attachment loss, plaque index, probing depth index, sulcus bleeding index at baseline was 9.11±1.054, 1.5278±19543, 8.44±1.130, 3.7222±.77504 respectively.

All these values reduced to 5.78±1.093, .6389±.37731, 3.67±.500, 1.2222±.75462 respectively at the end of the 3 months, 5.00±.707, .4167±.39528, 2.78±.667, .4167±.46771 respectively at the end of the 6 months. The mean bone fill baseline was 9.11 ± 1.054 mm which was reduced to 5.78 ± 1.093 mm at 3 months and reduced to 5.00 ± 0.707 mm at 6 months, showing a bone fill of 3.933 ± 0.3640 mm by the end of three months and 4.256 ± 0.3678 by the end of six months which were statistically significant (P=0.002).

Clinical attachment loss was statistically not significant initially at three months follow up but was statistically significant at six months follow up. Plaque index score was statistically not significant at the end of 6 months. Probing pocket depth and bone fill showed statistically significant at both 3 and 6 months. SBI score was statistically significant initially at three months follow up but was statistically not significant at six months follow up.

Similarly study done by Arthiie et al.[14] results at baseline, mean plaque index scores, oral hygiene index scores and gingival index scores, at (3rd and 6th) months showed insignificant results (p-value >0.05). Pandit et al [3] stated that intra-group comparisons showed significant improvement in the amount of defect resolution of all the groups from baseline to 6 months and 12 months, similarly in the present study bone fill showed significant results from base line to 6 months.

Future perspectives of the present study

1. Histological studies are required to claim true periodontal regeneration and biopsy is mandatory for the same. As none of the teeth included in this study were candidates for extraction, a histological study was not performed.
2. Further studies with a larger sample size over a longer post-operative follow-up period are to confirm the success of a Nanogen^{TM}.

Tables and Graphs:

Table 1:- shows the clinical attachment loss from baseline to 6 months.

S .no.	NANOGEN ™		
	Baseline	**3 Months**	**6 Months**
1.	11	6	5
2.	8	5	5
3.	8	5	4
4.	9	6	5
5.	11	8	6
6.	9	5	5
7.	9	5	4
8.	10	6	5
9.	10	7	6
10.	8	5	5

Graph 1:- Shows the clinical attachment loss from baseline to 6 months.

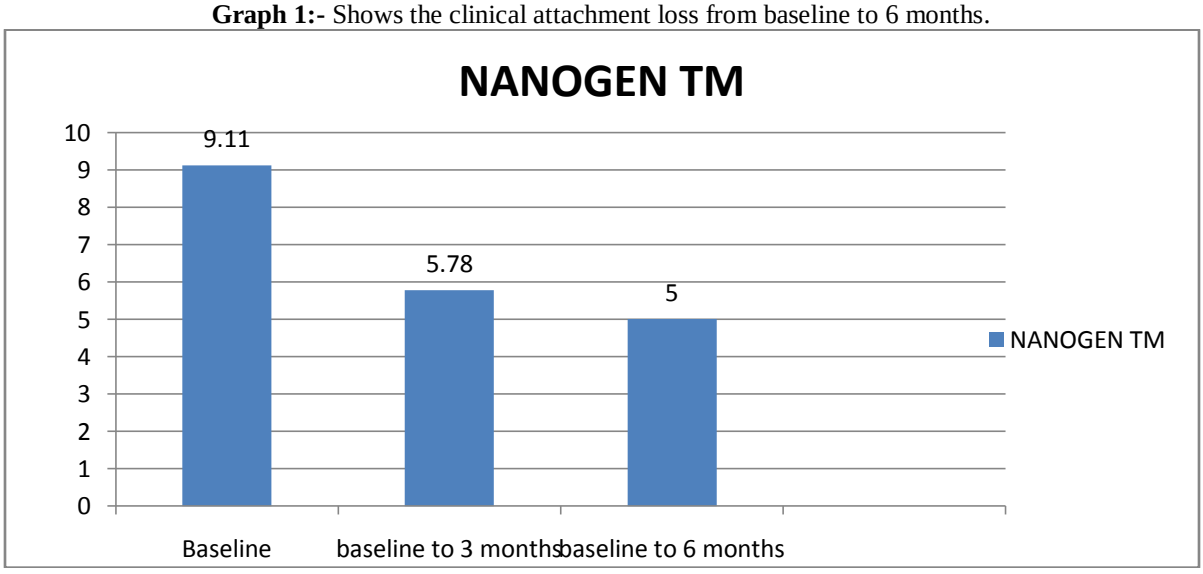

Table 2:- Shows the plaque index from baseline to 6 months.

S .no.	NANOGEN ™		
	Baseline	**3 Months**	**6 Months**
1.	1.75	1.25	1.25
2.	1.25	1	0.5
3.	1.5	0	0
4.	1.5	0.5	0.5
5.	1.75	1	1
6.	1.75	1	0.25
7.	1.5	0.5	0
8.	1.25	0.25	0.5
9.	1.5	0.5	0
10.	1.75	1	1

Graph 2:- Shows the plaque index from baseline to 6 months.

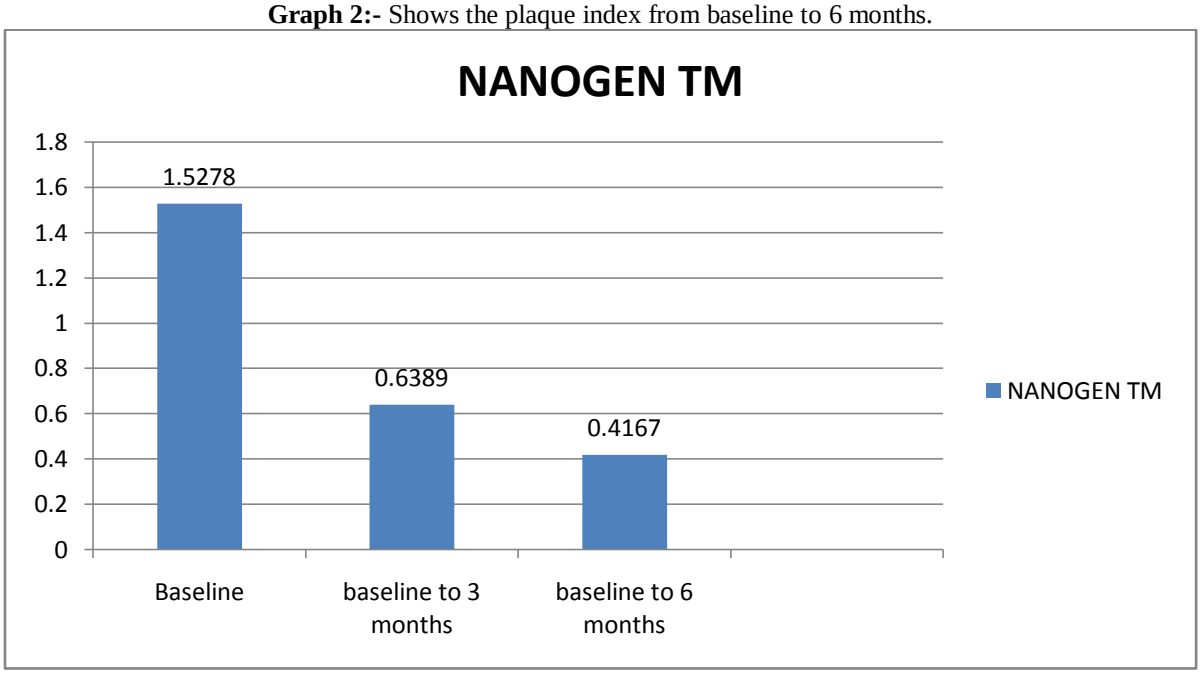

Table 3:- Shows the mean probing depth from baseline to 6 months.

S no	NANOGEN ™		
	Baseline	**3 Months**	**6 Months**
1.	9	5	3
2.	8	4	3
3.	8	4	2
4.	7	3	3
5.	9	4	2
6.	10	4	3
7.	9	3	3
8.	8	4	4
9.	10	4	2
10.	7	3	3

Graph 3:- Shows the mean probing depth from baseline to 6 months.

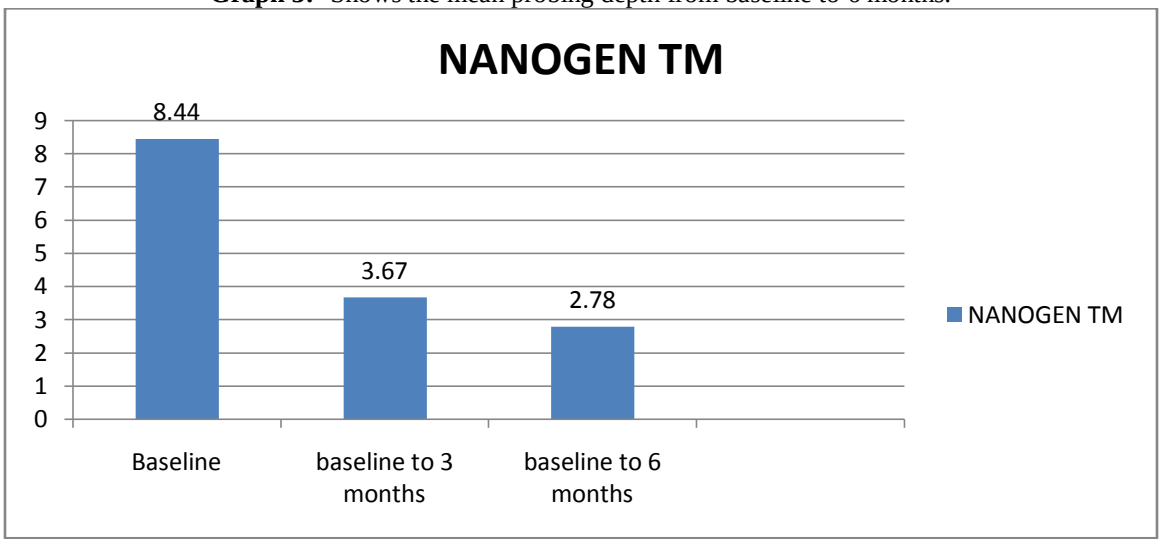

Table 4:- Shows the mean sulcus bleeding index from baseline to 6 months.

S .no.	NANOGEN ™		
	Baseline	**3 Months**	**6 Months**
1.	4	1	0
2.	2.5	0	0
3.	4	1	0
4.	4	1	1
5.	3.5	1.25	0.5
6.	4.75	2.5	1.25
7.	4.25	2.25	0.5
8.	3.75	0.75	0
9.	2.5	1	0.5
10.	4.25	1.25	0

Graph 4:- shows the mean sulcus bleeding index from baseline to 6 months.

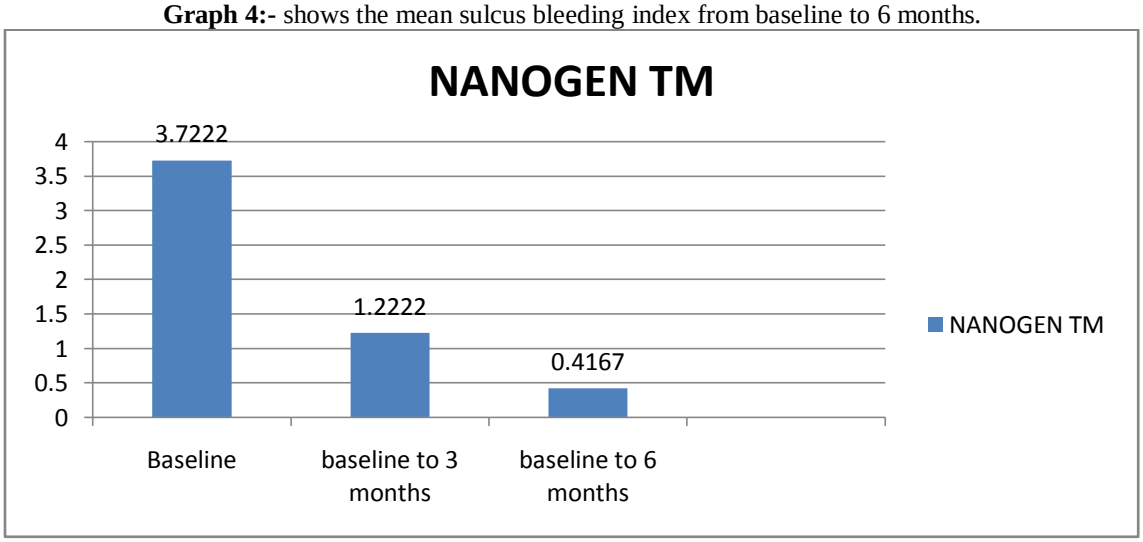

Table 5:- shows- Intra group comparison of CAL, PI, PPD and SBI in NANOGEN ™ group at different follow−up intervals.

Group	Variable	Time line	Mean	Std. Deviation	Std. Error Mean	t value	p value
NANOGEN ™	CAL	Baseline	9.11	1.054	.351	-1.344	.197
		baseline to 3 months	5.78	1.093	.364	.471	.644
		baseline to 6 months	5.00	.707	.236	3.568	.002
	PI	3 – 6 months	1.5278	.19543	.06514	1.535	.143
		baseline to 3 months	.6389	.37731	.12577	.917	.372
		baseline to 6 months	.4167	.39528	.13176	1.863	.080
	PPD	Baseline	8.44	1.130	.377	.707	.489
		baseline to 3 months	3.67	.500	.167	4.284	.001
		3 – 6 months	2.78	.667	.222	3.100	.007
	SBI	Baseline	3.7222	.77504	.25835	-1.042	.312
		baseline to 3 months	1.2222	.75462	.25154	2.936	.009
		3 – 6 months	.4167	.46771	.15590	1.485	.156

Table 6:- Shows-Intra group change in percentage defect fill at different follow−up intervals.

Group	Time line	Mean	Std. Deviation	Std. Error Mean	t value	p value
NANOGEN ™	baseline to 3 months	3.933	.3640	.1213	.174	.864
	baseline to 6 months	4.256	.3678	.1226	-1.183	.253
	3 – 6 months	.333	.0707	.0236	-3.569	.002

Figures:-

Figure 1:- Stent Preparation.

Figure 2:- Debridement

Figure 3:- Nanogen^{tm} Bone Graft Placement.

Figure 4:- Probing depth at 3 months

Figure 5:- Probing depth at 6 months

Figure 6:- CBCT at 3 months.

Figure 7:- CBCT at 6 months.

References:-

1. Shue, L., Z. Yufeng and U. Mony, 2012. Biomaterials for periodontal regeneration: A review of ceramics and polymers. Biomatter, 2(4): 271-277.
2. Carraro JJ, Sznajder Alonso CA. Intraoral cancellous bone autografts in the treatment of infra bony pockets. J ClinPeriodontol, 1976; 3: 104-109.
3. Jeffcoat MK. Current concepts in periodontal disease testing. J Am Dent Assoc 1994; 125:1071-1078.
4. Molander B. Panoramic radiography in dental diagnostics.Swed Dent J Suppl 1996; 119:1-26.
5. Jeffcoat MK. Radiographic methods for the detection of progressive alveolar bone loss. J Periodontol1992; 63(Suppl.):367-372.
6. Reddy MS. Radiographic methods in the evaluation of periodontal therapy. J Periodontol1992;63(Suppl.): 1078-1084
7. Ramadan AB, Mitchell DF. A roentgenographic study of experimental bone destruction.OralSurg Oral Med Oral Pathol 1962; 15:934-943.
8. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. Journal of periodontology. 2006 Jul; 77(7):1261-6
9. Aichelmann-Reidy ME, Heath CD, Reynolds MA. Clinical evaluation of calcium sulfate in combination with demineralised freeze-dried bone allograft for the treatment of human intraosseous defects. J Periodontol 2004;75:340-7.
10. Frame JW. Porous calcium sulphate dihydrate as a biodegradable implant in bone. J Dent 1975; 3:177-87.
11. Payne JM, Cobb CM, Rapley JW, Killoy WJ, Spencer P. Migration of human gingival fibroblasts over guided tissue regeneration barrier materials. J Periodontol 1996; 67:236-44.
12. Strocchi R, Orsini G, Iezzi G, Scarano A, Rubini C, Pecora G, et al. Bone regeneration with calcium sulfate: Evidence for increased angiogenesis in rabbits. J Oral Implantol 2002; 28:273-8.
13. Pecora G, Baek SH, Rethnam S, Kim S. Barrier membrane techniques in endodontic microsurgery. DentClin North Am 1997; 41:585-602.
14.Arthiie T. Comparative Analysis of Clinical and Radiological Parameters of Intrabony Defects treated with Autogenous Bone Grafts and Xenograft combined with PRP: A Six months Follow Up Study (Doctoral dissertation, JKK Nataraja Dental College, Komarapalayam).2011: