A Study to Compare The Trabecular Pattern In Edentulous Residual Alveolar Ridge Prior and After Loading Of Implant Supported Prosthesis – An In Vivo Study

Prof. Dr. Chethan Hegde	Head of Department, Dept. of Prosthodontics, A. B. Shetty Memorial Institute of Dental Sciences
Prof. Dr. Manoj Shetty	Head of Department of Oral Implantology, A. B. Shetty Memorial Institute of Dental Sciences
Dr. Kamal Hotchandani	P.G Student, A. B. Shetty Memorial Institute of Dental Sciences,
Prof. Dr. Rakshith Hegde	Professor, Department of Prosthodontics, A. B. Shetty Memorial Institute of Dental Sciences

ABSTRACT

OBJECTIVES: To evaluate the changes in trabecular pattern of bone in an edentulous residual alveolar ridge prior placement of implant and at 3rd, 6th month following the loading of implants.

METHODOLOGY: All implants were placed with minimum insertion torque of 25 Ncm2 assessed by physiodispensor. A two stage implant surgery was performed. Routine Digitized Periapical Radiograph was made in relation to the area of concern prior to the implant placement and also 3,6 months following loading. And variation in trabecular pattern were studied.

RESULTS: Analysis of the results with respect to variation in trabecular bone pattern following 3 months loading did not show any noticeable change. The radiographs of 6 months following functional loading showed the difference in the trabecular bone pattern changes. Of the 30 patients six months of following functional loading of implant, 12 (40%) subjects showed sparse and dense trabeculation, 15 (50%) subjects showed the dense trabeculation and 3(10%) subjects showed the sparse trabeculation. Overall 21 (70%) subjects showed the changes in trabecular pattern.

CONCLUSION: No significant change in trabecular pattern was noticed immediate following implant placement and 3 months following functional loading. Significant change in trabecular bone pattern was noticed 6 months following functional loading.

INTRODUCTION

The trabeculae or "trabecular" bone is the primary anatomical and functional unit of cancellous bone. Cancellous bone has direct contact with the majority of the implant surface. Accordingly, it influences the healing and osseointegration process at the implant– bone surface.[1,2] The mechanical and structural properties of bone should be clinically assessed precisely because they are essential for implant thread design and in planning dental implant treatment. It can be assessed on two-dimensional basic radiography (e.g. periapical intraoral radiography).[3,4]

Panoramic and periapical radiography are the primary diagnostic aid used in clinical dental investigations. Periapical images with sharpness and higher resolution provides information for assessment of amount and pattern of trabecular bone.[5,6] Periapical images showed high visibility of trabecular bone, which enhances its prospective in imaging studies of trabecular bone.[7] The quality of bone on periapical radiographs can be studied using the classification system of bone mentioned by Trisi and Rao, Misch, Lekholm and Zarb, but for the studies of trabecular bone in dental implants the Lekholm and Zarb system is most commonly used.[8] The trabecular bone is classified as Sparse Trabeculation, Dense Trabeculation and Sparse and Dense Trabeculation. According to classification of Zarb and Lekholm, in the sparse trabeculation trabeculae are relatively few in number giving the appearance of large marrow spaces, in dense trabeculation trabeculae are more numerous and trabeculae are more near to each other compare to sparse trabeculation, while in sparse and dense mixed trabeculation is noticed that is some region it is dense and in some region sparseness is noticed.

OBJECTIVES OF THE STUDY:

To compare the trabecular pattern in edentulous residual alveolar ridge prior and 3 and 6 months following loading of implant supported prosthesis.

MATERIALS AND METHODS:

SOURCE OF THE DATA

The study was conducted on a group of 30 subjects (age group 18-35 years) visiting outpatient department in A. B. Shetty Memorial Institute of Dental Sciences (Nitte University), Deralakatte, Mangalore. Informed consent to participate in the study was obtained from each subject.

INCLUSION CRITERIA

1. All patients in good health with no systemic diseases.
2. Patient aged between 18-35 years
3. Patients who are ready to undergo for implant supported tooth replacement in the posterior mandibular and anterior maxillary region.

EXCLUSION CRITERIA

1. Presence of obvious periapical pathological lesion.
2. Uncontrolled diabetes, coagulation disorders or any other systemic disease.
3. Smoking more than 10 cigarettes per day, alcohol or drug abuse.
4. Implants which are augmented with graft material.

DATA COLLECTION

Thirty subjects from the outpatient department of A.B.Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore were selected. Trabecular pattern was evaluated by digitized periapical radiograph which was made for routine evaluation and follow up of implant supported prosthodontic placement site. All patients requiring a single tooth replacement in the posterior mandible and anterior maxilla region were selected.

Radiographic Evaluation of Trabecular Pattern:-

General physical examination and complete blood investigation

was conducted before starting the surgical procedure. All implants were placed with minimum insertion torque of 25 Ncm^2 assessed by physiodispensor. A two stage implant surgery was performed. Routine Digitized Periapical Radiograph (Long Cone Technique) was made at the area of concern prior, soon after implant placement and 3 and 6 months following prosthodontic loading, when patient returns for routine evaluation of implant supported prosthesis. These digital Radiographs were used to assess the trabecular pattern changes of bone prior and after implant placement.

Two observers were trained to evaluate the trabecular pattern of bone. Both the observers evaluated 10 sets of digitized periapical radiograph separately. Both the observers evaluated the trabecular pattern of bone twice in different sequences on different days. Their assessment was checked for discrepancy in reading of trabecular pattern and the evaluation was repeated till the consistency in reading is attained to eliminate the intra-assessment discrepancy. Same sets of radiograph were evaluated by observers and were checked to eliminate inter-assessment discrepancy and evaluation was repeated till the consistency in reading is attained.

RESULTS

Data collected by analyzing digital radiography were tabulated and statistically analyzed. Results obtained were tabulated in 2 tables. Trabecular pattern of bone in periapical digital radiographs made immediately following implant placement and 3 months following functional loading did not show any statistically significant variation (p-value <0.001*). Out of 30 (100%) cases, 21 (70%) of cases showed the sparse and dense trabeculation immediately, whereas remaining 9 cases (30%) showed sparse trabeculation (Table no.I).

Statistically significant variation (p=0.001*) in trabecular bone pattern was noticed when on radiographic evaluation of images made immediately following implant placement, 3 months following functional loading was compared with radiographs made 6 months following functional loading (Table no. II). Of the 30 patients six months of following functional loading of implant, 12 (40%) subjects showed sparse and dense trabeculation, 15 (50%) subjects showed the dense trabeculation and 3(10%) subjects showed the sparse trabeculation. Overall 21 (70%) subjects showed the changes in trabecular pattern.

Table No:-I Radiographic evaluation and comparison of trabecular pattern of bone immediately following implant placement and 3 months following functional loading.

	Trabecular Bone Pattern	3 months of Functional Loading		Total
		Sparse and Dense Trabeculation	Sparse Trabeculation	
Immediate after Implant Placement	Sparse and Dense Trabeculation	21(70.0%)	0	21(70.0%)
	Sparse Trabeculation	0	9(30.0%)	9(30.0%)
	Total	21(70.0%)	9(30.0%)	30(100.0%)
	Cramer's V =1.00, p<0.001*			

Table No:-II Radiographic evaluation and comparison of trabecular pattern of bone immediately following implant placement, 3 months following functional loading and 6 months following functional loading.

	Trabecular Bone Pattern	6 months of Functional Loading			Total
		Sparse and Dense Trabeculation	Dense Trabeculation	Sparse Trabeculation	
Immediate after Implant Placement and 3 months of functional loading	Sparse and Dense Trabeculation	6(20.0%)	15(50.0%)	0	21(70.0%)
	Sparse Trabeculation	6(20.0%)	0	3(10.0%)	9(30.0%)
	Total	12(40.0%)	15(50.0%)	3(10.0%)	30(100.0%)
	Cramer's V Value=0.72 and p-value= <0.001*				

Diagram I:-Trabecular bone pattern immediately following placement of implant and 3,6 months following functional loading of implant.
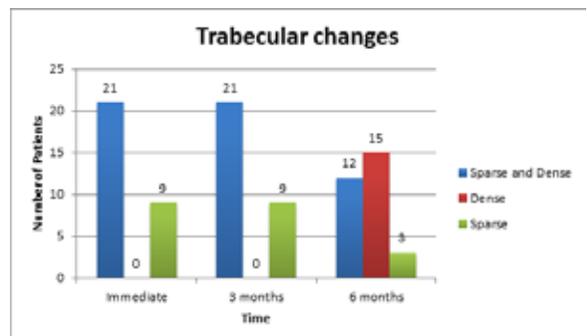
DISCUSSION

Periapical images with sharpness and higher resolution provides the information for assessment of an amount and pattern of trabecular bone.[5,6] Periapical images showed high visibility of trabecular bone, which enhances its prospective in imaging studies of trabecular bone.[7] On periapical radiographs the quality of bone can be studied using the classification system of bone given by Lekholm and Zarb is used.[8]

The routine peri-apical digitized radiographs were made. The radiographs of immediately after implant placement and 3 and 6 months after loading were assessed and compared to determine the changes in the trabecular bone.

The radiographs of 6 months following functional loading showed the difference in the trabecular bone changes. By assessing radiographs of immediately after implant placement and after 6 months of loading period, Of the 30 cases 12 (40%) subjects showed sparse and dense trabeculation, 15 (50%) subjects showed the dense trabeculation and 3(10%) subjects showed the sparse trabeculation. Overall 21 (70%) subjects showed the changes in trabecular pattern. This change can be attributed to the strain and load on implant, which remodels the bone around implant.

Osseointegration generally follows three stages: (1) incorporation by woven bone formation, (2) adaptation of bone mass to load (lamellar and parallel-fibered deposition) and (3) adaptation of bone structure to load (bone remodeling) (Schenk & Buser, 1998). During the third stage, when functional loading has been initiated, the bony structures adapt to the load by improving the quality of the bone; replacing pre-existing, necrotic and/or initially formed more primitive woven bone with mature, viable lamellar bone. This leads to functional adaptation of the bony structures to the load.

Lanyon in 1987 stated that strain emerge to be one of the initiater for an adaptive response of bone, it may take upto months or even years to adapt to strain and similarly for the trabrcular bone around the implant takes some time to remodel according to strain. Wolff's law stated that trabeculae tend to align themselves at right angles to each other. Most of the subjects showed change in the trabecular pattern following functional loading of 6 months. So in cases of progressive loading where the nature of the bone is soft initially, after some time period of loading with transitional prosthesis there will be change in the bone pattern which indicates that implant then can be loaded with final prosthesis.

REFERENCES

1. Sakka S, Coulthard P. Bone quality: a reality for the process of osseointegration. Implant Dent 2009; 18: 480–485.

2. Fanuscu MI, Chang TL. Three-dimensional morphometric analysis of human cadaver bone: microstructural data from maxilla and mandible. Clin Oral Impl Res 2004; 15: 213-218.

3. DeTolla DH, Andreana S, Patra A, Buhite R, Comella B. Role of the finite element model in dental implants. J Oral Implantol 2000; 26: 77–81.

4. Yi WJ, Heo MS, Lee SS, Choi SC, Huh KH. Comparison of trabecular bone anisotropies based on fractal dimensions and mean intercept length determined by principal axes of inertia. Med Biol Eng Comput 2007; 45: 357–364.

5. White SC, Pharoah MJ. Oral radiology: principles and interpretation. 5th edn. St Louis: Mosby; 2004.

6. Whaites E. Essentials of dental radiography and radiology. 3rd edn. London: Churchill Livingstone; 2007.

7. Couture RA, Whiting BR, Hildebolt CF, Dixon DA. Visibility of trabecular structures in oral radiographs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003; 96: 764–771.

8. Ribeiro-Rotta RF, Lindh C, Pereira AC, Rohlin M. Ambiguity in bone tissue characteristics as presented in studies on dental implant planning and placement: a systematic review. Clin Oral Implants Res 2011; 22: 789–801.