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Evaluation of Soft Tissue Response around Single Piece Zirconia Implants and Titanium Implants

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Abstract

Aim: Dental implants are anchored in jaw bone through a direct fusion between bone and the implant. Success and survival of an implant not depend solely on osseointegration. A soft tissue, which surrounds the transmucosal part of a dental implant, separates the periimplant bone from the oral cavity. This soft tissue collar is called "periimplant mucosa". The purpose of this study is a comparative assessment of gingival blood flow during healing of implant by ultrasound doppler flowmetry single piece zirocnia implant and titanium dental implant.

Materials And Methods: Twenty partially edentulous patient of age group 20 –50 years who are non smokers, with good general health will be enrolled in the study and will be randomly divided into 2 different sites bilaterally i.e zirconia dental implants and titanium dental implants were placed in total of 10 patients and vascular flow in peri-implant mucosa will also be assessed by ultrasound Doppler flowmetry at baseline (before placement of the Implant) and on the 10th day postoperatively.

Results: All the patients were regular for a follow-up duration of 12months by the completion of the study. Both the experimental sites showed no statistical significance, Doppler velocity values in Group A and Group B. Significant increase in the increase in Vascular Channels and Doppler Velocity rate in Group A and B when compared between baseline and follow-up.

Conclusion: All the implants healed uneventfully. However, by the comparison between groups, there is much significance between the groups. There is a significant improvement in vascularity from baseline to 10 days.

Keywords: Dental Implant, zirconia dental implant, Doppler Ultrasound, Peri-Implant Mucosa, Soft Tissue Healing, Microcirculation.

Introduction

Achieveing a desired implant installation with excellent esthetics consists of a visually pleasing prosthesis and complete and healthy surrounding soft tissue. The goal of achieving an optimal esthetic outcome with implants located in the esthetic zone remains a major challenge in implant dentistry. An ideal esthetic implant restoration is defined as a combination of both visually pleasing prosthesis and healthy, amicably scalloped surrounding peri-implant soft tissues[1].

Advance in dentistry has been the prosperous replacement of lost natural teeth by osseointegrated implants and the present and future application of implants to support intra- and extra-oral prostheses is a great importance in improving dental health. A dental implant is a fixture which is placed into bone to replace missing teeth[2]. Gingival blood flow can be asessed by the invasive and non-invasive methods. The former include vital microscopy of gingival margin, implantation of microspheres into the internal carotid artery in animals, infused radio isotopes and radio labeled microspheres and high speed cinematography.

Doppler Sonography is a non-invasive, accurate and simple technique to measure continuous microcirculatory blood flow in many tissues. It works on “Doppler Shift” principle, measuring the frequency change that light undergoes when reflected by moving objects, such as red blood cells (RBC). It has been extensively used in various medical clinical applications, also in the field of plastic surgery to monitor blood perfusion in skin transplants and flaps.

The color Doppler ultrasound imaging was performed with an APLIO mx TOSHIBA Ultrasound System, with 4D transducer technology. The probe used was a linear transducer probe with 10 MHZ capacity. The transducer was applied over the glove finger in a coronal plane with interspersed ultrasonic gel for proper contact. The water filled glove finger served as a water media for sound waves to pass, thus providing better clarity and detail[3]. Evaluation of the blood flow is done by ultrasound Doppler, today various other methods are available for the investigation of blood supply in clinics, some of which are excellent in concluding the presence and extent of arterial and venous disorders. However, only ultrasound Doppler gives information on microvascular status[4].

The purpose of this study was to compare the vascular flow during healing of the peri-implant soft tissue using ultrasound Doppler flowmetry around zirconia and titanium dental implants.

The stability of dental implants is of great significance for successful osseointegration. The long-term retention of implants, however, depends on how strongly the epithelial and connective tissues adhere to its titanium surface, that is on how efficiently the soft tissues seal the bone protecting it from the oral bacterial flora. It is very important that we create such soft tissues around the implants so that they can form a healthy soft tissue barrier[5].

Invasive and non-invasive methods can be used to measure gingival blood flow. Doppler sonography isa non-invasive, accurate and, simple technique to measure continuous microcirculatory blood flow in many tissues. It works on the “Doppler Shift” principle, measuring the frequency change that light undergoes when reflected by moving objects, such as red blood cells. It has been extensively used in various medical clinical applications, also in the field of plastic surgery to monitor blood perfusion in skin transplants and flaps. Evaluation of

blood flow changes between different sites in the same patient and within different patients are possible[6].

Materials and Methods

Study Design: The study population included patients who reported to the department of Periodontics St Joseph dental college who seek replacement of lost teeth between April 2018to April 2019. A randomized, double-blinded clinical trial was planned and patients were enrolled using the roll of dies method of partially edentulous patients was undertaken to evaluate the soft tissue response of zirconia dental implant and titanium implant. The selected sites were randomly divided into Experimental s**ite** A where zirconia dental implant is placed and Experimental site B where titanium dental implant is placed where as experimental sites were determined by the roll of dies method. A total of 20 implants were placed for the study bilaterally, after completion of the presurgical phase of treatment. Prior to commencement, the study the study design was discussed with every selected patient and his / her written consent was taken.

Patients with any systemic diseases, smokers, pregnant or lactating females, individuals with poor oral hygiene were excluded in the study. Following initial examination and treatment planning, the selected patients underwent phase 1 therapy. Detailed instructions and plaque control measures were given. All the selected patients underwent routine blood investigations and radiographs of the area of interest were taken. On completion of baseline examination and thorough initial therapy, dental implants were placed at the edentulous sites. Vascular flow in periimplant mucosa will also be assessed by ultrasound Doppler flowmetry at baseline (before placement of implant) and on the 10th day postoperatively which are shown in (figure 1 to figure 4). The clinical parameters like Vascular Channels (VC) and Doppler Velocity Rate (DVR) were assessed with graduated Plastic probe and Ultrasound Doppler Machine and were recorded at baseline, and 10 days.

Fig. 1: Site A ultrasound Doppler flowmetry indicating number of vascular channels and Doppler velocity at base line

Fig. 2: Site A ultrasound Doppler flowmetry indicating number of vascular channels and Doppler velocity at 10 days

Fig. 3: Site B ultrasound Doppler flowmetry indicating number of vascular channels and Doppler velocity at base line

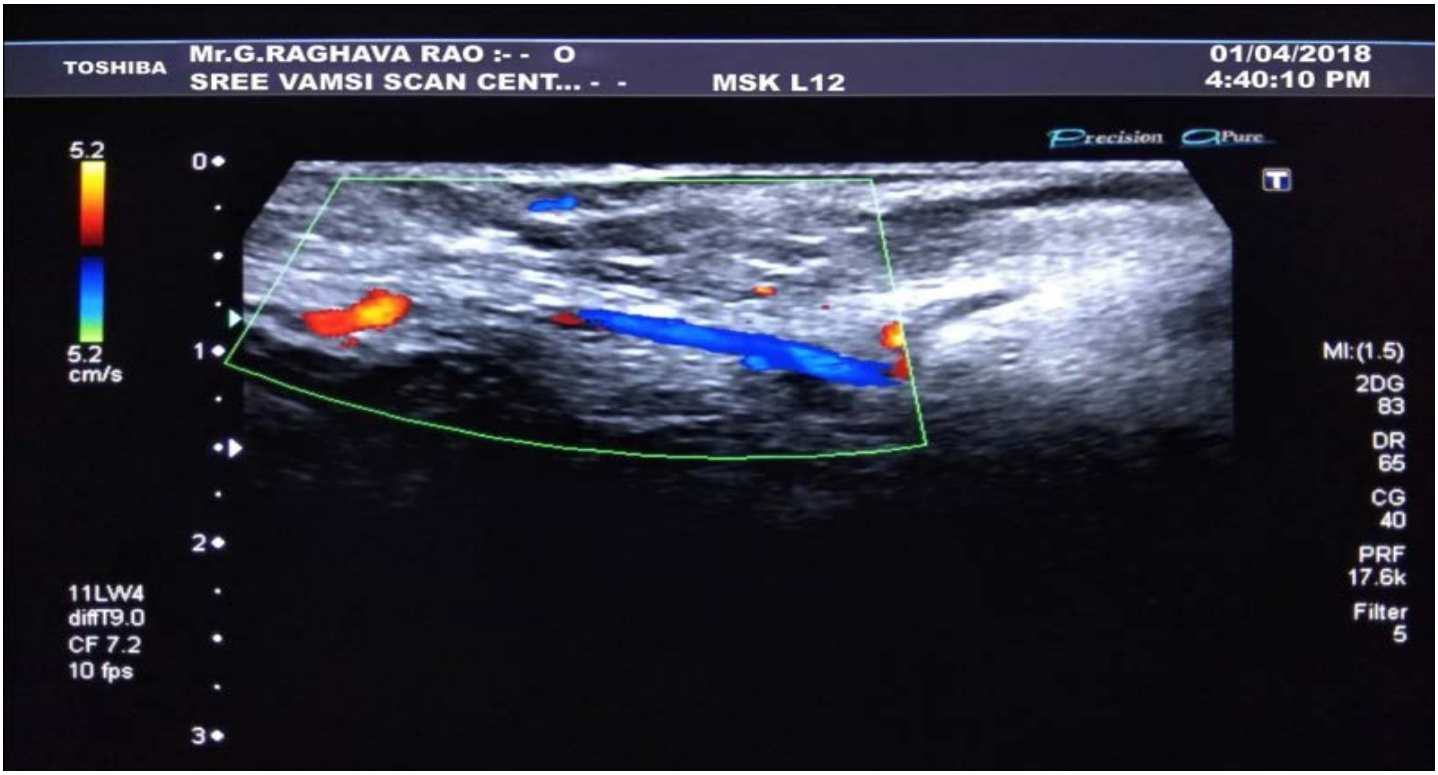


Fig. 4: Site B ultrasound Doppler flowmetry indicating number of vascular channels and Doppler velocity at 10 days

Results

This study was conducted to assess soft tissue response around zirconia and titanium dental implants. A total of 20 sites and 10 patients were selected randomly from the outpatient department of periodontics, St Joseph dental college. Clinical parameters for soft tissue response around zirconia and titanium implants were measured at baseline and followup the data obtained was subjected to statistical analysis

Data were entered in MS-Excel and analyzed in SPSS V22. Descriptive statistics were represented with Mean & SD. Independent t-test, were applied to find significance. $P<0.05$ was considered statistically significant. The results were presented under headings of various parameters which were considered in the study.

Table 1: Mean, Standard Deviation of Number of Vascular Channels of Group A and Group B

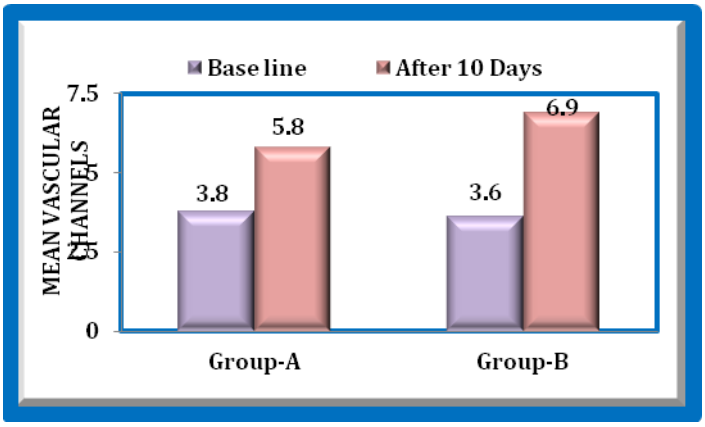
Variable	Group	Minimum	Maximum	Mean	SD	P-value
Number of vascular channels at baseline	A	3.0	5.0	3.80	0.79	0.33
	B	3.0	5.0	3.60	0.70	
Number of vascular channels at 10d	A	5.0	8.0	5.80	0.92	0.02
	B	5.0	8.0	6.90	0.99	
No of vc diff	A	1.00	4.00	2.50	1.08	0.31
	B	0.00	5.00	3.10	1.45	

Statistical Analysis: Independent t-test. Statistically significant if p value is < 0.05

Inference

The results showed a mean number of vascular channels at 10 days for group A, group B are 5.80 and 6.90 respectively which revealed statistical significance with P value 0.02. While comparing the means of group A and group B graph revealed greater for number of vascular channels group B.

The means of vascular channels at baseline and 10 days were 3.80 and 5.80 for group A and 3.60 and 6.90 for group B which revealed statistically insignificant with P value of 0.31.



Graph 1: Comparison of mean vascular channels between group And group B at base line and 10 days

Table 2: Mean, Standard Deviation of Doppler Velocity Rate of Group A and Group B

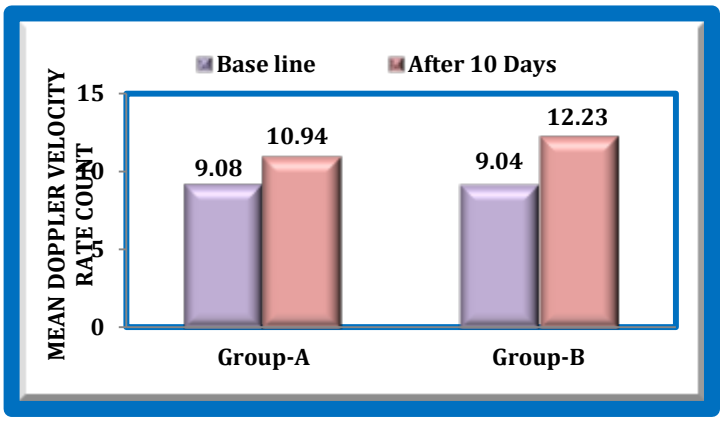
Variable	Group	Minimum	Maximum	Mean	SD	P-value
Doppler velocity rate at BL	A	7.2	11.2	9.08	1.37	0.95
	B	7.4	11.2	9.04	1.18	
Doppler velocity rate at 10D	A	10.2	12.2	10.94	0.79	**0.007**
	B	10.5	13.2	12.23	1.08	
Doppler velocity diff	A	0.00	6.20	2.38	1.80	0.39
	B	.30	5.80	3.08	1.74	

Statistical Analysis: Independent t-test. Statistically significant if p value is < 0.05

Inference

The results showed a Doppler velocity rate count means at 10 days 10.94 and 12.23 for group A and group B respectively which revealed statistical significance with P value 0.007. While comparing the means of group A and group B graph revealed greater doppler velocity rate count for group B.

The means of Doppler velocity at baseline and 10 days were 9.08 and 10.94 for group A and 9.04 and 12.23 for group B which revealed statistically insignificant with P value of 0.39.



Graph 2: Comparison of Doppler velocity between group A and group B at base line and 10 days

Discussion

Edentulism is contemplated as a physical disability since the loss of imperative body parts has been in the aged individual and affects distinctive parts of personal satisfaction. Edentulous individuals experience a debilitated competence to perform vital life assignments. Various treatment modalities have been put forth to replace the missing tooth. However, implant therapy has achieved more attention and connotation.

Dental implants are biocompatible metal anchors surgically placed into the jawbone within the gums to replace missing teeth. Osseointegration is an essential factor for outstanding modern dental implants. Titanium remains the material of choice for obtaining and maintaining this bone to implant contact Al-brektsson et

al. stated that the implant surface quality is one main factor that monitors the healing of wound healing at the site of implant installation and consequently affects osseointegration. Dark grayish color is the main drawback of titanium that appears via peri-implant mucosa, hence impairing esthetic results in a thin mucosa biotype's presence[7].

Zirconia is a metal oxide identified in 1789 by German Chemist Martin Heinrich Klaproth. Zirconium oxide is ivory in color making which, resembles the color of the natural tooth and is essential for the replacement of missing teeth in the mouth especially, in the aesthetic zone. Additionally, it also has the ability for transmission of light which, makes zirconia a suitable material for esthetics. Zirconium oxide implants have outstanding mechanical properties, good stability, high biocompatibility and, high resistance to scratching and corrosion[8].

Zirconia appears to be an appropriate dental implant material because of its mechanical properties, such as the color of tooth and biocompatibility. Gingival recession and apical bone loss connected to implants frequently expose portions of the metal implant, disclosing a bluish discoloration of the superimposing gingiva. The utilization of zirconia implants eliminates complications and meets the request of patients for metal-free implants. It also offers biocompatibility, fracture toughness and, high strength. Bone resorption and the inflammatory response produced by ceramic particles are less when compared to those caused by particles of titanium, recommending the biocompatibility of ceramics particles are less compared to those produced by particles of titanium[9].

Revascularization with the help of ultrasound Doppler flowmetry was used to assess the peri-implant soft tissue because of the added advantage that the comparison of blood flow changes between the same patient and different patients are possible. Echogenicity of the tissue refers to the ability to reflect or transmit ultrasound waves in the context of surrounding tissues, Whenever there is an interface of structures with different echogenicities, a visible difference in contrast will be apparent on the screen. Based on echogenicity, a structure can be characterized as hyperechoic (white on the screen), hypoechoic (gray on the screen) and anechoic (black on the screen)

Bone appears black or anechoic on US. Because the US beam cannot penetrate bone, it casts an acoustic shadow beyond it. Cartilage appears hypoechoic, and is more penetrable by US than bone. Blood vessels also appear black or anechoic. Blood vessels have a distinct appearance on color Doppler mode. Color Doppler studies depict vascular areas by color coding of blood vessels, the number of color coded structures indicates the number of blood vessels in the region of study [10, 11].

This study was to compare and evaluate soft tissue response around zirconia and titanium dental implant. The parameters that were included along with number of vascular channels, Doppler velocity count for this prospective study. Several factors such as surface characteristics, design and, nature of implant material and amount of mucosal seal around implants. The means of vascular channels and doppler flow velocity are insignificant for both group A and B how ever increases from baseline to 10 days. The means of the number of vascular channels and Doppler flow velocity at baseline to 10 days nonsignificant within the group B these findings were in accordance with studies by Karthik sivaraman et al 2018, Van brakel et al 2012[12]**.** However, studies with larger sample size are to be conducted to assess the soft tissue response between zirocnia and titanium dental implant.

Summary

In conclusion the present study was undertaken to evaluate soft tissue changes of zirconia and titanium dental implants placed in suitable edentulous sites. All the implants osseointegrated with any uneventful healing. The oral hygiene measures followed accordingly showed successful implants without peri-implantitis. Laser Doppler flowmetry aids in the measurement of the vascularity at the implant site; however, intraoral devices specially designed are required for added advantage. However, the study has certain limitations. The limited number of patients and shorter followup periods may have contributed to the lack of any detectable significance between the groups. Longer follow-ups with larger samples are necessary to study the efficiency of the material in attaining a predictable treatment outcome.

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