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RESEARCH ARTICLE

MARGINAL BONE LEVEL CHANGES AROUND DENTAL IMPLANT BASED ON CONE BEAM COMPUTED TOMOGRAPHY AND RADIOVISIOGRAPHY - AN IN VIVO STUDY

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Abstract

Purpose: The aim of the present study was to evaluate and compare the marginal bone level changes around dental implants based on radiological examination by Radiovisiography and Cone beam computed tomography

Materials and Method: For this in-vivo study, total of 14 implants were replaced in the edentulous area within the mouth randomly categorized under two groups which differ in evaluation method based on RVG and CBCT. Group 1 (n=7) Patients in which marginal bone loss was evaluated using RVG at baseline 3, 6 months interval. Group 2 (n=7) Patients in which marginal bone loss was evaluated using CBCT at baseline 3, 6 months interval

Result: At the 3 months time interval the mean bone loss in the RVG was 0.155 and 0.672 in the CBCT on the mesial side. The intergroup comparison of bone loss between RVG and CBCT was statistically significant when analyzed using Independent t test ($p=0.001$). At the 6 months time interval the mean bone loss in the RVG was 0.304 and 1.396 in the CBCT on the mesial side. The intergroup comparison of bone loss between RVG and CBCT was statistically significant when analyzed using Independent t test ($p=0.001$)

Conclusion: To conclude, though CBCT and RVG both are reliable tool for evaluation of marginal bone loss, the intergroup comparison showed in the result states the accuracy of CBCT as compared to RVG during the follow up time of the present study.

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Introduction:-

The goal of modern dentistry is to provide a healthy and beautiful smile that is supported by a functional and comfortable occlusion and to prevent tooth loss. However, there are situations in which extraction is the only course of treatment. In the posterior region, tooth loss is very embarrassing to the patient as it affects the aesthetics, speech and function.

After tooth extraction, bone loss remains an important issue in dentistry. Anatomically, bone resorption occurs both buccolingually and apicocoronally and the first 6 months post extraction are critical, carrying the highest rate of bone resorption in either direction. The clinical, anatomic and radiologic characteristics of the socket immediately after tooth extraction are distinctly different from the socket environment after 1 year of healing

Today, the two most common treatment options for single tooth replacement are the fixed partial denture and the implant supported prosthesis. Dental implant appeared as an alternative option after the accidental observation of integration of titanium screws into bone was observed by Bothe et al in 1940 and later described by Gottlieb Leventhal in 1951. The use of osseointegrated endo- osseous implant to support the fixed or removable prosthetic treatment has residual alveolar bone preservation . The reactions have been described by Leventhal and Bothe et al, were later coined into the term "osseointegration" by Per-Ingvar Branemark .

In 1965, Branemark began dental implant placement in edentulous patients, while titanium implants started to be widely exploited in dental treatment

Installation of dental implants for fixed or removable rehabilitation has become a common practice in the last decades , and its high rates of survival and success are well documented .

The aim of the present study was to evaluate and compare the marginal bone level changes around dental implants based on radiological examination by Radiovisiography and Cone beam computed tomography

Material And Method:-

The present in vivo study was conducted in the Department of Prosthodontics & Implantology, DJ College of Dental Sciences & Research Modinagar, Uttar Pradesh, for esthetic and functional rehabilitation of missing teeth irrespective of their socio-economic status, religion, age and sex

For this in-vivo study, total of 14 implants were replaced in the edentulous area within the mouth randomly categorized under two groups which differ in evaluation method based on RVG and CBCT .

Group 1 (n=7) Patients in which marginal bone loss was evaluated using RVG at baseline 3, 6 months interval

Group 2 (n=7) Patients in which marginal bone loss was evaluated using CBCT at baseline 3, 6 months interval

A total of 14 implants were placed for the study. All patients were prescribed with proper medication an hour before surgery. The required area was anaesthetized and strict asepsis protocols were observed to prepare the osteotomy site for implant placement. Postoperatively antibiotics, anti-inflammatory and analgesic were prescribed for 5 days and chlorhexidine 0.12% mouth rinse prescribed twice a day for 14 days

All patients were subjected to CBCT and RVG for assessing bone quality of the implant site .

In order to assess bone density of implant recipient sites, cone beam computerized tomography (CBCT) machine was utilized. The same scanning conditions (x-ray tube voltage 85 kv, tube current 10ma, slice thickness 1 mm, 14 bit gray scale, a field view of 8 * 8cm and 5000 milliseconds of exposure time) were provided for each CBCT scan. The cross-sectional, coronal and axial images for each maxilla/mandible were obtained from the CBCT machine. The suitable implant for each previously designated implant recipient site was selected by using the cross-sectional images. The rectangular area of each implant selected was plotted on the cross- sectional images with a tool incorporated in the CBCT machine, and the mean density of the implant recipient area was measured to a distance of 1 mm using the software (Triana Ver. 2.5.11.0) incorporated in the CBCT machine. The bone density, measurements were recorded in relative Hounsfield units (RHU).

The bone loss in RVG was evaluated using the software sidexis. The bone loss was measured by drawing 2 perpendicular line, one on the mesial aspect and one on the distal aspect fro crestal bone level. Marginal bone loss was measured from reference point on implant shoulder to the most coronal point of the bone using measuring tool in the RVG software

The bone loss was measured using cbct with the help of ruler in image tool software(Triana Ver.2.5.11.0). Four measurments were performed for each site : mesial horizontal , mesial vertical, distal horizontal, distal vertical.

Discussion:-

Most of the systematic review studies reported no statistically significant differences between groups regarding MBL. On the contrary, four studies found statistically significant differences between groups. However, these differences ranged only from 0.02 to 0.32 mm⁴³

Originally, a mean crestal bone loss of ≥ 1.5 mm after the first year of function and a ≥ 0.2 mm loss per year afterwards, were considered as threshold values to determine implant success reported by Albrektsson et al 1986 39. Mericske-Stern et al 200134 concluded the study showing a high cumulative survival rate of short implants > 8 mm supporting single crowns after 10 years was 98.3% and 5 years was 98.7%. This result is in agreement with the long-term observations reporting high survival rates on conventional implants with SLA or other moderately rough surfaces when supporting single-crown prostheses. The similar result is achieved in the present study by use of short implant modified with SLA surface

Pistilli et al 2013 strongly proved in his recently published study using a similar design, a mean MBL of 1.02 ± 0.06 mm was shown for short implants placed in the posterior maxilla after 1 year of function. Similar results also seen in the present study prove that the radiological parameters such as the mean bone loss at the mesial horizontal site was 1.86 ± 0.32 mm, mesial vertical site was 1.73 ± 0.34 mm, distal horizontal site was 1.09 ± 0.45 mm, distal vertical site was 0.81 ± 0.38 mm at 3 months . The mean bone loss at the mesial horizontal site was 1.81 ± 0.19 mm, mesial vertical site was 1.69 ± 0.27 mm, distal horizontal site was 1.06 ± 0.33 mm, and distal vertical site was 0.76 ± 0.29 mm at 12 months. The comparison of bone loss between 3 and 12 months at various sites (mesial horizontal, mesial vertical, distal horizontal, distal vertical) was done. The overall mean bone loss at 3 months was found to be 1.37 ± 0.57 mm. The overall mean bone loss at 12 months was found to be 1.33 ± 0.51 mm. The Comparison of the overall mean bone loss at 3 months and 12 months was 1.37 ± 0.57 mm and 1.33 ± 0.51 mm respectively³⁹

M. Kozakiewicz et al in 2014 found that marginal bone loss was statistically higher in younger patients compared to the older ones in the first 12 months after loading with a prosthetic appliance. The study also did not find any relation between gender and MBL. According to Lombardi T. et al(2019), early MBL occurred in the first six months after prosthetic loading. At 15-month follow-up, peri-implant marginal bone levels remained unaltered.⁵⁷ R. Anner et al in 2015 reported that high survival rates can be obtained after prosthetic treatment with 6 mm-wide tapered HA-coated implants. Though there was marginal bone loss observed in the current study it did not find any co-relation between gender and bone loss. However in this study no implants were prosthetically loaded until the study was completed

Current study results suggested that CBCT and RVG can be used as a reliable tool for correlating bone quality to marginal bone loss of implant site. These techniques also helps for implant placement and the treatment prognosis. Moreover the information gathered from CBCT aids in proper planning of surgical techniques to be applied during osteotomy procedure and implant placement. While the conventional osteotomy results in less primary stability and torque as in type 4 bone quality, expansion osteotomes can be recommended for better results. This further enhances the bone quality all around the implant. Selection of right surgical procedure is crucial for maintaining adequate bone quantity for better osseointegration of implants, maintaining crestal/marginal bone and to reduce other post operative complications, etc.,.

Results:-

At the 3 months time interval the mean bone loss in the RVG was 0.155 and 0.672 in the CBCT on the mesial side The intergroup comparison of bone loss between RVG and CBCT was statistically significant when analyzed using Independent t test (p=0.001)

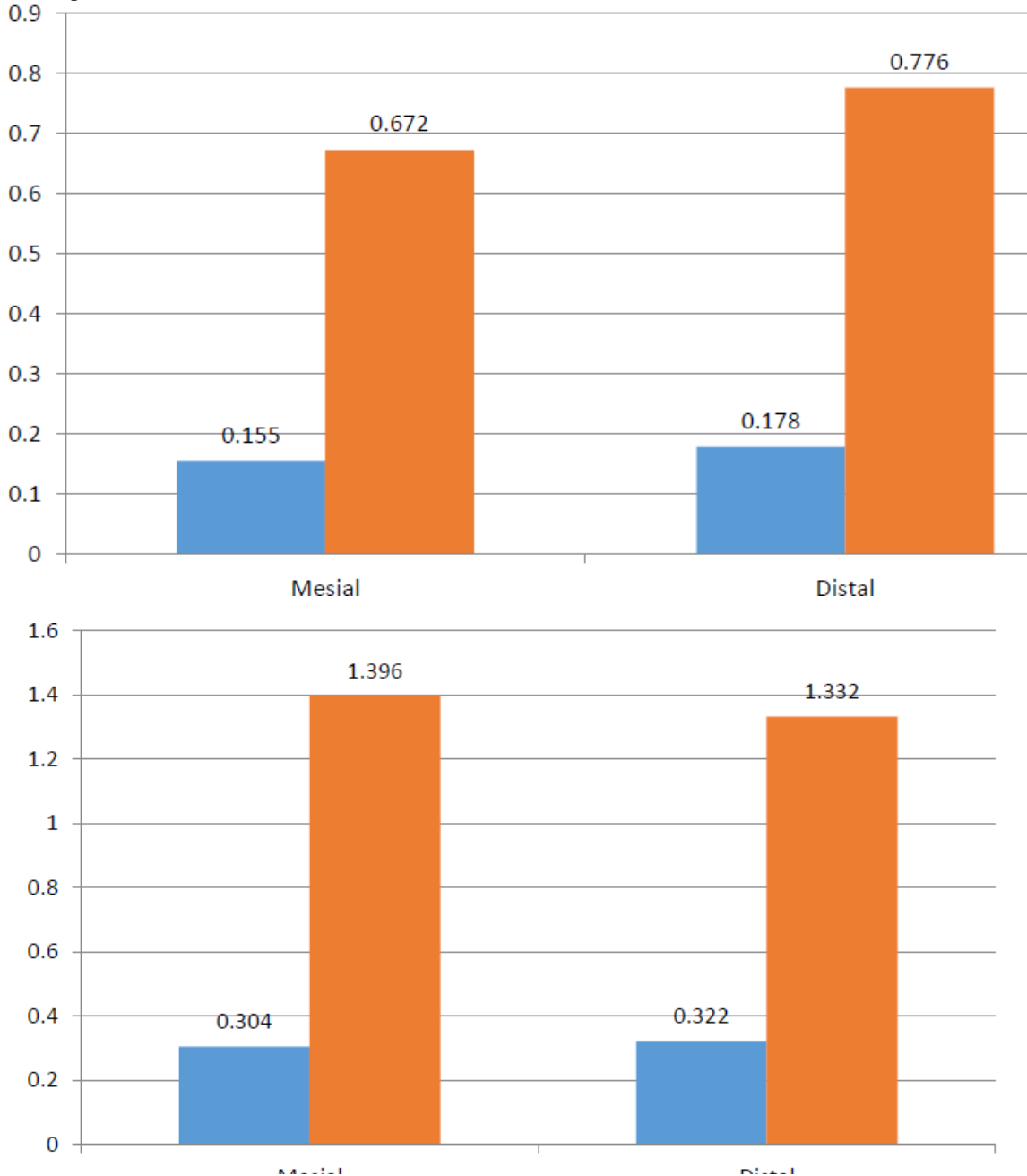
At the 3 months time interval the mean bone loss in the RVG was 0.178 and 0.776 in the CBCT on the distal side The intergroup comparison of bone loss between RVG and CBCT was statistically significant when analyzed using Independent t test (p=0.001)

At the 6 months time interval the mean bone loss in the RVG was 0.304 and 1.396 in the CBCT on the mesial side The intergroup comparison of bone loss between RVG and CBCT was statistically significant when analyzed using Independent t test (p=0.001)

At the 6 months time interval the mean bone loss in the RVG was 0.322 and 1.332 in the CBCT on the distal side The intergroup comparison of bone loss between RVG and CBCT was statistically significant when analyzed using Independent t test (p=0.001)

On the mesial side the 3 months time interval the mean bone loss in the RVG was 0.155 and at 6 months time interval the mean bone loss was 0.304. The intragroup comparison between 3 months and 6 months was statistically significant (p=0.001).

On the distal side at the 3 months time interval the mean bone loss in the RVG was 0.178 and at 6 months time interval the mean bone loss was 0.322. The intragroup comparison between 3 months and 6 months was statistically significant (p=0.001).



Conclusion:-

The data obtained was analyzed using a statistical software package for the frequency and comparisons between corresponding marginal bone loss of the implants and the results thus obtained draw to the conclusion that:-

- Patients with all type of bone quality experienced null or least values of marginal bone loss in the initial 3 months of follow up period which was followed by a slight increase from the third month to six months of period.
- Although bone loss was observed during this study period, the values obtained in all sites were insignificant from baseline to six months.

From this investigation, following suggestions are drawn:-

1. Replacement of missing teeth with Osseo integrated implants is a successful treatment modality.
2. Preservation of marginal bone loss is important for longevity and success of implant treatment
3. The study showed accuracy of CBCT evaluation for marginal bone loss around dental implants as compared with RVG
4. However, the bone loss is more evident during 3 months interval in both the groups
5. The intergroup comparison showed bone loss was precisely evaluated in CBCT as compared to RVG in 6 months interval

To conclude, though CBCT and RVG both are reliable tool for evaluation of marginal bone loss ,the intergroup comparison showed in the result states the accuracy of CBCT as compared to RVG during the follow up time of the present study.