ORIGINAL ARTICLE

Radiographic Comparison of the two Standardsized Implants with single Wide Diameter Implant for Replacement of one Mandibular Molar

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ABSTRACT

After the introduction of osseointegration, dental implants are becoming popular in the oral rehabilitation and are considered a successful treatment modality. Attempts to replace missing lower molars with a single implant is shown to be successful although long term prognosis is yet controversial. In this respect, insertion of two implants to replace one missing molar for restoring a optimal crown root ratio and providing increased surface area to support the prosthesis in molar region to bear the occlusal forces has been advocated by many authors. Here we present a study conducted in 5 patients were two standard size implants were used to replace one missing mandibular molar and compared with single wide diameter implant on the other side in the same patient on the basis of radiographic evaluation.

Keywords: Osseointegration, Marginal Bone Level(MBL), Bone Density(BD), Wider Diameter Implant(WDI), Standard Size Implant(SSI).

INTRODUCTION

First ever mention of the use of implants in human beings is by the ancient Egyptian thousands of years back. Since then there had been many modifications in material, surface texture, design and other aspects in this field. The implants have evolved tremendously in terms of physical, biochemical properties and the methods in which they are inserted at the recipient site. In the history of modern implants, Bränemark's breakthrough has revolutionalized the whole concept of implantology. Various improvements in abutment–implant interface design, wider implant platforms and the increased use of cemented restorations have greatly enhanced osseointegration ability of the implants and stability of the prosthetic component.

It has been repeatedly proved in short-term studies that the replacement of a molar with one implant is an effective treatment modality.[1] Natural tooth size significantly increases in the molar region and proportionately the root surface area is almost double as compared to the other teeth in the dentition. Therefore the clinicians face a unique biomechanical challenge. So to achieve the natural crown root ratio, implant diameter is often increased in the molar region for immediate loading, especially when the bone density is less or the masticatory forces are greater.[2-4] It is argued that for the same length, a wider diameter implant presents a greater surface area, thus bone to implant contact may be greater, thereby compensating for the lack of height or bone density[5]. But the fact is that even after insertion of widest diameter implant the natural crown root ratio is not achieved in all cases especially when the bone height is less. Therefore, single implant-supported molar restoration has historically presented a challenge in terms of form and function because a single implant does not provide the crown-to-root ratio that previously existed which may subject the implant to over load and may lead to implant failure.[6]

Use of two implants to restore a molar has been shown to eliminate problems associated with bone volume and prosthetic stability. The main purpose of the study is to evaluate the success of two standard size implants as opposed to one single wide diameter implant in the mandibular molar region radiographically.

AIM OF THE STUDY

The aim of this study was to evaluate radiographically the validity of using two standard size implants to support one missing mandibular molar and to compare it with the use of a single wide diameter implant.

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MATERIALS AND METHOD

In this study, five patients with good oral hygiene were selected irrespective of their gender. Patients with adequate alveolar bone height and sufficient interarch space were selected. All the selected patients were free from any local pathology or systemic disease. All the patients had a bilateral missing either first or second mandibular molar. For all the patients missing molars were replaced by inserting a total of fifteen implants which were threaded, sand blasted and acid-etched implants made from CP Titanium Grade IV using a standardized technique in all aspects. The patients were divided into two groups as follows:

Group I: Two standard-size implants (SSI) of 3.3 mm diameter and 11.5mm length were placed in the right missing mandibular molar site.

Group II: In left mandibular molar edentulous site of the same patient, one single wide diameter implant (WDI) of 4.2mm diameter and 10 mm length was inserted.

Preoperatively all the patients were evaluated clinically and radiographically using (OPG) and intra-oral periapical views, using digital radiography (DR) with the intraoral sensor for the periapical radiography to detect for

1. The absence of pathological lesion at the area of implant insertion, alveolar height above the inferior alveolar canal and condition of the adjoining teeth.
2. The condition of the bone and its suitability for implant placement.
3. Any root angulation in adjacent tooth, periodontal defects & amount of interdental bone.
4. The quantity and quality of the bone.
5. The vertical height of bone to select the suitable implant length.

For all these patients bone mapping was done using sectioned impression casts to assess the width of bone available for selection of appropriate diameter of the Implant.. Surgical stents were fabricated to accurately locate the implant site and direction of insertion. All the patients were given prophylactic antibiotics and the patients were given routine post operative instructions and were recalled for follow up regularly. The two-stage surgical technique was chosen in this study for implant placement. In the first stage, the implants were placed and were left undisturbed for a healing period of three months for complete osseointegration.

The initial stability of the implant was assessed at the time of seating through the adjusted torque wrench at 30 N/cm and proved successful due to the fact that it ensures that the implant has relatively rigid in good quality bone. All the patients were instructed to practice strict oral hygiene measures early in the post-operative phase and reinforced during the subsequent appointments with the use of chlorohexidine mouth wash.

In the second stage, at the end of the of 3 months post-operative period, the implants were uncovered after raising a mucoperiosteal flap. The tissues were left to heal for one week after placement of gingival former. The gingival former was removed after one week and abutment was fastened in place and prepared. Porcelain fused to metal crowns were constructed over the prepared abutment. Finished crowns were then cemented to the abutment. Computer assisted radiographic analysis was done immediately after the implant insertion and at 3rd, 6th and 9th months post-operative intervals. Comparative study was performed at each interval to detect and analyze the bony changes around the dental implants by making the following observations:

1. Marginal bone level (MBL).
2. Bone density (BD).

Accurate measurements of the bony changes were performed at standardized points on mesial and distal surfaces of all fifteen implants. Bone changes regarding bone quantity and quality were recorded. Measurements were taken as follows:

1. Assessment of marginal bone level (MBL) around the implants:

Mesial and distal bone height changes of implants were evaluated using the linear measurement system supplied by the digital OPG and digital intraoral sensor for periapical radiograph software. Measurement results were recorded in millimeters. The distance from the most apical part of the implant and the first point of bone-implant contact in cervical region mesially and distally were used to measure the bone level.

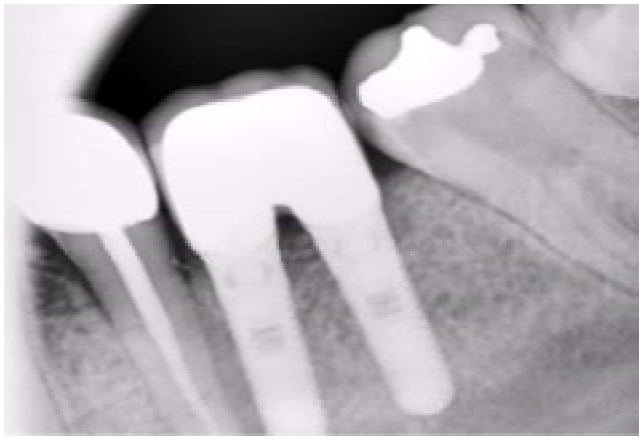
In Group I measurements, mean of mesial bone height and distal bone height for both the Standard Sized implants, were taken and tabulated. While in Group II similar measurements were taken in relation to the single WDI.

2. Assessment of the bone density around the implants:

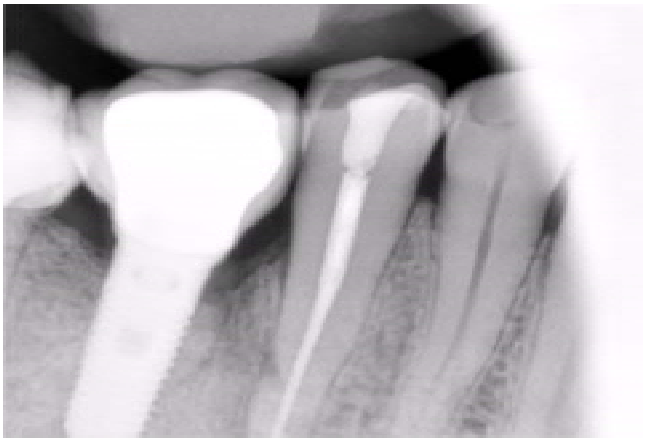
From the area of selection tools on the toolbar, the rectangular selection tool was used to specify the area. Two controlled and standardized dimension square areas were made just mesial and distal to the implant including the bone implant interface at the selected region of interest. The bone density measurement tool was selected and data recorded.

RESULTS

The results were collected, processed and statistically analyzed by a special statistical program. The obtained results are presented in tables.



Radiograph showing 2SSI loaded implants (6 months post operatively)

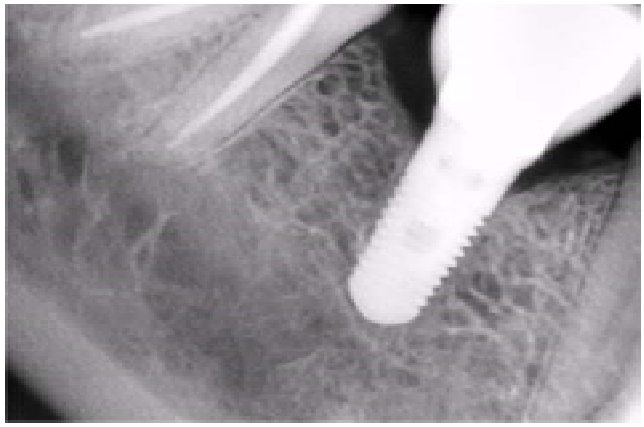


Radiograph showing WDI loaded implants (6 months post operatively)

Radiograph showing 2SSI loaded implants (9 months post operatively)

Assessment of the Marginal Bone Levels (MBL) around the implants

The marginal bone levels on mesial and distal surfaces of the implant were recorded from computerized radiographs post-operatively at the immediate, 3rd month, 6th month and 9th month interval. The results were tabulated and analyzed as follows:



Radiograph showing WDI loaded implants (9 months post operatively)

Table 1: Mean MBL in two groups at different time intervals

Time interval	Group I (n=10)		Group II (n=5)		Significance of difference (Mann-Whitney U-test)	
	Mean	SD	Mean	SD	z	p
Immediate	1.257	0.214	1.201	0.024	0.614	0.594
3 months	1.213**	0.157	1.173*	0.024	0.919	0.371
6 months	1.178**	0.134	1.149*	0.035	0.306	0.788
9 months	1.078**	0.122	1.004*	0.093	1.165	0.254

*p<0.05; **p<0.01 as compared to immediate value (Wilcoxon signed rank test).

Statistical Analysis: As the sample size was too small, non-parametric analysis plan was adopted. Mann-Whitney U test was used to compare the data in two groups. Wilcoxon signed rank test was performed to compare the values within each group at different time intervals. The confidence level of the study was kept at 95%, hence a "p" value less than 0.05 was considered to be statistically significant.

Despite the fact that the length of implant in group I was 1.5mm shorter as compared to the length of implants in group

Table 2: Mean BD in two groups at different time intervals

Time interval	Group I (n=10)		Group II (n=5)		Significance of difference (Mann-Whitney U-test)	
	Mean	SD	Mean	SD	z	p
Immediate	99.754	6.172	100.674	7.755	0.431	0.679
3 months	86.292**	7.589	85.730*	10.356	0	1
6 months	91.753**	7.154	89.056*	9.710	0.797	0.440
9 months	97.059*	6.003	96.202*	7.147	0.122	0.853

*p<0.05; **p<0.01 as compared to immediate value (Wilcoxon signed rank test)

II, the absolute mean value of MBL is marginally more in group I patients. However no significant difference in mean MBL of two groups was observed at any time interval ($p>0.05$). In both the groups a significant difference from immediate previous time interval was observed from 3 months onwards ($p<0.05$) showing that in both the groups there was a statistically significant marginal bone loss in both the groups.

In both the groups BD in vicinity to the implant surface decreased significantly during first 3 months of implant insertion. This value increased in both groups significantly at 6 months and 9 months interval. However in both the groups at the end of 9 months the bone density was marginally less as compared to the bone density immediately after implant insertion but this difference was found to be statistically insignificant in both the groups. No significant difference in mean BD of two groups was observed at any time interval ($p>0.05$). However the decrease of mean bone density in group I was less as compared to decrease of mean bone density in group II when immediate values were compared to values after 9 months.

DISCUSSION

After the introduction of osseointegration, dental implants are becoming popular in the oral rehabilitation and are considered a successful treatment modality.[7] Attempts to replace missing lower molars with a single implant is shown to be successful although long term prognosis is yet controversial[8]. In this respect, insertion of two implants to replace one missing molar for restoring a optimal crown root ratio and providing increased surface area to support the prosthesis in molar region to bear the occlusal forces has been advocated by many authors.[9]

The present study compared both the replacement options by selecting five patients suffering from bilateral missing mandibular molars and replacing the right molar by two SSI and the left side by one WDI. In the present study, software programs helped in achieving the determination of all the five radiological objectives of implant imaging (bone quality and quantity; pathology and vital structures; implant position and orientation). This agrees with Tepper *et al*[10], Gahleitner *et al*[11] and Aranyatachkul *et al*[12] work.

Standardized periapical radiographs were used in the present work, using the long-cone paralleling technique for periapical radiograph. These serial radiographs were used in this work to measure the peri-implant bone level changes by using special software where bone length was used as reference for calculations. This agrees with Sewerin[13] and Lekholm[14], who used the same technique and advocated that radiographic interpretation of alveolar bone level has proven to be one of the most valuable parameter to clarify implant success.

In the present study, the mean marginal bone level around implants showed that there was statistical significant decrease of marginal bone level comparing the values of immediate post-operative measurement and 9 months measurements in group I and group II. Comparison between marginal bone level in both groups showed statistical non-significant difference in both groups. However, the bone loss was greater in group II with WDI. Moscovitch et al results also show that Wide-diameter implants are limited in their ability to fit in bone recipient sites that are narrow buccolingually and there have been reports of greater crestal bone loss compared to standard-diameter implants[15].

The present results are comparable to those obtained by Braynt *et al*[16] who found the MBL at the end of their 12 months follow-up period to be 1.2 ± 0.8 mm, while our results recorded at the end of the 9th month a mean of 1.078 ± 0.122 in group I and 1.004 ± 0.093 in group II. Moreover comparable results were reported by Rungcharassaeng *et al*[17] who recorded 1.16 ± 0.89 mm of MBL and by Anastasios[18] who recorded 1.1 ± 0.8 mm of MBL. However, the present results exceed those reported by Digidi *et al*[19] and Lorenzoni *et al*[20] who recorded a mean MBL of 0.6 ± 0.2 mm and 0.75 ± 0.5 mm respectively.

The measurement of changes of bone density is an important sign of success or failure of implant integration and management. This goes hand in hand with Brägger et al[21]. The mean radiographic bone density scores recorded in our study were high at the time of insertion. These findings could be attributed to compression of bone during implant placement as stated by Brägger *et al*[21]. There was a significant decrease of bone density at the 3rd post-operative month, which could be attributed to bone remodeling at the bone-implant interface. This was followed by an increased bone density suggestive of successful osseointegration till the end of the 9 months follow-up period.

This agrees with Piatelli *et al*[22] who conducted a histologic and histomorphometric study in monkeys and reported that the bone changed from a fine trabecular pattern after initial healing to a more dense and coarse trabecular pattern after loading. Further agreement with our work has been reported by Mitsias *et al* [23] works who studied 21 implants placed in natural bone and found that bone density surrounding implants increased after successful osseointegration, they stated that the increase in bone density is due to osteoblastic activity following functional loading.

However, in the present study although no statistically significant differences in clinical and radiographic results were observed between both groups, yet two SSI implants were relatively superior to WDI. This is in agreement with Blatz et al[24] who comprehensively, suggested the use of both techniques, however, they concluded that two SSI are better options to replace a single mandibular posterior molar and

provide more surface area and better biomechanical properties than one WDI implant.

Moreover, the present findings also support the findings of Tawil et al who demonstrated that there was no significant difference between the bone loss around 5 mm diameter fixtures and adjacent 3.75mm diameter standard fixtures.[25] Bone loss associated with wide diameter implants in our study is comparable to values reported by other researchers' findings in the range of 0.7-1.5.

CONCLUSION

Wider diameter implants are reported to be successful in the rehabilitation of posterior edentulous ridges. However the associated drawbacks like unfavorable crown root ratio, repeated loosening of the prosthetic component and at times deficient implant recipient sites prompts the researchers for looking for a better solution. This research shows that the use of two standard sized implants to restore a single molar provides an effective and flexible answer to the above shortcomings especially where the mesiodistal width of the crown is more and also in cases where the bone height is unfavorable for insertion of a single lengthier implant. Our study shows that two standard sized implants are also well received by the bone at recipient site. These results need to be duplicated on a larger sample of patients and for a longer follow-up period, to reach to a definitive conclusion.

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