International Journal of Dentistry and Oral Science (IJDOS)
ISSN: 2377-8075

Evaluation Of Bone Density Around One-Piece Dental Implants After Immediate Loading: Radiographical Study

Research Article

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Abstract

Research Objective: Assessing the radial density around one-piece implants and comparing the values of radial bone density before and after implantation with immediate loading, the changes that will occur, and their long-term implications.
Materials and Methods: The research sample consisted of 10 single-piece implants from the Swiss company (ROOT), where the implantation was performed in the posterior region of the mandibular and were immediate loaded, and the changes in the radial density were studied by a CBCT image before and after the implantation and after loading.
Results: From the buccal side the bone density increased from before implant placement (496 ± 23) to after implant placement (572 ± 28) to after 3 months (1161 ± 104) to after 6 months (1185 ± 111), there was a statistically significant difference between timepoints ($p < 0.001$). From the lingual side bone density increased from before implant placement (510 ± 26) to after implant placement (577 ± 17) to after 6 months (1173 ± 62) to after 3 months (1179 ± 78).
Conclusion: With the limitation of our study, we can conclude that single-piece dental implants have a good result when we use it with immediate loading in posterior mandibular area.

Keywords: Dental Implant; Immediate Loading; Bone Density.

Introduction

Since the beginning dental implants, the trend has always been to improve the quality of this important treatment option in dental treatment plans in general. The improvement was in more than one way with regard to dental implantation, whether that was by reducing the period of treatment including dental implants, reducing the number of surgical interventions needed to complete the implant, or reducing the amount of trauma that might be associated with the dental implant procedure. The start of one-piece implants is important, as we have given up the need for a second surgical intervention in addition to the possibility of immediate and early laoding on the one-piece dental implant.

Bone absorption around the neck of the implant: The assessment of the marginal bone level around the implants is one of the important criteria in evaluating the success of implants, as absorption in the marginal bone level consider an important risk factor in the failure of implants and also reduces the achievement of aesthetic results [1]. To achieve aesthetic results in the implants, the vestibular tissue covering the implants must be preserved. Bone absorption cannot be avoided around implants and the reasons for this absorption are many and complex [2].

The marginal bone level is defined in radiographs (Apical images or CBCT images) as the distance from the implant shoulder to the first visible point or view of the bone's contact with the implant [1]. It is accepted that there is a natural absorption of the marginal bone around the implant by 1.5 mm during the first year, and then an absorption of 0.1 mm annually later [3], while at [4] and [5] it is considered that the bone absorption during the first year does not exceed 2 mm. And then by 0.2 mm annually, one of the criteria for the success of implants [6].

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Received: March 18, 2021
Accepted: April 29, 2021
Published: May 06, 2021

Citation: Alaa Subuh, Bassel Brad, Zuhair Al-Nerabieah. Evaluation Of Bone Density Around One-Piece Dental Implants After Immediate Loading: Radiographical Study. *Int J Dentistry Oral Sci.* 2021;08(5):2357-2361. **doi:** http://dx.doi.org/10.19070/2377-8075-21000463

It was considered that absorption during the first year of 1.8 mm is normal and acceptable. The studies that evaluated the catalytic absorption around the implants relied mostly on the Apical images compared to the CBCT images. The Apical images are considered good and reliable in assessing the medial and lateral adjacent bone marital level, but there are obstacles that must be overcome for reliability in measurements made on the Apical images, such as achieving good parallelism and maintaining posture Imaging, the difficulty of being able to repeat the images in the same position, the difficulty of knowing the implantation of the implant with respect to the Buccal-lingual level, and the buccal surface of the bone cannot be assessed on the Apical images, which is the most important bone surface in lateral grafting techniques and GBR techniques, and most importantly in the cosmetic aspects.

To assess the Buccal bone level, CBCT images are the appropriate solution, as there is no difference in assessing the adjacent fossil level between the Apical and CBCT images [1, 2] and are characterized by being three-dimensional and clear and can be repeated measurements on them accurately and less disruptive than traditional CT images. It is also considered accurate in making measurements [2].

One-piece dental implant: This type of implant is designed to provide a better connection between the soft and bony tissues surrounding the implant and the implant support, which forms a single piece with the implant. This offers several advantages, including [7]: 1. The absence of any space between the implant and the abutment, which reduces the accumulation of plaque and germs at their point of contact [8]. 2. Reducing the time of surgery 3. The possibility of immediate loading [7].

Single-piece implants are designed to be directly functional without the need for a waiting period compared to the traditional method, which requires a waiting period of between two months and up to six months [9]. Single-piece implants can be placed directly after extractions, and they can be placed with or without a flap lift.

The protocol for immediate compensation provided by this type of implant provides additional benefits, which are: 1. Reduction in total treatment time [10] 2. Securing the aesthetic and functional aspects in less time [10, 11] 3. Reducing the patient's exposure [10].

The one-piece implant provides an additional advantage, which is eliminating the need to use screws to secure the abutment with the implant because the abutment and implant are one piece [11] and thus there is no longer any need to fear the occurrence of loosening of the screw that connects the abutment to the implant, which is one of the most important problems facing specialists in oral surgery.

The jaws, where after a period of fixation of the prosethesis, the patient returns with a movement of the crown cementing on the implant, to reveal that the screw connecting the abutment with the implant has been subjected to a reverse rotation that has led to a loss of stability and thus the movement is the movement of the abutment with the crown, forcing the doctor to puncture the crown to reach The screw and reinstall it in case the crown is fixed with cement [12].

Note that the previous problem, if not treated within a short time, will lead to an additional problem as a result of the increase in the space between the abutment and the implant, which will increase the accumulation of bacterial plaque and start the inflammatory process in this region [11], which will eventually lead to bony absorption around the neck of the implant [11].

Cone beam computed tomography (CBCT)

3D radiography plays an important role in planning the procedure for dental implants in areas adjacent to the important anatomical structures, and when it is needed to determine the width and height of the alveolar bone, obtaining cross-sections in the radiographs is necessary [13]. Having accurate information prior to surgery greatly reduces the need to change the treatment plan during surgery.

This gives the surgeon the ability to determine the location of the implants and enables him to place the implants in a hypothetical model in terms of alveolar bone height, width, nerve location, and allows measurements of bone quality to be made [14]. CBCT is a new technology and has many advantages compared to traditional CT, such as lower dose of radiation, lower cost, shorter imaging time, increased patient comfort, in addition to giving values of density [15, 16].

The practitioner can study and make various measurements on an image that represents the patient's true three-dimensional anatomy, and so on. Usually producing sections and slices of the studied object at any level of space, where any structure can be seen in the form of multiple slides, in addition to bypassing the obstacles associated with 2-dimensional imaging such as distortion and overlay [17].

Bone Density

An internal bone structure is called Quality or Density, which reflects the biomechanical properties of the bone such as strength and modulus of elasticity. And the bone density in the jaws decreases after extraction. This decrease is mainly related to the length of time that occurs after an extraction, the amount of bone density already present, and many other factors.

The bone density is evaluated radiographically by several radiographic techniques, and a CT scan is the preferred method for evaluating bone density radiographically. The periapical and panoramic radiographs are not very useful in determining bone density, while the bone density can be accurately determined by means of CT radiographs, especially CT images, and in 2008 Misch used computed tomography to develop a classification of bone density based on Hounsfield units. This method allows an accurate evaluation of the quality Bone [15].

Materials and Methods

The research sample consisted of 10 single-piece implants from the Swiss company (ROOT), where the implantation was performed in the posterior region of the mandibular and were immediate loaded, and the changes in the radial density were studied by a CBCT image before and after the implantation and after loading. (Figure 1)

Inclusion criteria

1. The patients are healthy and do not have any general diseases
2. In patients, the loss of one or more teeth in the posterior region of the mandibular
3. Patients do not have any bad habits such as smoking or clinching

Exclusion criteria

(The availability of any of the following conditions is sufficient to exclude the patient from the research):

1. The presence of general diseases or factors that prevent surgery under local anesthesia.
2. Patients with complete tooth loose of the mandibular.
3. Patients have bad habits such as smoking or clinching.

The implant used in our research is an implant in which the implant and abutment are one piece and it is a Swiss implant of a system called (ROOT) and its surface treatment is (SLA +) which is according to the surface analysis (SEM: scanning electron microscope) from the purest surface known so far. A computed tomography (CBCT) image was performed for each case before the dental implant procedure and the measurements were taken on the sections of the implant site, then the dental implant was performedand the impression was taken for the final restoration at the same implantation session, and the patient was followed up after a week to remove the stitches and place the final restoration and after three months another CBCT was requested and another one after six months.

Implant placement

We first perform local anesthesia and then we check the effectiveness of anesthesia with a dental probe, and then we make a horizontal incision on the top of the socket without any release incision, followed by a lift of the buccal and lingual flap by the periosteum elevator. After the use of the Pointer drill, we enter this drill (DSTEP1) into the entire working length and then use a drill (DSTEP2) which is wider than the pointer drill to determine the width of the implant to be inserted and then the implant is placed according to the diameters of the drills that we reach. Finally, we do a simple suture to close the wound around the implant.

Statistical Analysis

Statistical analysis was performed with SPSS (statistical package for the social sciences) v.25 (IBM, New York, NY). Statistical significance level was established at $p < 0.05$.

All data were normally distributed as assessed by Shapiro-Wilk's test.

One-way repeated measures ANOVA tests were conducted to determine the difference of bone density among time points buccally and lingually. Bonferroni adjustment was applied to post-hoc analysis.

Results

Study sample consisted of 9 patients, 1 male and 8 females and the age of the patients ranged between 20 - 48 years with a mean of 32.2 years.

Buccally bone density increased from before implant placement (496 ± 23) to after implant placement (572 ± 28) to after 3 months (1161 ± 104) to after 6 months (1185 ± 111), there was a statistically significant difference between timepoints ($p < 0.001$). (Table 1)

Bone density after 6 months was statistically significantly higher than both before implant placement by 689, and after implant placement by 612 ($p < 0.001$), however, no statistically significant

Figure 1. CBCT Sagittal view shows the bone density after prosthesis lingually and Buccally.

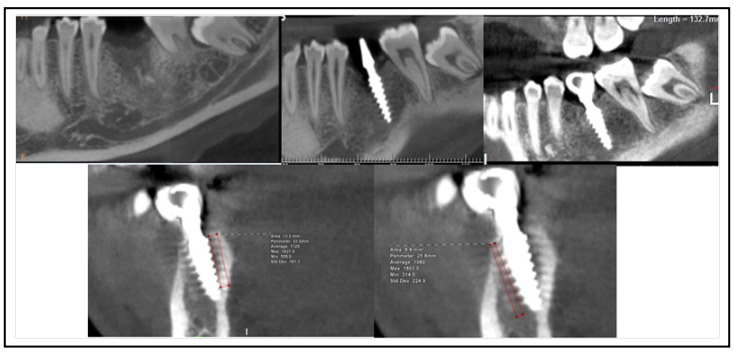

Table 1. Bone density during time points.

	Before implant placement	After implant placement	After 3 months	After 6 months	P
Bone Density	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	
Buccal	496 ± 23	572 ± 28	1161 ± 104	1185 ± 111	.000*
Lingual	510 ± 26	577 ± 17	1179 ± 78	1173 ± 62	.000*

Repeated measures ANOVA test*p<0.05

Table 2. Pairwise comparisons of time points.

Bone Density			Mean Difference	p
Buccal	Before implant placement	After implant placement	-76	.000*
		After 3 months	-665	.000*
		After 6 months	-689	.000*
	After placement	After 3 months	-589	.000*
		After 6 months	-612	.000*
	After 3 months	After 6 months	-23	0.265
Lingual	Before implant placement	After implant placement	-66	.000*
		After 3 months	-668	.000*
		After 6 months	-662	.000*
	After placement	After 3 months	-602	.000*
		After 6 months	-596	.000*
	After 3 months	After 6 months	6	1.000

*p<0.05

difference was found between after 6 and 3 months (p = 0.265). Also, bone density after 3 months was statistically significantly higher than both before implant placement by 665, and after implant placement by 589 (p < 0.001). Finally bone density after implant placement was statistically significantly higher than before implant placement by 76 (p < 0.001). (Table 2)

Lingually bone density increased from before implant placement (510 ± 26) to after implant placement (577± 17) to after 6 months (1173 ± 62) to after 3 months (1179 ± 78), there was a statistically significant difference between timepoints (p < 0.001). (Table 1)

Bone density after 6 months was statistically significantly higher than both before implant placement by 662, and after implant placement by 596 (p < 0.001), however, no statistically significant difference was found between after 6 and 3 months (p = 1.000). Also, bone density after 3 months was statistically significantly higher than both before implant placement by 668, and after implant placement by 602 (p < 0.001). Finally bone density after implant placement was statistically significantly higher than before implant placement by 66 (p < 0.001). (Table 2)

Discussion

This study included 10 dental implants consisting of one piece, in which the abutment and implant were one piece, and it was placed in the posterior region of the mandibular and a permanent prosthesis was placed on the implant after a week, and the insertion torque for these implants ranged between 40 and 55 Newtons and this conform to the study (Horiuchi et al), which He recommended in his study that the torque required for immediate loading be equal to 40 Newtons or more [18].

In a study reported by (Wörhle), which included the procedure of implantation and immediate loading after extractions for 14 implants, the insertion torque reached up to 45 Newtons, and it had a success rate of 100% after observing 9-36 months, which is consistent with the success rates of implants in our research [19]. It was found that the design of the conical implant and the wide threads of the implant increases the bone density immediately after the implant slightly , and the bone density increased significantly during the follow-up periods after the immediate loading of the implants, which is consistent with a study reported by the University of Alexandria in Egypt by both Joaquín García-Rodriguez and (Riham Mostafa Eldibany), where the study included the equivalent of 448 implants that were placed in the mandibular and immediately loaded in 56 patients.

Cases were followed up over 10 years, and the success rate of the implants reached 98% [20]. Another study reported by (John C. Minichetti) which was a retrospective study to evaluate the results of 33 implants placed in 24 patients over a period of ten years of observation.

All implants were one-piece, and the survival rate of the implants was 100%, but he explained in his study the existence of problems sufferedIncluding this type of implants at the level of marginal bone loss in addition to the difficulty of achieving full appropriate of prosthesis with the implant, unlike our study, which showed that there is a good appropriate of prosthesis with the implant, knowing that implants were used in his study from the company ZIMMER International [21].

Conclusion

With the limitation of thisstudy, we can conclude that one-piece dental implants have a good result when we use it with immediate loading in posterior mandibular area. but it is necessary to specify the candidate cases for this procedure, and the characteristics of the implant that best for immediate implantation.

Acknowledgment

Damascus university has funded this study.

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