

## Evaluation Of The Effectiveness of High Insertion Torques on Implant Stability Quotient (ISQ) and Marginal Bone Loss of Implants in Posterior Mandible

Research Article

Somar Dahdal<sup>1</sup>, Isam Alkhorri<sup>2</sup>, Safaa Shihabi<sup>3\*</sup><sup>1</sup> Phd student in Department of Oral & Maxillofacial Surgery, Faculty of Dentistry, Damascus University, Syria.<sup>2</sup> Professor in Department of Oral & Maxillofacial Surgery, Faculty of Dentistry, Damascus University, Syria.<sup>3</sup> MSc in Pediatric Dentistry, Faculty of Dentistry, Damascus University, Syria.

### Abstract

**Background:** Implant stability is an indicator of the osseointegration of dental implants, as it affects the healing process and success of osseointegration and it is usually related to the insertion torque during implant placement. As a matter of concern, implants inserted with torques greater than 50 N/cm can cause excessive pressure on the surrounding bone with temporary local bone necrosis.

**Aim:** Comparison the effect between high and low insertion torques on implants stability quotient and marginal bone loss of implants in posterior mandible.

**Methods:** Twenty implants were inserted in 10 patients. Implants were divided into two groups according to high insertion torque (Group A) and low insertion torque (Group B). ISQ was measured by ostell device and the marginal bone loss was measured by CBCT.

**Results:** Pvalue was much lower than the value 0.05 after six months of implantation in the (Group A) according to the thickness of the vestibular plates (in mm). also, the values of (ISQ) immediately after implantation and after 6 months in the (Group A) were greater than in the (Group B).

**Conclusion:** High insertion torque(above 50 N/cm) leads a higher Implant Stability Quotient(ISQ) immediately after implantation and after 6 months, compared with low IT (25-35 N/cm), and leads to higher buccal bone plate loss after 6 months compared with low IT.

**Keywords:** Dental Implants; Insertion Torque (IT); Implant Stability Quotient (ISQ); Bone Loss.

### Introduction

The use of dental implants to replace missing teeth has become a safe treatment method over the past decades [1]. The initial stability of implants is one of the clinical factors that influencing the success of the implant [2].

In 2006, Cochran presented a recent description of osseointegration, which reflects the biodynamic process of the implant-bone area, where the stability of the implant is represented by a dynamic equilibrium between the existing bone (primary contact), and the formation and remodeling of new bone (secondary contact) [3].

Bone healing around the implant involves a series of cellular and extracellular life events that play a role on the implant surface with

the bone until the implant surface is covered by the new formed bone [4].

During the first hours, the surface of the implant is covered with serum proteins, followed by adherence of platelets, and the formation of a fibrin clot, which is a reservoir for growth factors and cytokines, providing a physical barrier that prevents the continuation of bleeding. The shape of the outer surface of the implant is also responsible for maintaining the stability of this blood formed between the implant and the bone [5].

Implant stability is an indicator of the osseointegration of dental implants, as it affects the healing process and success of osseointegration, and it is a measure of the clinical movement of the implant, and plays a role in the long-term success of dental im-

#### \*Corresponding Author:

Safaa Shihabi,  
DDS, MSc in Paediatric Dentistry, Damascus University, Syria.  
E-mail: safaa2671991@gmail.com

**Received:** August 28, 2021

**Accepted:** October 15, 2021

**Published:** October 30, 2021

**Citation:** Somar Dahdal, Isam Alkhorri, Safaa Shihabi. Evaluation Of The Effectiveness of High Insertion Torques on Implant Stability Quotient (ISQ) and Marginal Bone Loss of Implants in Posterior Mandible. *Int J Dentistry Oral Sci.* 2021;8(10):4887-4891. doi: <http://dx.doi.org/10.19070/2377-8075-21000988>

**Copyright:** Safaa Shihabi©2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

plants, and its importance increases when it is used in the modern treatment protocol as acceleration of treatment, where it is relied on the stability of Implant when deciding to immediately load implants [4].

The initial stability results from the mechanical attachment to the cortical bone, and depends on the quantity and quality of the bone at the recipient site, the design of the implant used, and the surgical technique used to place the implant. The secondary or vital implant stability is the increase in stability resulting from [6] [7], and the process of bone formation and remodeling in the area where the implant meets the surrounding bone [8].

The initial stability of the implants is usually related to the insertion torque during implant placement. In addition, several studies have suggested that the insertion torque (between 25-45 N/cm) can prevent reversible microscopic movements (threshold level between 50-100  $\mu$ m), and this allows The healing process by osseointegration [9].

It is clear that the high insertion torque of the implants gives the surgeon a comfortable feeling that the implant is initially stable. However, it may cause dangerous pressure on the bone surrounding. Several studies have shown that high insertion torque may cause micro-fractures with some absorption in the cortical region and consequently a delayed healing process. Also, there are several laboratory studies on animals that showed that high insertion torque did not cause any bone necrosis or implant failure [10]. Even if the initial stability and insertion torque are not significantly bound, implants inserted with torques higher than 20 N/cm show higher success rates than implants with lower torques [11].

Although the available information is not clear or sufficient about the ideal insertion torque to obtain good initial stability, it is clear that the insertion torque is related to the initial contact between the implant and bone surface [12].

As a matter of concern, implants inserted with torques greater than 50 N/cm can cause excessive pressure on the surrounding bone with temporary local bone necrosis. Excessive insertion

torque may also be responsible for the phenomenon of osteoporosis due to pressure, such an effect may result in high failure rates or delayed excessive loss of the cortical bone [12].

## Materials And Methods

The sample consisted of 20 implants divided into 2 groups, the group A included 10 implants of high torque ( $>50$  N/cm) and the group B included 10 implants of low torque (25-35 N/cm), implant type is (Megagen, anyone). The patient's personal and written consent to participate in the research was documented.

The inclusion criteria were: implant sites should be symmetrical in the posterior mandible (Figure 1), the implant receiving socket should be more than 6 mm wide, more than 6 months have passed since the extraction at the implantation sites, length range of implant is (10-11.5mm), Diameter range is (3.5-4.5mm), the patient should have a good jaw relation between the jaws, absence of severe abnormal oral habits, patients should be committed to oral care, and have healthy periodontal tissues, Finally the patients were non-smoker and non-alcoholic.

Furthermore the patients with acute and chronic periodontitis and who have diseases that constitute a general contraindication to implantation or surgery (such as uncontrolled diabetes patients, osteoporotic patients, patients with hemorrhagic diseases, patients who are not interested in oral health, and patients who are taking any medication that affects bone healing) were excluded from the study.

### Surgical method of operation in the high torque group:(Figure 3)

After performing local anesthesia, a crestal incision was made without vertical incisions, and full thickness mucoperiosteal flap was raised to gain access to the bone. A small round bur was used to localize the sites where implants will be placed, The implant cradle was drilled with burs 0.9 mm less than the implant diameter as megagen implants were used. It is designed primarily for insertion with high torques above 45N/cm, featuring a conical body,

Figure 1. Clinical picture of symmetrical loss.



Figure 2. Insertion of the first implant with low torque.



spaced helixes and a self-tapping type.

**Surgical method in low torque group: (Figure 2)**

After performing local anesthesia, a crestal incision was made without vertical incisions, and full thickness mucoperiosteal flap was raised to gain access to the bone. A small round bur was used to localize the sites where implants will be placed, the cradle of the implant was excavated and the burs reached the diameter of the planned implant, where MEGAGEN implants were also used. Postoperative recommendations.

- Maintaining the compressive gauze on the surgical area for an hour.
- Apply cold compresses to the cheek skin corresponding to the work area on the day of the surgery.
- Start using antiseptic rinses from the day following the surgery.
- the recall appointment should be after a week to remove the surgical stitches.

The patient is also given a prescription that includes the following: An antibiotic (amoxicillin + clavulanic acid) oral tablets at an amount of 625 mg three times daily for a week.

A non-steroidal anti-inflammatory drug (ibuprofen) oral tablets of 600 mg three times daily.

Oral rinse (chlorhexidine 0.12%) twice a day for a week starting from the day after the operation to maintain the cleanliness of the surgical site.

**Radiological evaluation method for bone resorption. (Figure 5)**

Immediately, after implantation, and after 6 months, a three-dimensional image using conebeam computed tomography (CBCT) were taken to evaluate bone resorption (buccal- lingual).

**ISQ evaluation method: (Figure 4)**

After the implants are inserted into the posterior symmetrical loss areas of the lower jaw, the initial stability of the implant is measured at both ends by means of the OSTELL device after inserting an implant with a high torque and an implant with a low insertion torque. Evaluation is done immediately after transplantation and monitoring is done after 6 months.

**Results**

Studying the effect of the insertion torque applied to the implant on the values of the plates thickness according to the studied side and the studied time period:

P. value was much lower than the value 0.05 after six months of implantation in the group of measurements made in the vestibular side, so, at the 95% confidence level, there were statistically significant differences in the average values of the thickness of the vestibular plates (in mm) after six months. We conclude that the values of the thickness of the vestibular plates (in mm) after six months in the group A were smaller than in the group B.

Studying the effect of the IT applied to the implant on the values of the implant stability ISQ according to the studied time period:

P.value was much lower than the value 0.05 regardless of the time period studied, so, at the 95% confidence level, there were statistically significant differences in the average values of the amount of implant stability between 2 groups immediately after implanta-

**Figure 3. Inserting the second implant with high torque.**



**Figure 4. ISQ with ostell device.**



**Figure 5. Buccal-Lingual absorptiometry.**

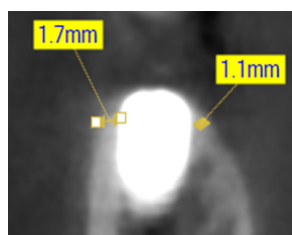


Figure 6. Implant kit.



Table 1. Shows the results of the student's T-test for independent samples to study the significance of the differences in the average values of plate thickness (in mm) between the group of implants with high insertion torque (more than 50 N/cm) and the group of implants with low insertion torque (between 25 and 35 N/cm) according to the studied aspect and time period.

The studied variable = thickness of the plates (in mm)					
The time period studied	Studied side	The difference between the two averages	t-value	P. Value	The significance of the differences
Immediately after implantation	Buccal side	0	0	1	no significant differences
	Lingual side	0	0	1	no significant differences
After 6 months	Buccal side	-0.31	-4.223	0.001	There are significant differences
	Lingual side	-0.14	-1.514	0.147	no significant differences

Table 2. Shows the results of the student's T-test for independent samples to study the significance of the differences in the average values of the amount of implant stability ISQ between the group of implants with high insertion torque (more than 50 Newton / cm) and the group of implants with low insertion torque (between 25 and 35 Newton / cm) according to the period of time.

The studied variable = the values of Implant Stability Quotient ISQ				
The time period studied	The difference between the two averages	t-value	P. Value	The significance of the differences
Immediately after implantation	9.8	3.973	0.001	There are significant differences
After 6 months	7.4	5.4	0	There are significant differences

tion and after 6 months. We concluded that the values of (ISQ) immediately after implantation and after 6 months in the group A were greater than in the group B.

**Discussion**

Osseointegration is a complex biological phenomenon directed by a series of biochemical events that stimulate angiogenesis, osteoblasts, mesenchymal cell differentiation, extracellular tissue placement and ultimately the mineralization process [13].

The primary stability of the implants during implant insertion is essential for obtaining stability, especially when masticatory pressures are applied. It is a key factor in obtaining high rates of implant durability [13].

There are several theories that concluded that the high insertion torque of the implants may cause severe pressure on the bone, which leads to bone necrosis as a result of cracks and pressure on the bone [14]. On the other hand, many studies have shown that to obtain a high rate of implant durability, we need a torque of at least 20 N/cm [14].

Several studies in the medical literature demonstrated the relation-

ship between insertion torque and initial stability of the implant. In the study of Ottoni et al 2005, it was found that a higher insertion torque can improve implant stability rates. In a study conducted by Trisi et al 2009, it was shown that the insertion torque (higher than 80 N/cm) may cause micromovements that lead to the failure of the implant in the end [9].

Antonio Barone and his colleagues demonstrated that implants inserted with high-IT (>= 50 Ncm) group showed greater marginal bone loss in the mandible than in the maxilla. This could be attributed to the higher bone compression effects on the cortical and poorly vascularized crystal bone, which is more represented in the mandible than in the maxilla [15].

Khayat et al, did not observed any significant differences between the low and high insertion torque groups and concluded that high IT (up to 176) could not jeopardize the osseointegration healing or increase the peri-implant bone loss [16].

The theory that high insertion torque can promote excessive bone compression, generation dangerous micro-cracks, or pressure necrosis, which disturb micro circulation and lead to bone resorption was not confirmed because the meta-analysis indicated no significant differences in terms of marginal bone level between



high and regular or low insertion torque of the implant [17]. Moreover, many studies as (Moher D et al, Grandi T et al, Khayat PG et al) did not show significant difference between high and regular or low insertion torque [18, 19], except one study (Marconcini S et al) that reported significantly high marginal bone loss for implants placed with high insertion torque in the maxilla and mandible [20].

According to the results of our current study, which included 20 implants, were performed in patients with symmetrical loss in the posterior mandible in terms of the missing location and the quality of the recipient bone. Thereby, our study disagrees with previous studies as (Moher D et al, Grandi T et al, Khayat PG et al) and this could be attributed to difference in implants sites between jaws, different insertion torques and type of the used implant.

There are studies that showed a close relationship between insertion torque of implants and initial stability, including (Baldi d. et al 2018, Degidi M. et al 2012, Park KJ. et al 2012, Sarfaraz H. et al 2018), while other studies concluded that there is no association between The insertion torque and the initial stability of implant, including (Santamaría-Arrieta G. et al 2016, Açil Y. et al 2017), and this difference in results is due to the different methodologies between these studies [21].

In the study (JP do Vale Souza et al 2021), it was found that there is a close correlation between the insertion torque and the initial stability of the implant (P-Value = 0.022), which means that the high insertion torque is the same as the initial high stability of the implant and vice versa. This result is important because it indicates two different variables in terms of the initial stability, but they are compatible together, because the initial stability quotient (ISQ) refers to the resistance to bending forces, while the insertion torque refers to the resistance to the shear forces [21].

According to the results of our current study, in which 20 implants were performed in patients with symmetrical loss in the lower posterior region, We agree with the results of the study (JP do Vale Souza et al 2021) that a higher insertion torque corresponds to a higher initial stability of the implants. While we have disagreed with several studies (MR Norton et al 2017, A. Simunek et al 2012, AK de Oliveira Nicolau Mantovani 2018, FS Lages et al 2018), this is due to the different type of implant placed, the different places of loss and bone densities between the jaws and within One jaw, and also a difference in the diameters and lengths of the implants.

## Conclusion

We conclude from our current study that a high IT (above 50 N/cm) leads a higher (ISQ) immediately, after implantation and after 6 months compared with a low IT (25-35 N/cm), and leads to higher buccal bone plate loss after 6 months compared with low IT.

## Acknowledgment

This research was funded by Damascus University.

## References

- Albrektsson T, Donos N, Working Group 1. Implant survival and complications. The Third EAO consensus conference 2012. *Clinical Oral Implants Research*. 2012 Oct;23:63-5.
- Testori T, Del Fabbro M, Bianchi F, Francetti L, Weinstein RL, Feldman S, et al. A multicenter prospective evaluation of 2-months loaded Osseotite® implants placed in the posterior jaws: 3-year follow-up results. *Clinical Oral Implants Research*. 2002 Apr;13(2):154-61.
- Cochran DL. The evidence for immediate loading of implants. *The journal of evidence-based dental practice*. 2006 Jun 1;6(2):155-63.
- Lindhe J, Meyle J. Group D of the European Workshop on Periodontology. Peri-implant diseases: consensus report of the sixth European workshop on periodontology. *Journal of clinical periodontology*. 2008 Sep;35:282-5.
- Coelho PG, Granato R, Marin C, Teixeira HS, Suzuki M, Valverde GB, et al. The effect of different implant macrogeometries and surface treatment in early biomechanical fixation: an experimental study in dogs. *Journal of the mechanical behavior of biomedical materials*. 2011 Nov 1;4(8):1974-81.
- Sennerby L, Meredith N. Implant stability measurements using resonance frequency analysis: biological and biomechanical aspects and clinical implications. *Periodontology* 2000. 2008 Jun;47(1):51-66.
- Tabassum A, Meijer GJ, Wolke JG, Jansen JA. Influence of surgical technique and surface roughness on the primary stability of an implant in artificial bone with different cortical thickness: a laboratory study. *Clinical oral implants research*. 2010 Feb;21(2):213-20. Pubmed PMID: 20070754
- Atsumi M, Park SH, Wang HL. Methods used to assess implant stability: current status. *International Journal of Oral & Maxillofacial Implants*. 2007 Sep 1;22(5). Pubmed PMID: 17974108.
- Trisi P, Perfetti G, Baldoni E, Berardi D, Colagiovanni M, Scogna G. Implant micromotion is related to peak insertion torque and bone density. *Clinical oral implants research*. 2009 May;20(5):467-71. Pubmed PMID: 19522976.
- Falco A, Berardini M, Trisi P. Correlation Between Implant Geometry, Implant Surface, Insertion Torque, and Primary Stability: In Vitro Biomechanical Analysis. *International Journal of Oral & Maxillofacial Implants*. 2018 Jul 1;33(4).
- Friberg B, Sennerby L, Meredith N, Lekholm U. A comparison between cutting torque and resonance frequency measurements of maxillary implants: A 20-month clinical study. *International journal of oral and maxillofacial surgery*. 1999 Aug 1;28(4):297-303.
- Liu C, Tsai MT, Huang HL, Chen MY, Hsu JT, Su KC, Chang CH, Wu AY. Relation between insertion torque and bone-implant contact percentage: an artificial bone study. *Clinical oral investigations*. 2012 Dec;16(6):1679-84.
- Elbeialy RR, El-Beialy WR. OUTCOME OF DENTAL IMPLANTS PLACED WITH HIGH INSERTION TORQUE. *Egyptian Dental Journal*. 2017 Jan 1;63(1-January (Oral Surgery)):299-306.
- De Santis D, Cucchi A, Righi G, Longhi C, Nocini PF. Relationship Between Primary Stability and Crestal Bone Loss of Implants Placed with High Insertion Torque: A 3-Year Prospective Study. *International Journal of Oral & Maxillofacial Implants*. 2016 Sep 1;31(5). Pubmed PMID: 27632269.
- Barone A, Alfonsi F, Derchi G, Tonelli P, Toti P, Marchionni S, et al. The effect of insertion torque on the clinical outcome of single implants: a randomized clinical trial. *Clinical implant dentistry and related research*. 2016 Jun;18(3):588-600. Pubmed PMID:26043651.
- Khayat PG, Arnal HM, Tourbah BI, Sennerby L. Clinical outcome of dental implants placed with high insertion torques (up to 176 Ncm). *Clinical implant dentistry and related research*. 2013 Apr;15(2):227-33.
- Lemos CA, Verri FR, de Oliveira Neto OB, Cruz RS, Gomes JM, da Silva Casado BG, Pellizzer EP. Clinical effect of the high insertion torque on dental implants: A systematic review and meta-analysis. *The Journal of Prosthetic Dentistry*. 2020 Sep 8.
- Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 6: e1000097. Open Med., 2009.
- Grandi T, Guazzi P, Samarani R, Grandi G. Clinical outcome and bone healing of implants placed with high insertion torque: 12-month results from a multicenter controlled cohort study. *International journal of oral and maxillofacial surgery*. 2013 Apr 1;42(4):516-20.
- Marconcini S, Giammarinaro E, Toti P, Alfonsi F, Covani U, Barone A. Longitudinal analysis on the effect of insertion torque on delayed single implants: A 3-year randomized clinical study. *Clinical Implant Dentistry and Related Research*. 2018 Jun;20(3):322-32.
- do Vale Souza JP, Neto CL, Piacenza LT, da Silva EV, de Melo Moreno AL, Penitente PA, Brunetto JL, Dos Santos DM, Goiato MC. Relation Between Insertion Torque and Implant Stability Quotient: A Clinical Study. *European journal of dentistry*. 2021 Jul 7.