



EFFECT OF INSERTION TORQUE ON SUCCESS RATE OF IMPLANT: A REVIEW

Dental Science

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ABSTRACT

Implant success and stability is directly influenced by the insertion torque. Bone resorption and necrosis is recorded with high insertion torque in few studies. Whereas, some suggest no effect on bone with high insertion torque.

KEYWORDS

Insertion Torque, Osseointegration, Primary Stability, Bone Density, Implant Success

INTRODUCTION

With recent advancements, dental implants have turn out to be common treatment modality in order to replace missing tooth, besides a success rate more than 90% is observed in day to day practice.^[1,2] Healing period has precisely reduced after loading with the development.^[3] A dental implant is used to restore tissue contour, function, comfort, esthetics and speech.^[4] Implant success rate greatly depends on crestal bone loss around the implant.^[5] Protection of bone from the occlusal forces is necessary to prevent fibrointegration during healing period, it can be attained by reduction in the micromovements up to 150um (at bone implant interface).^[6,7]

Primary implant stability signifies to the function of local bone characteristics, implant design, the position, the surgical procedure used and the right fit in the bone.^[8] Primary stability can be achieved during implant placement by reducing the undue micromotion at the implant bone surface, which may interfere in osseointegration.^[9] Various modalities exist to measure primary stability, comprising non-invasive methods such as Periotest, Resonance Frequency Analysis and Insertion Torque.^[10]

The force required to introduce a dental implant is referred as insertion torque. Various studies have used a common insertion torque as a marker of primary stability.^[9,10] Few authors have suggested insertion torque near the range of 35 Ncm to be satisfactory, whereas some observed no bone damage upto 176 Ncm.^[3,9,11,12] However, impact of high and low insertion torque depends on various factors.^[10]

This article reviews the available literature discussing the insertion torque of a dental implant, which ultimately decides the success rate and failure of an implant.

FACTORS AFFECTING INSERTION TORQUE^[10]

- Bone density
- Bone Quality
- Bone Quantity
- Use of under sized drills
- Tapered design implants

Primary stability of implants is influenced by two main factors comprising of residual bone at implant bone interface and function of compressive stresses at implant tissue interface. Although, these stresses may be useful, but they can attain elevated levels which would cause necrosis and localized ischemia of the bone.^[8] Torque is directly related to density of the bone.^[10] The level of torque is generally expressed in Newton centimeters (Ncm).^[3] Implant insertion torque can be assessed by the electronic devices integrated with physiodispenser or manual ratchets.^[10]

Insertion torque is an essential factor for the implant's primary stability and is a deciding factor for loading protocol, which in turn decides whether an implant will be successful or not. More the insertion torque, more the stability.^[10] Lower values have been associated with

failures.^[13] Studies have shown insertion torque near the range of 35 Ncm to be effective.^[10] Various studies have indicated that the higher insertion torque has no effect on hard and soft tissues, whereas others reported necrosis and marginal bone loss.^[9,10,13] Thus, several studies have been published to determine the relationship between insertion torque and bone changes, concluding a positive correlation between both.^[9,10,11,12]

Table 1

Author	Type of Study	Result
Otoni et al (2005) ^[13]	Controlled randomized: in vivo (humans)	Average insertion torque in their study was 38 Ncm and successful osseointegration was achieved.
Neugebauer et al (2006) ^[11]	Prospective: in vivo (minipig)	Successful osseointegration observed when average insertion torque was kept higher than 35 Ncm.
Duyck et al (2010) ^[14]	Controlled randomized: in vivo (rabbits)	Higher peri implant bone loss observed when insertion torque was kept above 50 Ncm.
Makary et al (2011) ^[15]	Controlled randomized: in vivo (humans)	The range of insertion torque was kept between 15 to 150 Ncm and found successful outcomes in D1 to D4 type of bone.
Trisi et al (2011) ^[16]	Controlled randomized: in vivo (sheep)	Studied that higher IT (mean 110Ncm) caused no bone necrosis however increased primary stability observed.
Khayat et al (2011) ^[9]	Prospective: in vivo (humans)	With use of high (upto 176 Ncm) no deleterious effects insertion torque observed on osseointegration.
Chai John et al (2012) ^[17]	Controlled randomized: in vivo (humans)	Concluded IT as viable mean to assess mandibular bone quality in patient with compromised bone density.
Consolo et al (2013) ^[18]	Controlled randomized: in vivo (sheep)	No significant differences in histological evaluation, resonance frequency analysis, removal torque.
Hof et al (2014) ^[19]	Controlled randomized: in vivo (humans)	No clinically significant differences in marginal bone resorption after 1yr observed.
Rea et al (2015) ^[9]	Controlled randomized: in vivo (dogs)	Similar type of osseointegration was observed with high and low insertion torque.
M. Wada et al (2016) ^[20]	Review article	Revealed bone density as a useful indicator of implant success, preoperative CT may help to predict the initial implant stability.
Gehrke et al (2016) ^[12]	Controlled randomized: in vivo (humans)	Their results proved 35 Ncm as best IT value for Conical internal connection.

Venkatakrishnan et al (2017) ^[21]	Short review	40 N load in normal bone and 32 N load in osteoporotic bone had same stress-strain value
Gary Greenstein et al (2017) ^[22]	Literature review	Minimum torque to attain primary stability not defined. With increasing IT(>50) no bone damage observed and Implant micromotion reduced.
Grandi et al ^[3]	Controlled Randomized: In vivo(humans)	When insertion torque used between 30 Ncm and 100 Ncm, there was no difference in peri implant bone resorption.

RELATIONSHI BETWEEN INSERTION TORQUE, OSSEOINTEGRATION, SUCCESS RATE

Successful osseointegration is a result of good primary stability, which in turn depends on insertion torque.^[10,23] Osseointegration is a structural and functional association between living bone and the loading implant interface, it's crucial for implant stability and a requirement for implant success in long run.^[24] The success rate depends on interrelationship of various components consisting of implant surface and design, biocompatibility, surgical technique used, undisturbed healing phase, quality and quantity of available bone^[24]

The quality of bone is the foremost factor than the quantity of bone in implant success.^[25] Four types of bone quality was first described by Lekholm and Zarb^[26] (type 1-4), where type 1 is the most dense (in anterior mandible) and type 4 is the poorest quality. Type 1 bone has the best insertion torque values and implant stability therefore has the highest success rate. Type 3 and type 4 bone is present in posterior maxilla, has good primary stability, but long term success rate can't be comparable with anterior mandible in case of high insertion torque values.^[35,26] With recent advancements success rate has elevated in all bone types.^[27,28]

CONCLUSION

Insertion torque leads to primary stability of implants which ultimately leads to implant success. It was observed that most of the studies used an insertion torque around 35 Ncm. A specific value of insertion torque is still a controversial issue. The available literature shows numerous other components affecting insertion torque during placement of implant.

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