



Comparing the Primary and Secondary Stability of Compressive One-Piece Implants with Conometric Cap vs. Compressive-M Implants

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Abstract

Background: This research was conducted to assess and compare the stability of compressive one-piece implants with conometric caps and compressive-M implants (screw type) at the time of implant insertion, three months, and six months after insertion. **Experimental:** A total of 15 patients (8 females and 7 males) with a mean age of 54 ± 17.5 years participated in this study. A total of 82 implants from two implant designs (ROOTT Compressive implants with conometric caps and ROOTT Compressive-M implants with screw-type prosthesis) were placed in the lower premolar-molar areas using standard surgical protocols. The implant stability test (IST) readings were clinically measured by the Anycheck implant stability meter in both buccal and lingual directions immediately after insertion of the implant (T_0), three months (T_1), and six months (T_2) after insertion. **Results:** The results displayed that the highest mean value was 63.17 using IST for Compressive implants with conometric caps on the buccal direction at T_2 , while the lowest mean value was 52.47 for Compressive-M implants with a screw-type prosthesis at T_1 . The comparison of mean values of IST showed statistically significant ($P < 0.05$) differences between Compressive implants and Compressive-M implants at T_1 and T_2 but non-significant differences at T_0 in both buccal and lingual directions. The mean IST values for the 39 compressive implants in lingual direction were 61.83 at T_0 , 59.77 at T_1 , and 61.57 at T_2 , while the mean IST values for the 35 Compressive-M implants in the same order were 59.4, 51.2, and 52.13 at T_0 , T_1 , and T_2 , respectively. **Conclusion:** We found that the stability of Compressive conometric implants is higher than that of Compressive-M implants in both T_1 and T_2 .

Introduction

the replacement of missing teeth with implant-borne restorations has become a cure modality for rehabilitating entirely and partially edentulous cases [1]. Nowadays, immediate loading protocols are being widely accepted since this technique has too many advantages, including fewer surgical interventions, decreased available treatment duration, diminished soft and hard tissue loss, and psychological contentment to the patient [2].

Previously, two kinds of associates between implants and prostheses have been utilized screw-retained and cement-retained connections. Both modules were adorable and impressive, but they were not out of some drawbacks. The first one created too many mechanical complications, such as screw loosening and fractures, although it offers tight retention. Whereas the second system created more complications, such as soft tissue inflammation nearby the implant neck due to cement intrusion, but it provides better aesthetics [3-6].

The one-piece implant was introduced by ROOTT in 2016 and had a unique monobloc scheme that assimilates both implant and superstructure for prompt and modest one-stage or two-stage procedures. This type of implant was based on the Schroeder single surgery philosophy, which offers continuity with no connection between the implant body and the abutment by screw (Figure 1)[7].



Figure 1. Shows compressive one-piece implants [7].

Additionally, there was no risk of loosening a screw, screw fracture or pumping effect that may induce bone loss around the implant neck. The Compressive-M implant is another compressive design introduced by ROOTT and had a tissue-level connection instead of a bone-level connection. This tissue-level connection ensures that even if there is a pumping effect, it will not induce bone resorption since it is far from the bone level (Figure 2) [7].



Figure 2: Shows Compressive-M implants with the tissue-level connection [7].

Immobile joining between implant and prosthesis can similarly be attained via a Morse taper conometric system [8]. The conometric perception involves a cone-in-cone junction between an abutment and the particular coping with keeping an implant reinforced rebuilding without either screws or cement (Figure 3). The appropriate between the abutment and the restoration is completed with mass-produced materials [9].



Figure 3. Shows conometric components [9].

In a conometric system, the appearance outline of the restoration can be located subgingivally deprived of the danger of cement residual at the abutment coping interface. Although single copings have a retaining strength compared to the values stated for the interim cement used in transplant dentistry, their abutments have no anti-rotational characters [10, 11].

Osseointegration is considered the most imperative criteria for implant success as it determines implant stability in two diverse steps; primary and secondary stability [12]. Implant stability can be assessed either by invasive/destructive approaches (histologic/histomorphologic analysis, tensional test, push-out/pull-out test, and removal torque analysis) [13] or by noninvasive/nondestructive approaches (radiographical analysis/imaging, cutting torque resistance, insertion torque measurement, seating torque test, modal analysis, and implant test, reverse torque, percussion test periotest, pulsed oscillation waveform (POWF), resonance frequency analysis (RFA) [14].

In 2017, a recent restraining capability technique instrument, Anycheck (Neobiotech, Seoul, Korea), was presented to measure the time of interaction between the impacting rod and the therapeutic abutment. It attacks the healing abutment six times more during 3 seconds and changes the time into the implant stability test (IST) values with less power compared to the periotest and also halts automatically when the stability is low to keep the implant [15].

Currently, these designs (ROOTT Compressive and ROOTT Compressive-M implants) are used by many dentists, but there is a shortage in a study about their methods, mechanism of work; therefore, this work was implemented to assess and compare the stability of Compressive one-piece implants with conometric caps and Compressive-M implants (screw type) at time of insertion, three months and six months after insertion.

Materials and Methods

A. Subjects

A total of 15 patients (8 females and 7 males) with a mean age of 54 ± 17.5 years who attended Kurdistan Board for Medical Specialties; Sulaimaniyah center for implant replacement of mandibular posterior teeth were involved in this study.

B. Patient consent and ethical approval

Information about the study and related instrumentation was explained to each participant before surgery, as well as verbal/written consent was obtained. The working protocol was revised and approved by the Ethics Committee at the Kurdistan Board for Medical Specialties' Restorative Dentistry Department, Sulaimaniyah, Iraq.

C. Inclusion criteria

Any patients fit for surgery or had recipient sites included old extraction sites in the posterior mandible (more than one adjacent extraction site as these systems are designed for multiunit restorations). Also, those with sufficient bone volume for the insertion of implants with a minimum length of 14 mm and minimum crystal ridge width of 5.5 mm and those without local inflammation and adequate oral hygiene were enrolled in this study. On the other hand, the D2 bone density type was selected for standardization.

D. Exclusion criteria

Patients with a single missing tooth or insufficient bone volume for implant placement were excluded from this study. Additionally, smokers (>10 cigarettes/day), drug or alcohol abuse, pregnant women, and those patients on bisphosphonate medicine or with chronic diseases were also not included.

E. Data grouping

A total of 82 implants from 2 implant designs (41 from ROOTT Compressive implants with conometric caps and 41 from ROOTT Compressive-M implants with a screw-type prosthesis, TRATE company, Swiss) were placed in the lower jaw using standard surgical protocols. Then, the adequate bone volume at the implant site was checked by clinical evaluation and by Cone-beam computed tomography (CBCT) for all cases pre-operatively, and surgical stents were made for all patients.

F. Surgical procedure

Local anesthesia (2% lidocaine hydrochloride with 1:80,000 epinephrine) was given to the lower jaw buccally and lingually by infiltration. Then implants were placed using the surgical stent prepared for each patient pre-operatively and flapless immediate loading (FILO) technique. Later on, a drilling sequence was applied according to the manufacturer's instruction to create a hole for implant placement. The diameter of all implants used in this study was 3.5 mm, and the lengths were 12 mm and 14 mm. If implant insertion, torque less than 35 N appeared, the fenestration and dehiscence of the supporting bone of implant were excluded.

After that, IST readings were clinically measured by Anycheck implant stability meter (Neobiotech, Seoul, Korea) on both buccal and lingual directions immediately after insertion of the implant (T_0), three months (T_1), and six months (T_2) after insertion (Figure4).

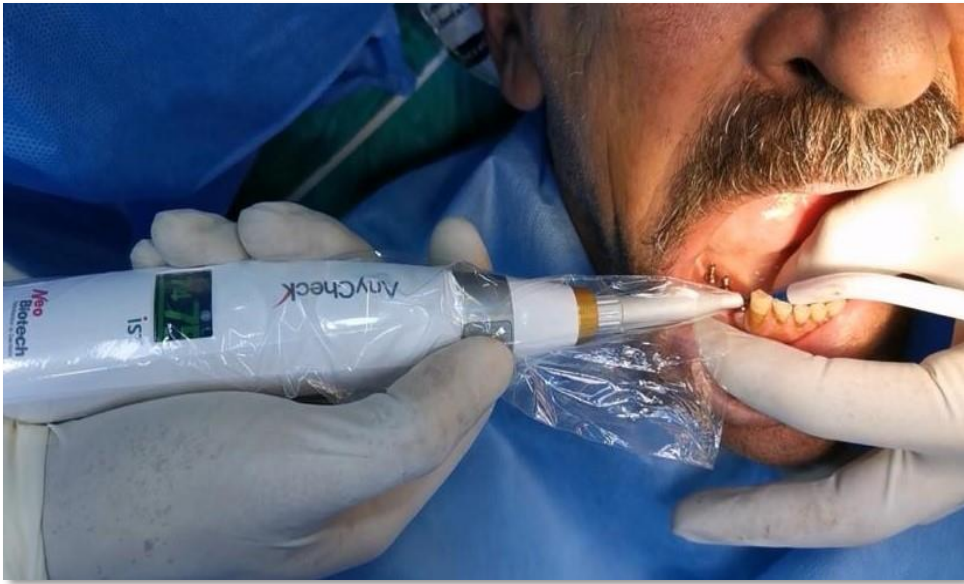


Figure 4. Shows Anycheck device used for measuring implant stability.

For the Compressive implants (one-piece implants), the Anycheck device directly contacted with the abutment of the implant to measure the stability, while for the Compressive-M implants; a gingival former is placed on the implant and tightened to 15 N with a wrench ratchet (according to the manufacturer's instructions) and then contacted with the Anycheck device to measure the stability of the implant. All implants were loaded within 72 hours, in which half of them were screw type, and another half were conometric concepts for retention. Two of the implants (Compressive type) were failed in the first month and excluded from the study, and one of the patients that provided with 6 Compressive-M implants was not attending the subsequent visits and also excluded from the study. The remaining implants till the end of the study were 39 (ROOTT Compressive implants with conometric caps) and 35 (ROOTT Compressive-M implants with screw-type restorations). All measurements were accomplished by the same assessor to exclude intra-observer error.

G. Statistical analysis

The descriptive statistics calculate (mean and standard deviation (STD)), and analysis was performed using the SPSS software (version 26.0). In addition, analysis significant (t-test) was performed using the SPSS 26 for Windows, the level of statistical significance set up at p-value <0.05.

Results

As indicated in Table 1, the highest value of IST was 63.17 for Compressive implants with conometric caps on the buccal direction at T₂, while the lowest one was 52.47 for Compressive-M implants with a screw-type prosthesis at T₁. The comparison of mean values of IST showed significant differences (P<0.05) between Compressive implants and Compressive-M implants at T₁ and T₂ but non-significant differences at T₀ on buccal directions.

Table 1. Shows comparison of IST mean values between Compressive implants and Compressive-M implants in buccal direction.

Type of implant	Time of reading	No. of implants	IST Mean	STD	P-value
Compressive-conometric	T ₀	39	59.23	8.807	0.303
Compressive-M		35	61.70	8.363	
Compressive-conometric	T ₁	39	60.07	8.967	0.007*
Compressive-M		35	52.47	9.145	
Compressive-conometric	T ₂	39	63.17	9.498	0.001*
Compressive-M		35	55.27	9.214	

STD: Standard deviation, *: Significant Difference

Table 2 shows the mean IST values for 39 compressive implants on lingual direction as 61.83 at T₀, 59.77 at T₁, and 61.57 at T₂, while the mean IST values for 35 Compressive-M implants in the same order were 59.40, 51.20, and 52.13 at T₀, T₁, and T₂, respectively. Thus, the comparison IST mean values showed significant differences (P<0.05) between Compressive implants and Compressive-M implants at T₁ and T₂ but non-significant differences at T₀ in lingual directions.

Table 2. Shows comparison of IST mean values between Compressive-conometric implants and Compressive-M implants on a lingual direction.

Type of implant	Time of reading	No. of implant	IST Mean	STD	P-value
Compressive-conometric	T ₀	39	61.83	6.28	0.127
Compressive-M		35	59.40	7.07	
Compressive-conometric	T ₁	39	59.77	9.14	0.003*
Compressive-M		35	51.20	8.9	
Compressive-conometric	T ₂	39	61.57	11.41	0.003*
Compressive-M		35	52.13	10.61	

STD: Standard deviation, *: Significant Difference

Discussion

Implant stability is a potential aspect to earn effective and fruitful implant therapy. Proper protocols need a stable mechanical connection between dental transplants and bone [16]. Unfortunately, to the best of the authors' knowledge, there is a shortage of researchers to evaluate and compare the stability of compressive one-piece implants with conometric caps and Compressive-M implants.

Thus, in this current research, primary implant stability was assessed at implant placement using Anycheck device and monitored for up to 3 and 6 months to observe dynamic alterations that may happen around dental implants during curative stages. Anycheck device is safe since the tapping motions were enhanced by decreasing the quantity of tapping sequences to 6 and discontinuing tapping in cases of weak implant stability [17]. Also, it is less costly compared to other stability measuring devices.

In the present study, IST mean values show various readings at T₀, T₁, and T₂. This is attributed to both implant designs inserted in the lower posterior arch since mandibular bone usually offerings 1 to 3 mm cortical width followed by softer bone. Therefore, this cortical area of the bone probably plays the leading role in preliminary primary stability as implants may be simply stabilized in this solid tissue. This outcome agrees with a study done by Janine, 2017 who found that implant stability in the posterior region of the mandible depends on the ratio of cortical and medullary bone tissues [18].

However, the dynamic behavior over six months was found to occur by the healing process that arises around dental implants. In this relation, Berglundh et al., 2003 defined different periods of bone healing around the implants in a canine model. They proposed that osseointegration is a dynamic course that initiates an early formation phase described by bone resorption at contact points between the implant and surrounding tissues, followed by a maintenance phase characterized by new bone development around the implant surface. It is during the establishment phase that osteoclastic activity affects initial mechanical stability leading to a reduction in corresponding IST values. After that increase of IST can presumably be explained by new bone formation over the osteoconductive implant surface leading to biological stability by a bone-implant interlocking effect [19].

The conometric caps use the friction between the abutment and the titanium coping with retaining the prosthesis without cement or screw. This retention approach to support definitive prostheses has displayed excellent prosthetic results in the short term [20]. In addition, according to Lee et al., 2020, a modified Damping Capacity Analysis device (Anycheck) was developed to measure implant stability [15].

The IST value from 1 to 99 indicates more excellent implant stability [17]. However, IST values between 1 – 59 designate low strength, values from 60 to 64 mean moderate stability, and values > 65 specify high stability. Although these implants have the same fixture taper design, the compressive one-piece implants (with conometric cap) displayed moderate poise. In contrast, the Compressive-M implant (screw type) showed low strength that could be attributed to that the Compressive-M implant has two pieces while other types have a one-piece implant, and screw loosening that happened in some cases for Compressive-M implant.

Conclusion

The results predicted statistically significant differences between Compressive conometric implants and Compressive-M implants at T₁ and T₂ but non-significant differences at T₀ in buccal and lingual directions. Thus, the stability of Compressive conometric implants is higher than that of Compressive-M implants in both T₁ and T₂.

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Conflict of interest

The authors declared that there is no conflict of interest in this current research study.

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