J Oral Med Oral Surg 2022;28:39
https://doi.org/10.1051/mbcb/2022024

https://www.jomos.org

JOMOS
Journal of Oral Medicine and Oral Surgery

Original Research Article

The impact of zero insertion torque on flapless immediate implant placement in the maxilla (5 years follow up clinical study)

Samy Elian[1,*], Ahmed Salem[2]

[1] Oral & Dental Surgery Department, Sohag University, Egypt
[2] OMFS Department, Faculty of Dentistry, Mansoura University, Egypt

(Received: 15 October 2021, accepted: 8 September 2022)

Keywords: Torque / implant / primary stability / immediate placement

Abstract – Introduction: The achievement of good osseointegration in immediate implant placement can occur in the presence adequate primary stability. The insertion torque varies between cases depending on many factors. **Aim:** To assess clinically the impact of zero insertion torque on the survival of immediate implant placement in the maxilla for more than 5 years follow-up. **Methods:** A flapless immediate 2018 implants were in the maxilla in non-restorable single rooted teeth osteotomy site. The insertion torque of the implant was measured clinically by an integrated software. **Results:** The final insertion torque for 42 implants out of 2018 placed in fresh extraction sockets in the maxilla was zero (no primary stability). Their survival rate was 83.3%. **Conclusions:** The lack of certain conditions during immediate implant surgical installation and healing had the major effects on success. The loss of torque during immediate implant placement to zero may jeopardize the survival of the implants, but it may not be statistically significant with their failure and loss. The implant primary stability is not an absolute prerequisite to osseointegration; however, it may affect the implant survival rate.

Introduction

The immediate dental implants have become a daily common dental procedure in oral rehabilitation. Implant stability is a clinically valuable measurement of the strength of implant anchorage in the bone during placement and in the post-osseointegration period. The insertion torque varies between cases depending on the local bone quality and quantity, time passed since extraction, and the recommended drilling protocol. Furthermore, implant macro-design (parallel walled and root-form), thread characteristics (depth, pitch, helix angle) and implant surface characteristics as roughness have also major effects on primary stability of immediate implants [1–6].

The primary stability of dental implant is considered the back bone to get the adequate healthy osteointegration. It is a biomechanical stability that depends mainly on the mechanical friction and engagement with the jaw bones. Secondary implant stability occurs after healing and remodelling of bone, creating a biological osseointegration. During the surgical drilling protocol bone necrosis may occur from overheated drills.

Furthermore, a micromotion passing the threshold (50–150 nm) will lead to implant failure where fibrous tissue will form around the implant [4]. There are many popular ways to measure the implant stability and osseointegration as the cutting resistance (CR) during implant placement, removal torque after osseointegration, resonance frequency analysis (RFA) and periotest. Nevertheless, all these could be misleading in the accuracy of measuring the implant stability and the description of the success after the insertion of a dental implant [7–10].

Rodrigo *et al.* clinically classified the implant primary stability as follows [11]:
- No rotation at all.
- A light rotation with a feeling of resistance.
- Implant rotates without resistance.
- Both rotation and lateral oscillation of the implant.

There are many research studies for the factors that affects the stability of implants, but there are few researches that analysis the success of dental implants with the loss of implant primary stability to zero insertion torque [11–13]. Clinical studies that evaluated the success of implant osseointegration with zero insertion torque at the time of placement are scarce and were conducted on animals [14,15]. The objective of this

* Correspondence: drsamiyazied@gmail.com

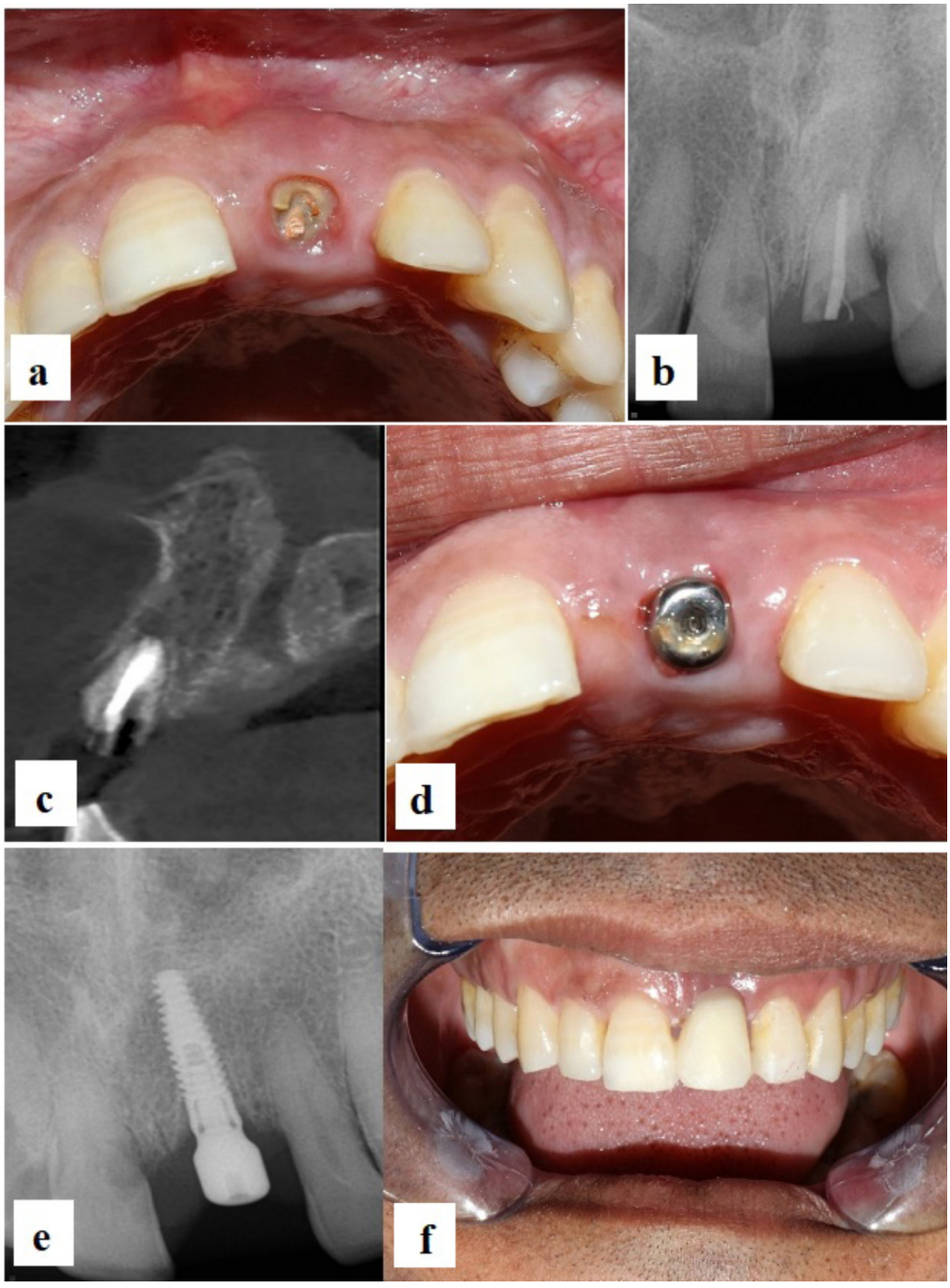

Fig. 1. A case with immediate implant placement with dropping of primary stability to zero insertion torque.

study was to assess clinically the impact of 0 measurement insertion torque on immediate flapless implant placement in single rooted teeth in the maxilla after 5 years of follow up.

Materials and methods

A retrospective clinical study, out of 2018 implants, 42 implants for both gender (19 males and 23 females) were included in the study. All implants lost their initial primary stability and their final insertion torque were zero. All cases requested to do CBCT prior to dental implant planning (Fig. 1c) and signed an informed consent to give their acceptance to the procedure. This study followed the Declaration of Helsinki in medical protocol and ethics. Also, the study was approved by the Regional Ethical Review Board of Sohag University Hospitals, Faculty of Medicine, Sohag University.

All patient's selection was based on unrestorable single rooted teeth in the maxilla that need extraction and immediate implant placement (Fig. 1a). All cases showed radiographically no periapical infection, previous apical root surgery nor bone

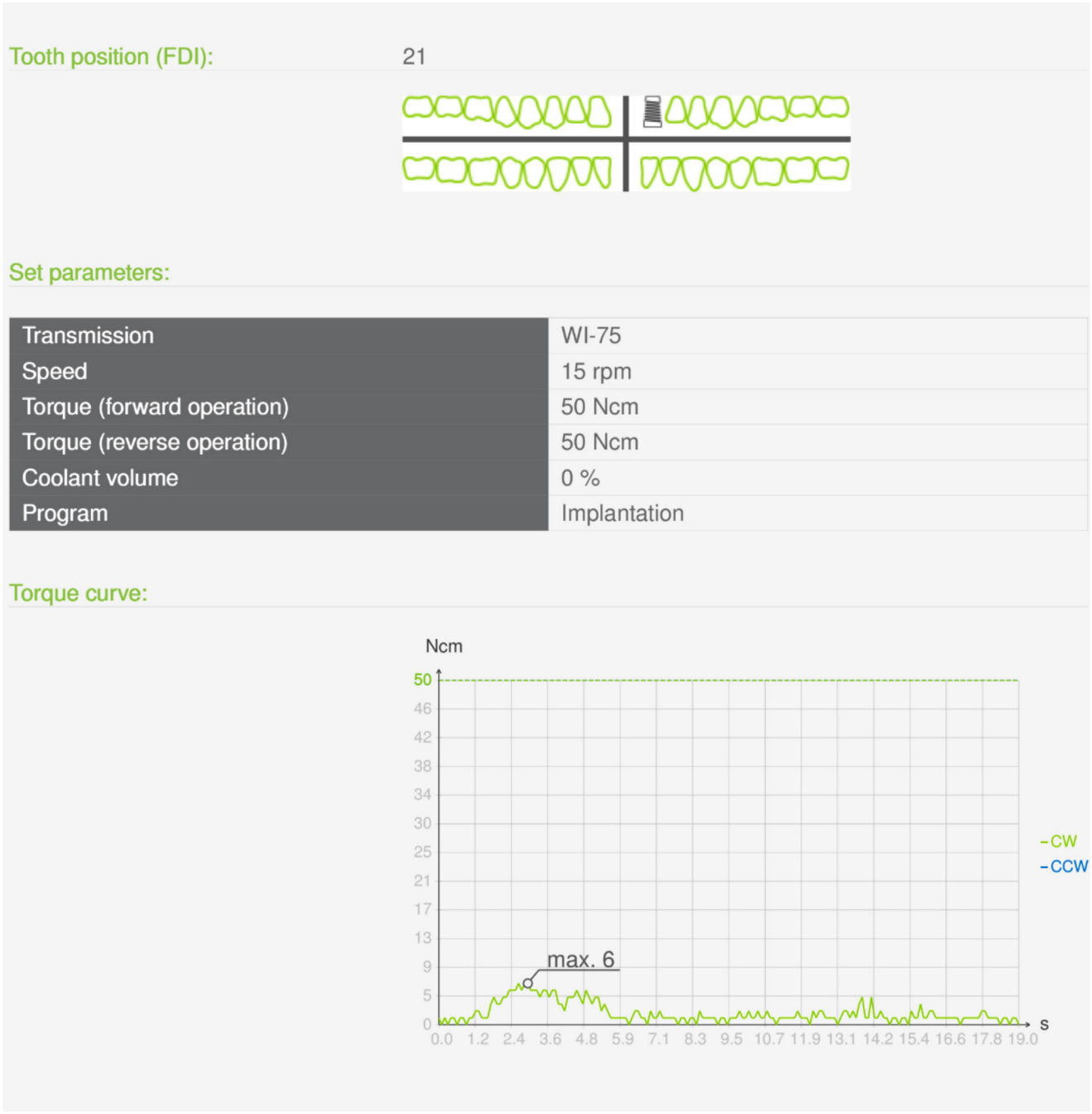

Fig. 2. Final insertion torque dropped to zero.

augmentation (Fig. 1b). Patients do not have any systemic disease nor a local factor that may jeopardize osseointegration or contraindicate dental implant surgical procedures. There should be adequate buccopalatal bone width and about 4 mm of native bone height above the root apex to get implant primary stability of the selected cases. The size of the implants ranged between 3.3 and 4.5 mm in diameter and between 11.5 and 15 mm in length (Myriad-Plus, Equinox Medical Technologies B.V., the Netherland). Cases with a high gab thickness more that 2 mm were excluded to avoid using bone grafts.

The same criteria were selected for all cases as: the surgical motor (Implantmed Plus, W&H, Austria), the surgeon, the type of implant and the digital integrated surgical software that measures the insertion torque of the implant (Fig. 2). The torque value appears as a graph on the implant motor display and can be documented and saved for every patient on a USB port as a PDF file [16,17].

Preoperative prophylactic antibiotic medication was prescribed in the form of Amoxicillin at a dose of 500 mg three times daily for 4 days and ibuprofen as analgesic and anti-inflammatory

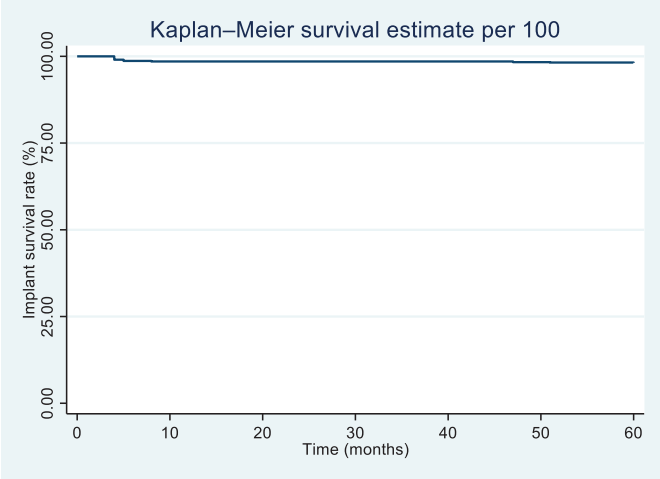

Fig. 3. Kaplan Meier survival curve showing the success rate for implants with good primary stability.

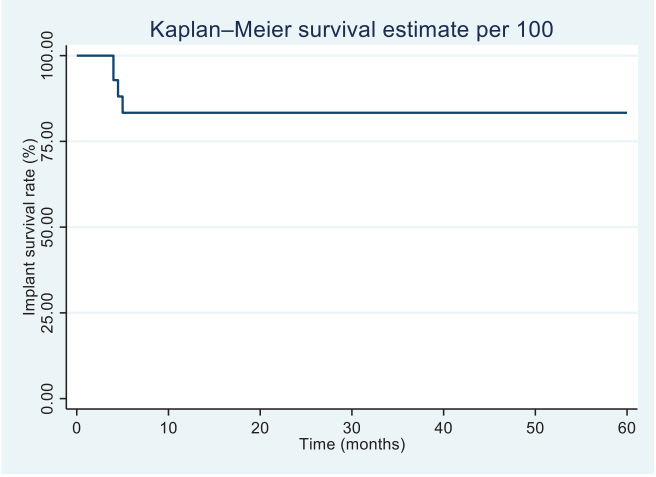

Fig. 4. Kaplan Meier implant survival curve showing the success rate of the 5-years for all implants with zero insertion torque.

Table I. Cumulative survival rates for zero torque implant placement.

Years	No. of total implants	No. of failed implants	Survival rate for period (%)	CSR (%)
0–1	42	7	83.3	83.3
1–5	35	0	100.0	100

at a dose of 400 mg three times daily as well. Chlorhexidine Gluconate 0.2 % was used as a mouth wash preoperatively as well as postoperatively three times daily for a week. Before commencing in the drilling, the patient data and tooth position was inserted and saved in the surgical motor software. The contra-angle handpiece parameters were set to place the implant at a speed 15 rpm and a torque 50 N-cm. A flapless, postextraction implant placement technique was followed as atraumatic extraction, excavation and cleaning of the socket from any granulation tissue or the remnants of periodontal ligaments. All the patient's data and the torque curve until complete implant insertion were displayed and documented through a USB port in the surgical motor (Fig. 2). The surgical drilling sequence was done as recommended by the implant manufacturer.

In all cases, the prosthodontics phase commenced with gingival former after about 4 months from the time of implant insertion (Fig. 1d and e). Temporary restoration was done with average of 2 months (Fig. 1f). Follow ups were done for more than 5 years for all cases after final crown insertion to evaluate clinically and radiologically the outcome and survival of immediately placed dental implants in the maxilla that lost its primary stability to zero torque during implant placement.

The implant survival rate was analyzed using Kaplan Meier curve and estimated using the 95% confidence at different times of follow up.

Results

A total of 2018 implants were placed immediately in fresh extraction sockets. Out of these immediately placed implants, 1976 implants were with good primary stability (category A according to the Rodrigo classification) and have a survival rate (98.1%) (Fig. 3). Forty-two implants did not get primary stability which reached final insertion torque 0. The mean value and SD of the maximum reached torque of these implants were represented as (12.43 ± 6.23) and get cumulative survival rate 83.3% after the first year (Tab. I).

In the first year, 7 implant cases were failed (16.7%) out of total 42 (P value 0.001), while the cumulative survival rate for the remaining 35 implants was 100% with a minimum time of follow up more than 5 years and with statistically significant difference in the first year and other 4 years (Tab. II and Fig. 4).

Among Category C (according to the Rodrigo classification), two implants (5.7%) of total 35 implants which showed rotation without resistance and no lateral movement were failed, while 5 (71.4%) implants of total 7 (Category D according to the Rodrigo classification) which showed rotation and lateral movement were failed with statistically significant difference ($p < 0.001$). The success rates were high in category C implants that has rotation inside the osteotomy site without lateral movement incomparable with category D implants which have a high failure percentage in the presence of lateral movement (category C, 94.28% *vs.* category D, 28.57%) (Tab. II and Fig. 5).

Discussion

At present, there are no standards to measure the primary stability. However, the most widely used simple noninvasive

Table II. Success and failure for zero implant insertion torque with& without lateral movement.

Rotation grade	No.	Success (failure)	% of success (failure)	*P* value
Rotation without resistance & no lateral movement (Category C)	35	33 (2)	94.28 (5.72) %	0.001
Rotation without resistance and with lateral movement (Category D)	7	2 (5)	28.57 (71.42) %	

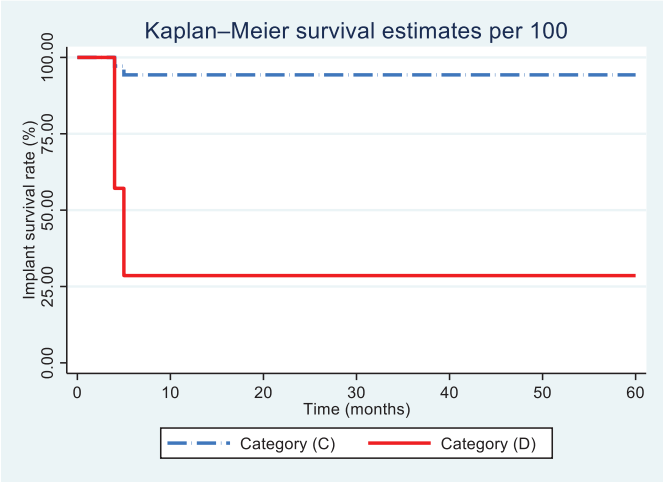

Fig. 5. Kaplan Meier implant survival curve showing the success rate for implants with zero insertion torque (category C *vs.* category D) for 5-years follow up.

manoeuver are resonance frequency analysis (RFA), Insertion Torque (IT), and the Periotest, but all are frequently debated for their limited Boundaries [18–20]. They are inaccurate to evaluate the expectedness of implant success [2,18]. The primary stability of a dental implant can be measured only at the time of its insertion but never after that time. An insertion torque value could be increased with direct friction of the implant with the dense cortical plate and this can be misleading in giving a tremendous primary stability [21]. Furthermore, many researches compared the survival rate of implants that had low primary stability *versus* that of those with high primary stability [22–25].

Regarding the judgment of the clinical evaluation, the inserted implants were left in the osteotomy site about 4 months and a follow up was 5 years to see the destiny of zero inserted torque implants in comparison with others who made invasive tests as histologic or microscopic analysis which were considered the gold standard method to evaluate implant stability, but it has ethical issues. The clinical assessment of implant stability depends on the experience of the operator as there are limitations in the measuring instruments of bone density [20–27].

Although the insertion torque was zero, the biological response led to a structural direct connection between the vital bone and the surface of an implant. Successful osseointegration that comes from secondary implant stability is the main required criteria for functional dental implants where the low values of insertion torque have a tendency to increase, in the transition to secondary stability [1].

The osseointegration can be accelerated with a meticulous surgical protocol as well as the surface of the implant [28]. It is reported from the literature that machined surface implants have a low survival rate [27]; in comparison with the predictable osseointegration of rough surface implants with no primary stability at placement [1,23,25]. In another study done by Orenstein *et al.* on 2770 of 6 different modified implant surfaces, they concluded that the survival rate after 3 years for low primary stability implants was 79.8% while it was 93.4% for the stable implants [29].

Regarding the cumulative implant success rate in this study, the results were in accordance with other authors success rate [30,31]. Veradi *et al.*, in a study for 11 implants with insertion torque less than 10 N-cm found that the survival rate was 100% and concluded that primary stability is not a prerequisite for osseointegration although there was a slight mobility to lateral force of 250 g at the time of placement [31]. These results agree with Orenstein *et al.* that followed 2641 implants, reporting that the survival rate in implants without primary stability in the presence of undisturbed healing 93.8% was also significantly lower than the survival in primary stable implants 97.5% [28].

Although all the 42 implants have final Zero insertion torque, only 7 implants failed that could be attributed to traumatic extraction, unseen apical granulation tissue or eccentric movement during insertion. There should be an argue regarding the removal of any implant from the osteotomy site if there was any loss of primary stability and replacing its size with a bigger one. Thus, based on the clinical findings of the small limited sample: very low or even zero insertion torque in immediate implant placement may not statistically significant in the loss of implants if the surrounding intact socket walls, thick gingival phenotype, atraumatic extraction, hand skills and absence of major lateral eccentric implant movement are guaranteed during the implant insertion [32]. Furthermore, the mother nature biology of bone healing will aid improvement of the osseointegration leading to extraordinarily successful implants.

Conclusion

The primary stability may be extremely low or lost to zero torque during immediate implant insertion but it can osseointegrate. Therefore, the implant primary stability should not be the main requirement to osseointegration. Although the expectable outcomes for implant stability may be unknown in zero insertion torque of implants; the scrupulous hand skills and the experienced surgeon have a main role in the success of the immediate implant placement.

Ethics approval and consent to participate

The Regional Ethical Review Board, Sohag University Hospitals, Faculty of Medicine, Sohag Uinversity approved the research and study. All patients gave the written informed consent to participate in the surgery.

Conflict of interest

The authors Samy Elian and Ahmed Salem declare that they have no conflict of interest.

Informed Consent

All patients gave the consent to participate in the surgery and the study.

Funding

This research was carried out without funding.

Authors' contributions

Samy Elian carried out the surgical procedure and implant placement. Ahmed Salem did the final revision for the manuscript. All authors read and approved the final manuscript for publication.

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