Evaluation of Implant Abutment Screw Torqueing Protocols on Reverse Torque Values: An In-vitro Study

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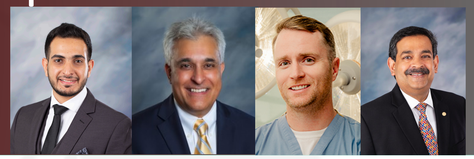


INTRODUCTION

Dental implant survival and success depends on many factors. Most common prosthetic complications occur due to implant abutment screw loosening.[1] This prosthetic complication may lead to abutment/crown mobility resulting in screw fracture or even bacterial leakage.[1,2] Screw loosening can be caused by multiple factors such as inadequate torque[3], poorly machined components, excessive loading, screw and restoration design.[4,5]

The screw is primarily subjected to 2 different types of forces; the first one being the force working on separating the parts, called joint separating force, and the other is the force keeping the components together, called clamping force.[4]

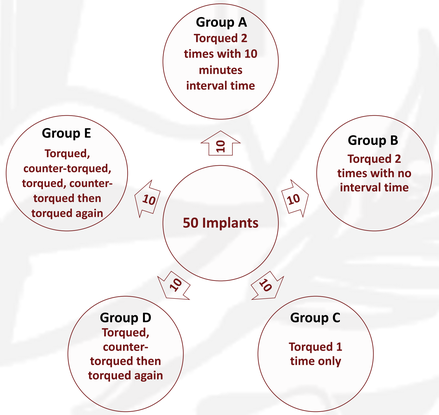
Implant manufacturers provide no guidance on tightening protocols in the instructions for use. There are few published protocols in the literature, some that recommend tightening the screw and waiting 10 minutes before tightening again.[6,7] The null hypothesis for the study is, there would be no significant difference in torqueing protocol with regards to the reverse torque value (RTV).

OUR RESEARCH QUESTION:

"What is the OPTIMUM protocol to torque an Implant Abutment Screw"?

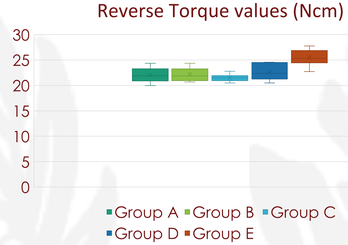
MATERIAL AND METHODS

50-implants (Proactive, Neoss) were used in this study. The implants were randomly distributed to 5 groups; each group was assigned 10 implants (n=10). The implants were embedded in a light polymerizable composite material (Triad TrueTray) ensuring the implant would be perpendicular to the applied torque during the tests. The torque was delivered and measured using a digital torque measuring device. The protocol developed was to replicate procedures that is typically encountered during the clinical procedure as it relates to screw tightening of this implant system. Final abutment screws (Crystaloc, Neoss) were hand tightened initially, and then tightened with the torque monitoring device to the manufacturer recommended torque of 32 Ncm. At each stage of torqueing the input torque used was recorded.
All implants remained at ambient room temperature (21 degrees Celsius) for 3 hours before RTV was measured .



RESULTS

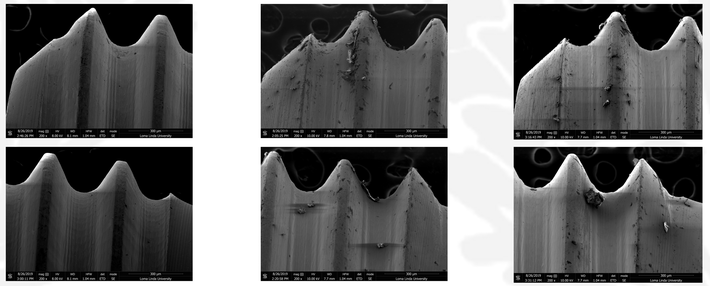
ANOVA (Post hoc) and Pairwise comparison indicated that the torqueing, counter-torqueing, torqueing, counter-torqueing then torqueing again protocol (Group E) was significantly different when compared to other groups (P <.05). No difference was detected between any other group (P >.05).



SEM ANALYSIS

An observational study was conducted with three representative screw specimens which were scanned at 200X to allow detection of any deformities that occurred to the screws from different torqueing protocols.

NEW SCREW (CONTROL GROUP) | **GROUP C** | **GROUP E**



	Sum Of Squares	df	Mean Square	F	Sig.
Between Groups	99.981	4	24.995	13.418	.000
Within Groups	38.825	45	1.863		
Total	183.806	49			

The null hypothesis was rejected

DISCUSSION

Number of torqueing events:

1 time torqueing vs. 2 time torqueing showed no significant difference among groups. However, 3 time torqueing with counter-torque (Group E) revealed significantly higher RTV.

Time interval between torqueing :

Time of 10 and 0 minutes respectively **did not show a significant difference** in RTV. This differs from the results reported by Siamos et al[7], who stated that re-torqueing the implant abutment screw after 10 minutes increased the RTV. However, the study had a low specimens size per group (n=2) compared to our study where specimens size were higher (n=10).

Clinical scenario:

Our study followed an actual clinical component connection protocol, while other studies did not. The healing abutments were placed and tightened, then an impression coping placed and tightened following manufacturers instructions to mimic realistic clinical procedure sequences.

CLINICAL IMPLICATION

Interval time between torqueing and retorqueing the implant abutment screw has no effect on RTV. However, to achieve the optimal RTV, 3-time torqueing protocol is recommended.

LIMITATIONS

The limitations of this study were; it was an in-vitro study with 1 implant abutment screw type, contamination that could occur in the clinical setting was not Included, the specimens were not subjected to the forces that may be encountered in a clinical setting and an ageing test with cyclic loading was not performed under wet conditions to mimic the intra-oral environment.

CONCLUSIONS

Within the limitation of this in-vitro study the following conclusions are made:
- Interval time did not significantly influence the RTV.
- Best RTV was observed with a 3 time torqueing protocol.