Measurement of Clinicians' Ability to Hand Torque Dental Implant Components

Ali Kanawati, DDS, MBA, MS; Mark W. Richards, DDS, MEd, FACP; Jeffery J. Becker, DDS, MSD, FAGD; Natalie E. Monaco, BS

There is a varying degree of hand torque abilities using finger drivers among clinicians. Calibrating one's own abilities requires complicated instruments not readily available. This study evaluated a simple-to-use method that allows dental practitioners to have a quantifiable clinical assessment of relative torque ability using finger drivers to torque down dental implant components. A typodont that includes dental implants was mounted in a mannequin placed in a patient-reclined position. The subjects were asked to torque as tightly as they could a new healing abutment to an implant secured firmly in resin within the typodont. All participants wore moistened gloves when using a finger driver. The healing abutment was countertorqued using a certified precalibrated precision torque measurement device. The reading on the torque driver was recorded when the healing abutment disengaged. An average of torque values of dentists and dental students was calculated. Fifty subjects had an average maximum torque ability of 24 Ncm (male dentists: 28 Ncm; students: 22 Ncm; male students: 24 Ncm; female students: 19 Ncm). Maximum torque values for all participants ranged from 11 Ncm to 38 Ncm. There was no significant difference between groups. This study showed a varying degree of hand torquing abilities using a finger driver. Clinicians should regularly calibrate their ability to torque implant components to more predictably perform implant dentistry. Dental implant manufacturers should more precisely instruct clinicians as to maximum torque, as opposed to “finger tighten only.”

Key Words: dental implants, torque, hand drivers, torque drivers, preload

INTRODUCTION

The use of osseointegrated dental implants for the rehabilitation of partially edentulous and edentulous patients has been thoroughly documented with successful long-term results. The success of these restorations is attributed to following strict surgical and prosthodontic protocols.

One of the most common complications following successful implant therapy has been screw loosening. The importance of abutment screw tightening with proper preload continues to be emphasized. Not only is a minimum torque critical, but excessive torque may exceed the yield strength of the screw, resulting in permanent deformation, loss of mechanical prop-
Problems associated with abutment screw loosening and fracture may be due to inaccurate fit and improper tightening. Today, standardization of screw tightening through the use of electrical and mechanical torque devices has overcome some of these challenges.

A recent study stated that “for various reasons, some clinicians might use handheld drivers for definitive tightening of implant-abutment screws rather than obtaining manufacturer’s torque wrenches to achieve established preload forces.” Studies evaluating the torque generated by various operators using hand drivers have shown a wide range of results. If dentists are going to continue to rely on hand drivers for many of the phases of prosthodontic implant therapy, it is important for them to identify the level of torque they are able to achieve.

Within the field of implant dentistry, clinicians should realize their relative level of performance when torquing implant components. Dentists or dental students should have an idea of how strong or weak they are when using finger drivers to torque down dental implant components. Most implant manufacturers label provisional abutments as “finger tighten only.” Final abutments are normally required to be torqued down between 20 and 32 Ncm, while healing abutments, impression posts, or cover screws usually are not given a specific torque requirement by manufacturers.

Previous studies relative to this topic have used intricate methods of assessing clinicians’ maximum torque ability using a finger driver to torque down dental implant components. Unfortunately, these methods are not readily reproducible in a mainstream clinical setting. Using engineering principles, a component torqued down to a specific Ncm will have to be countertorqued an equal and opposite Ncm for that component to release. A pilot evaluation to confirm that an equal but negative torque is required to disengage abutments from an implant typodont was performed. New healing abutments were torqued to 15, 25, and 35 Ncm. It was confirmed that the exact level of torque required to tighten the abutments was the same torque value required to disengage the abutments at the different levels tested.

A simple and readily available method of evaluating maximum torque ability using finger drivers was developed based on the findings of the pilot study. The purpose of the current study was to describe and test a protocol that allows dental practitioners to have a quantifiable clinical assessment of their relative torquing ability using finger drivers to torque down dental implant components.

**MATERIAL AND METHODS**

A maxillary typodont (Figure 1) that includes dental implants (Zimmer DuSER Maxillary Fixed Model, Zimmer Dental, Carlsbad, Calif) was mounted in a dental school mannequin on a dental chair placed in the reclined patient position. To better simulate a clinical setting, subjects were asked to sit in proper operator position with their gloves moistened.

A total of 50 subjects participated in this study. The first group of subjects included 16 male dentists at West Virginia University (WVU) School of Dentistry. The other group of participants included 34 third- and fourth-year dental students currently enrolled at WVU School of Dentistry. This group consisted of 15 women and 19 men. The age of all participants ranged from 24 to 64 years of age, with a median age of 28 years.

The participants were asked to torque down a new healing abutment (TH5C3/6, Zimmer Dental) as tightly as they could, to an implant (6.0 mm diameter by 13 mm long; TSV6B13, Zimmer Dental) in the maxillary left second molar area (Figure 2) secured firmly with resin within the typodont. All participants used the same hand driver (1.25 mm tapered frictional hex tool 23 mm; THX1.25, Zimmer Dental).

After the subject torqued down the healing abutment, the typodont was removed from the mannequin, and the healing abutment was counter- torqued with a precision torque measurement device (MONO torque ratchet, article no. 3.03.160; Thommen Medical USA, Cleveland, Ohio). The Thommen torque driver (Figure 3) was chosen because of its unique...
patented 1-piece design as well as its precise torque readings in increments of 5 Ncm compared with 10-Ncm increments found in other companies' torque drivers. The torque driver used in the study was direct from the manufacturer and not previously used. The torque driver was delivered by the manufacturer as certified precalibrated. According to Goheen et al.,\textsuperscript{8} manually operated mechanical drivers are capable of delivering required torques in a consistent manner. The reading on the torque driver was evaluated closely up until the healing abutment's initial movement as it disengaged from the implant. As the healing abutment's initial movement began, the torque reading on the torque driver was recorded.

The same individual was responsible for all of the testing to minimize the chance for subjectivity. As the readings were being evaluated for the amount of countertorque, a second observer was also watching the readout on the torque driver relative to initial movement of the healing abutment. Measurements reading between the 5-Ncm increments were interpolated, and the 2 evaluators came to a consensus on the countertorque reading. An analysis of variance was performed to compare relative torque values between dentists and students as well as female students versus male students.

### RESULTS

Of the 50 subjects participating in the study, 32% were dentists and 68% were students. Of the 34 students, 55% were male students, and 44% were female students. Of the entire group of participants, 70% were men and 30% were women, with a mean maximum torque value for all participants of 24 Ncm. The mean torque value for all students was 22 Ncm. Results with standard deviations are presented in the Table. Maximum generated torque values ranged from 11 Ncm to 38 Ncm. The mean maximum torque ability of dentists was 28 Ncm (male students 24 Ncm, female students 20 Ncm). The maximum torque value reached was 38 Ncm by a male student, and the minimum torque value reached was 11 Ncm, also by a male dental student.

An analysis of variance at the 5% level of significance between the male and female student participants as well as between the students and
dentists indicated statistical differences between groups. However, the statistical differences were not significant. A comparison for all pairs using the Tukey-Kramer HSD test demonstrated a significant difference between the dentist group and the female student dentist group only (Prob \( > F = .0004 \)).

**DISCUSSION**

Both Goheen et al.\(^8\) and Hill et al.\(^10\) showed a wide range of variability in torque force delivered with hand screwdrivers among tested individuals. Our study verifies their findings and also demonstrates that some individuals could generate more torque than the highest desired target value of most dental implant manufacturers (32 Ncm). Therefore, clinicians must be concerned about both undertightening and overtightening of implant components. Because of this varying degree of torquing ability among dentists, dental implant manufacturers need to be more precise as to the recommended as well as maximum allowable torque values for all components. Instructing clinicians to “finger tighten only” is not sufficient, as this could possibly vary anywhere from \(~11\) to \(~38\) Ncm (from our study data) depending on the clinician.

The participants in our study had clinically realistic limited access to simulate the oral cavity environment, as did the participants in the study by Hill et al.\(^10\) Despite these similarities, the subjects in this study had a mean torque value of nearly twice that found by Hill et al: 24 Ncm versus 12.9 Ncm for Hill’s group. This could be due to other variables, age of the subjects, implant position, operator position, measuring device, and so forth. Although the paper by Hill et al did not provide an age range or average age, it did state that the group was composed of general dentists attending the state dental meeting. Hill’s study did indicate no difference in the ability to generate abutment screw preload torque based on years of practice experience in dentistry.

**CONCLUSIONS**

This study showed a varying degree of hand torquing abilities using finger drivers. The variability among operators emphasizes the need for a consistent method to apply tightening torque and the use of mechanical calibrated torquing procedures for final torquing of abutment screws. With interim procedures requiring torquing of abutment screws and other implant components, it may not be practical or necessary to use mechanical torquing devices. Dentists routinely placing and removing implant components and restorations should have a clear idea of the amount of torque force he or she is able to generate. A simple test using a known calibrated torque driver to unscrew an abutment screw after tightening, as demonstrated in this study, will provide that information.

**REFERENCES**