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IMPLANT THERAPY OUTCOMES, PROSTHETIC ASPECTS

The Accuracy of Torque Wrenches Used in A Tertiary Dental Care Centre in the UK.

Mohammad Bustani ⁽¹⁾, Mac Suleiman ⁽²⁾.

⁽¹⁾ DDS (JU-Jo), Prosthodontics ST (KCL-UK).

⁽²⁾ Guy's and St Thomas' NHS Foundation Trust, London, UK

Abstract

Screw loosening is a common clinical complication in implant-supported prosthodontics (Jung et al., 2012). A probable cause for this unintentional loosening can be inadequate tightening of the restoration in the first place. Torque wrenches are divided into two categories depending on the mechanism they use to limit the torque; spring-style and friction-style. The proper use of these devices is essential to generate enough torque to apply the necessary preload to secure it. The effect of the clinical use time on the torque produced by the torque wrenches is not completely clear yet.

A sample of 55 torque wrenches, spring-loaded and friction-style were tested. The peak torque measurements were taken with a digital torque gauge after being calibrated with an industrial torque gauge. The mean percentage error of five repetitions of each of the three torque groups (15, 20, and 25 Ncm) was calculated. All measurements were achieved by the same operator.

A mean percentage error of $23\% \pm 7$ was found in the spring-loaded group. While in the friction-style torque wrenches group the delivered torque was higher than the intended one with an average percentage error was $6\% \pm 2\%$. Higher error percentages were found at lower torques (15 and 20 Ncm) than on the 25Ncm.

Fig. 1: (Top-Left) Spring-loaded AstraTech TX torque wrench. (Bottom-Left) Friction-style AstraTech EV torque wrench. (Right) Digital torque gauge (Model BG-1, Mark 10).

Results

In the spring-loaded group, all of the torque wrenches showed a general pattern of delivering lower torque than expected, with a range of 8% to 41% and mean percentage error of $23\% \pm 7$.

While in the friction-style torque wrenches group the delivered torque was higher than the intended one but within the $\pm 10\%$ of pre-set values, the average percentage error was $6\% \pm 2\%$, and the range was -2 % to 10%.

In general, higher error percentages were found at lower torques (15 and 20 Ncm) than at the 25Ncm level.

Fig.2: A box plot showing the mean, 1st and 3rd quartiles, maximum and minimum percentage error for each torque wrench group.

Background and Aim

Limited previous studies have been published investigating the accuracy of the torque wrenches: comparing new vs. aged wrenches (Erdem et al., 2017), or comparing different manufacturers and mechanisms of actions (Steinebrunner et al., 2015). Some studies were done in a dental school setting (McCracken et al., 2010). The aim is to achieve torque within $\pm 10\%$ range according to most manufacturers and previous studies.

The purpose of this study was to determine the accuracy of torque wrenches after repeated sterilization and clinical use. The aim was to measure the variability of torque produced by the torque wrenches used in a tertiary dental care centre in the UK.

Conclusion

- The torque wrench design has an impact on the torque delivered as none of the spring-loaded group delivered torque to $\pm 10\%$ of pre-set values at the three studied torques.
- In the friction-style group, higher than intended torque values were seen. This might be attributed to, design or operator factors. Further work is required to plot the relationship with clinical use time and variances in operators.
- It would be beneficial if clinicians were able to check their torque wrench accuracy easily and more frequently as this might have an impact on the longevity of their implant-supported prostheses.

Methods and Materials

A sample of 55 torque wrenches, 33 spring-loaded AstraTech TX and 22 friction-style AstraTech EV (DentsplySirona, Weybridge, UK) which are a part of the implant restorative kits used in different departments in a tertiary dental care centre were tested.

The peak torque measurements were taken with a digital torque gauge (Model BG-1, Mark 10 – Corporation, Copiague, USA) after being calibrated with an industrial torque gauge. Three different torques (15, 20, and 25 Ncm) were examined as these are recommended for various components by the manufacturer. Fifteen measurements were taken using each torque wrench; five repetitions for each required torque group.

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