

The Accuracy of Release-Type Dental Implant Torque Wrenches After Two Years of Clinical Usage

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Introduction

Risks associated with incorrect torque may include mechanical failures like screw loosening or screw fracture of abutment or implant. Screw loosening is still the most common type of implant prosthetic complication that any practitioner faces in implant dentistry.¹ Therefore, applying sufficient torque according to the manufacturer's instructions is empirical for a successful long-term outcome. The ISO 6789-1 standard.² recommends that the maximum relative deviation of the torque tool be $\pm 6\%$, whereas a $\pm 10\%$ deviation has been reported in the dental literature as acceptable.^{3,4,5,6}

Purpose

To investigate the loss of accuracy in release-type dental torque wrenches (Neoss 5711) after two years of use in the Prosthodontics clinic at Rutgers School of Dental Medicine. The study aims to ensure that the wrenches maintain tolerances acceptable to professional and academic standards. Additionally, it explores the precision differences between manual and automated torque testing.

Materials and Methods

Wrenches Tested: 5 Neoss 5711 torque wrenches were used for 25 months, and 3 were newly purchased for comparison. Testing Methods: Automated testing was done using an MTS-20 digital closed-loop controlled servo-hydraulic piston. Release Torque Measurement: An average of three trial results constituted a test result. Methods of small group sampling are used to estimate unbiased sample standard deviation. Comparison Groups: 7/20 (manual testing), 8/22 (automated testing), and 11/22 (new wrenches).

Results

- The average release torque loss after 25 months of clinical use was 5.02 Ncm, 15.35 % loss from the initial tests, and 13.46 % below the 32.00 Ncm target.
- Automated testing variability was 53.0% lower than manual testing.

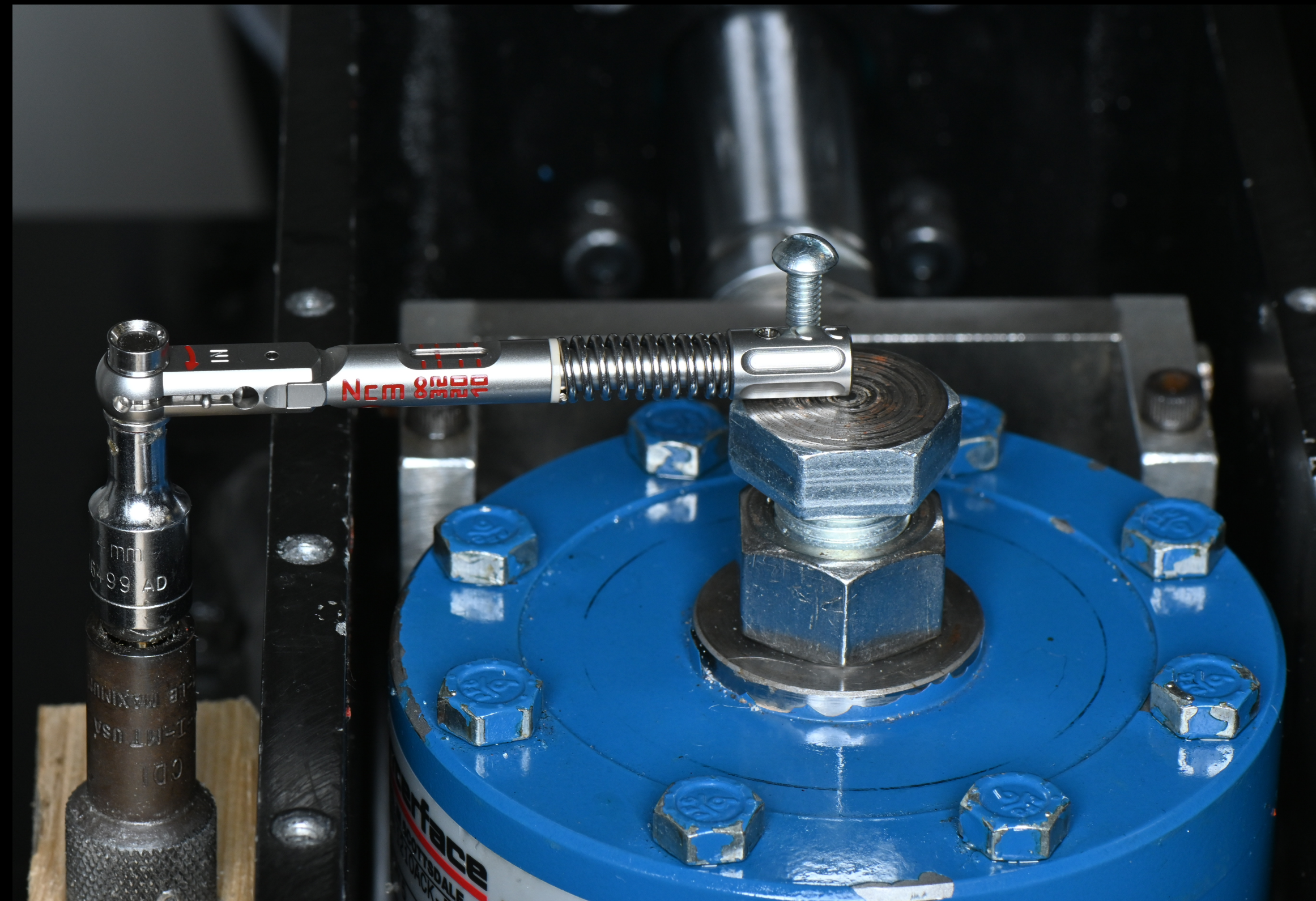


Figure 1. Experimental set-up, MT-20 on left, (big load cell acts only as a carrier for the finger.)

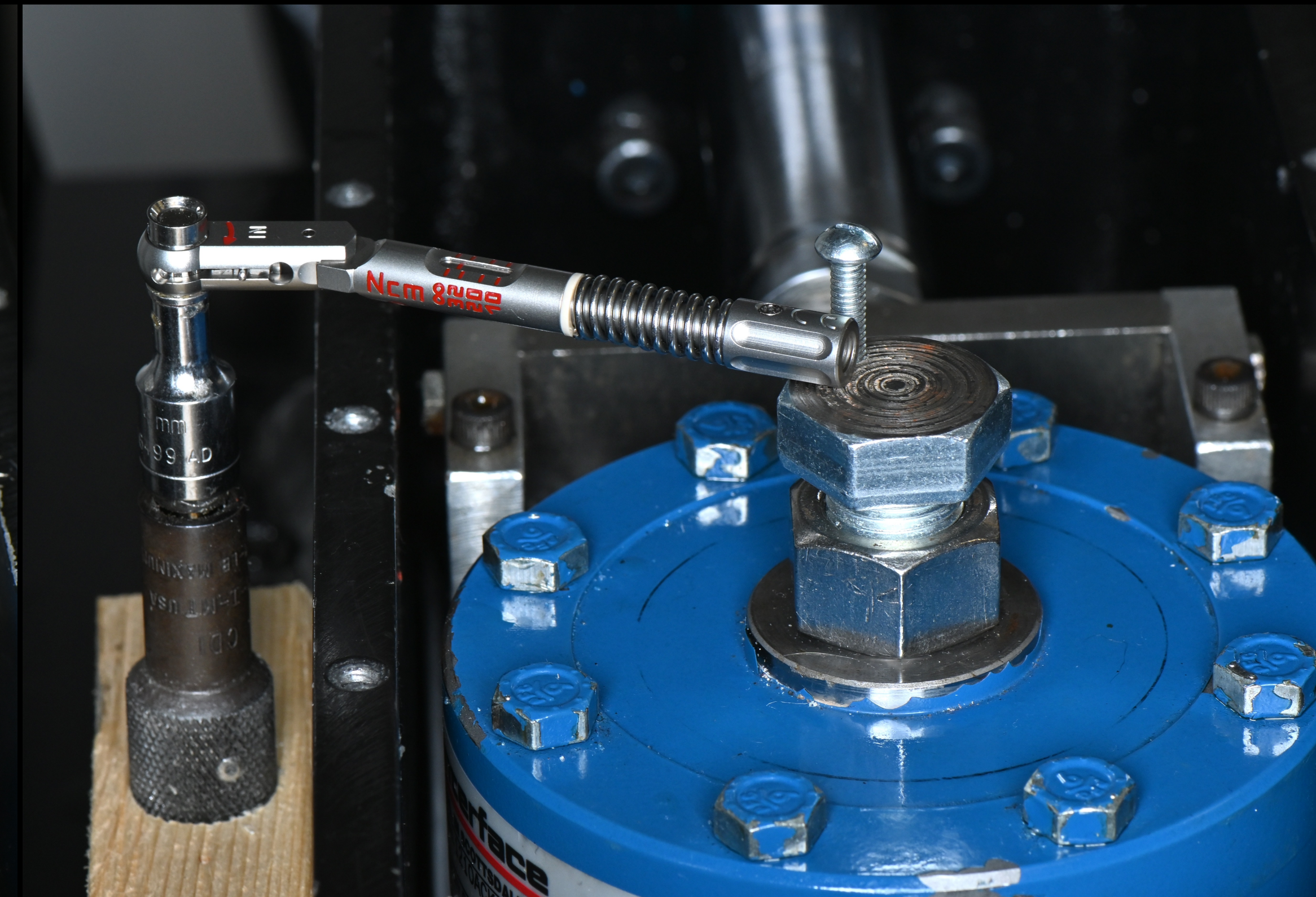


Figure 2. Actuator stopped just after wrench “break” showing wrench still in sure contact with the finger.

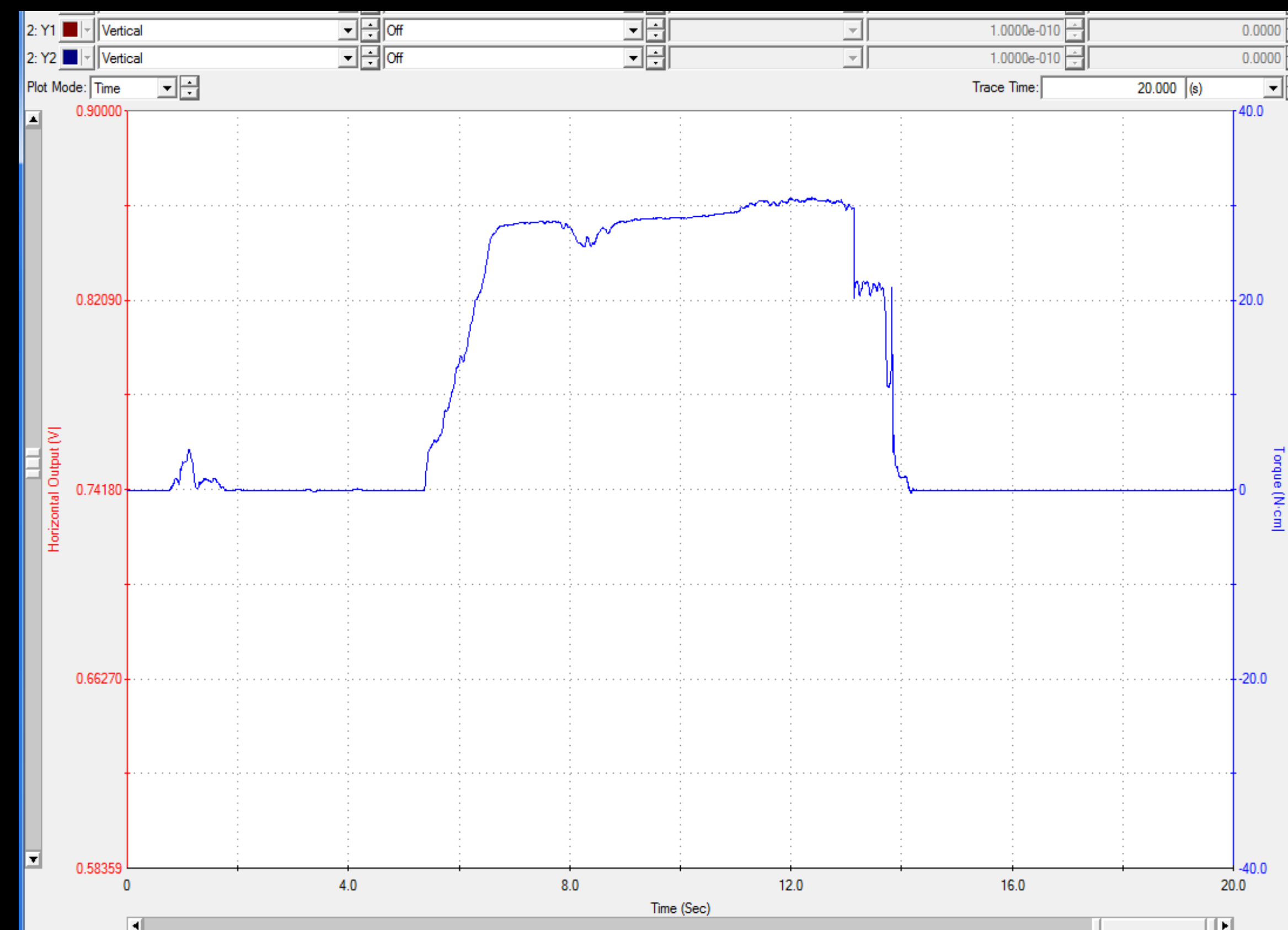


Figure 3. Piston motions demonstrated in the Basic Test Ware program that was run by the MTS Flex Test 40 digital controller

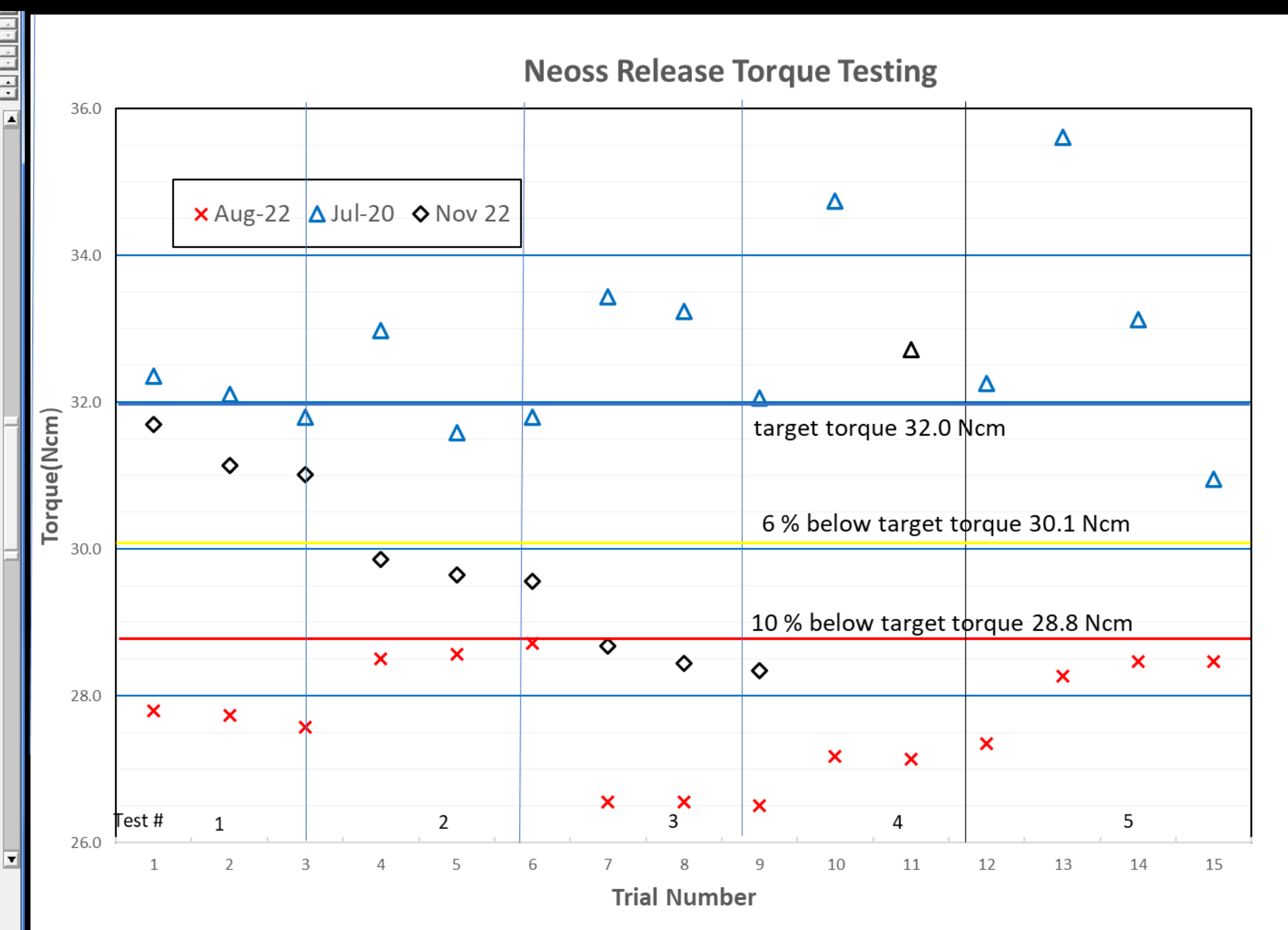


Figure 4. Point plots of release torque tests. Each shape on the graph represents the different time frame of the test. Each torque wrench was tested 3 times numbered 1 to 5 on the x-axis. The y-axis represents the torque in Ncm for each test.

Discussion

- After 2 years of clinical use, torque delivered from all wrenches had fallen below clinically acceptable requirements.
- Lower torque noted on automated testing of new wrenches.
- Loss of accuracy may be due to temperature-dependent spring constant of the spring-controlling release mechanism.^{7,8,9}
- Neglecting the manufacturer’s instructions which state that the torque setting should be returned to the minimum after use, may also contribute to the loss of accuracy.
- A comparison between the precision of human and machine wrench actuation can also be made.

Conclusion

Within this pilot study, the release-type torque wrenches showed a notable decrease in accuracy after two years of utilization. Aspects like temperature-driven spring degradation, storage conditions, and incorrect handling might have contributed to this gradual decline in precision. This underscores the importance of periodic calibration for dental torque wrenches.

Recommendations

- Training in proper use and maintenance of torque wrenches.
- Frequent calibration or replacement of torque wrenches.¹⁰
- Tracking usage to monitor performance.

Limitations

- The torque transducer was calibrated as part of the study, the sample size was limited, only one type of system was evaluated, and record of maintenance was not documented.

References

