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EFFECT OF TYPE OF MOTION ON TORQUE GENERATED INTRA-CANALLY (IN VITRO STUDY)

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ABSTRACT

Objective: To measure cumulative torque values generated during different types of motions during instrumentation by rotary files.

Method: Forty extracted human premolar teeth with single canal have been utilised, instrumentation was performed with a single-file procedure with tip end no. 25 and taperness of 6% by two groups of files; Protaper Gold and Wave One Gold. Each group was subdivided into two subgroups; Group A (10 in no.) set at 2.5 N.cm^2. Group B (10 in no.) set at 1 N.cm^2 using an endodontic motor. A software has been used for precise torque measurements of range of 0.05 N.cm^2 for every 30 seconds.

Results: The t test showed a highly significant difference between groups 1A and 2A ($p \leq .01$). Cumulative torque also showed non-significant differences by the groups 1B and 2B, ($p \geq .05$) (Table 2).

Conclusion: At high torque setting, the preparation mode was affected by cumulative torque values whereas the same comparison was neutral at low torque control motor.

KEYWORDS: Intra-canal torque, Rotary endodontic instruments, Reciprocation motion

INTRODUCTION

During endodontic instrument usage, major shortcomings have been recorded such as fracture, dentin cracks and sound tooth structure removal[1]. NiTi tools claimed to be strong enough for torsional fatigue because of manufacturer treatment and style[2]. Some of those developments have been tested in vitro in spite that each separate test might not indicate cumulative stress that might be noticed when comparing the type of motion which might be missed in most researches[3].

Static torsion was initiated previously for testing SS manual tools and might be a demand for another manoeuvre for other types of instruments. Custom made platforms have been used by some authors[4]. Use of extracted natural teeth for those purposes will be more reasonable to simulate the clinical situation and get repeatable methods. Therefore, a study demonstrated that excessive stress due to torsion was the major reason for NiTi tools fracture[1].

If this variable gained by the engine overcoming the alloy inherent resistance, it will be subject to plastic deformation and separate. Reciprocation motion might be suggested as a solution to control torque intra-canal [5]. Since the generated stress is multifactorial as reported by a study[6], one of them is the type of motion, though the aim of this study was to assess torque values generated during different types of motion. The null hypothesis was that both motions would require the same torque values.

MATERIALS AND METHODS

Forty extracted human premolar teeth with single canal and average curvature 10-15 degrees, the reasons for extraction were diverse, randomly distributed into 4 groups. Access cavities were executed using round burs, then the access were widened by taper fissure bur with safety non-cutting tips to limit that K-file # 10 had no contact to any lateral wall to get straight line access to apical constriction. All canals were negotiated as a patency step initially with no. 10 K-file and final length (WL) was decided using no. 15 K-file till the tip of the file just appeared. Glide-path with hand manoeuvre was created for the canals up to size 20 K-file. Root canal instrumentation was done by using a technique of single-file with taper of 6% and tip no. 25. Protaper Gold and Wave One Gold (Dentsply Sirona, USA). Group one (20 in no.); was instrumented by Protaper Gold with rotation motion, while Group two (20 in no.); was

instrumented by Wave One Gold with reciprocation motion.

All instruments were motioned at 300 rpm with two torque values; therefore, each group was subdivided into two subgroups; Group A (10 in no.) set at 2.5 N.cm^2 using an endodontic motor (ProMark Endo Motor, Dentsply Sirona, USA) and a Tulsa 1:1 hand-piece. Group B (10 in no.) set at 1 N.cm^2 using an endodontic motor (ProMark Endo Motor, Dentsply Sirona, USA) and a Tulsa 1:1 hand-piece. A software (Torque 10 software, Magtrol SA, Switzerland) has been used for precise torque measurements of range of 0.05 N.cm^2 for every 30 seconds. The time and strokes of instrumentation were fixed by inward movement for 3 min. and 6 strokes for full working length. Recorded data can be then gained as a spreadsheet digital document. One mL of normal saline, before the instrumentation was used as lubrication. Data recorded was analysed statistically.

RESULTS

Table 1 shows the mean cumulative torque numbers measured in each group for both motions and set torque by endodontic motor. Descriptive statistics show the average, standard deviation, variance and minimum and maximum cumulative values.

The t test (paired) showed a high significance (1A and 2A) ($p \leq .01$). The cumulative torque measurements showed non-significance (1B and 2B), ($p \geq .05$) (Table 2).

DISCUSSION

The factors that affect the torque can be expected to be design of endodontic instruments, motion that a given instrument executes its work, canal curvatures whether radius or angle and speed and torque of the engine[6]. Severe canal curvature leads to increased torque required to reach apical terminus, in addition increased file taperness leads to higher resistance to torsional stress and less fatigue resistance[7].

The philosophy of a "low torque instrumentation technique" was initiated by scientist[8].The danger of intracanal separation of file will be high percentage; if the torque is done too high, and if the set was too small; it will obstruct the glide inside the canals. Literature has reported shortcomings of the low torque, mainly related to difficulty in progress and decreased cutting efficiency[8]. The present study revealed that at low torque there was non significant change in torque values between two preparation motions as expected so the null assumption can not be rejected.

Table (1) represents the cumulative torque recorded for two factors; type of motions and torque control magnitude. The conventional engine provokes the torque if the resistance inside the cylinder was gained. The logical explanation of this phenomenon might be due to the fact that rotation inside the cylinder (canal) requires cutting power and dentin chips removal. The present study results showed higher torque values when rotation motion were used compared to reciprocation. The instrument's blades numbers when increased and where are in contact due to rotation action with increased surface area due to file design, the greater is the torque, thus the null hypothesis was rejected for high torque motors, (Table 2). Mostly straight canals with a single pathway were selected to remove the effect of the canal curvature variable.

By expectation, the low torque (1 N.cm^2) had better results. Plus detection of non significance via the two preparation methods was clear. Canal complexity might provoke the condition for a high torque motor rather than control it; the reverse might be expected from low torque control motors to rule out or at least minimise their effects [9].

Literature showed that fatigue of metals might be due to stresses generated by the bend of that metal. [(2,5)]; the same might occur due to stresses by torsion. So, when NiTi rotary files are managed, stresses should be avoided by withdrawal of them when determination of final length was established. Progression with greater taper percentage and/or tip size is substituted by more debridement with the same size and different manoeuvre.

CONCLUSION

At high torque setting, the preparation mode was affected by cumulative torque values whereas the same comparison was neutral at low torque control motor.

Conflict of Interest

The author has stated explicitly that there are no conflicts of interest in connection with this article.

REFERENCES

Sattapan B, Palamara J, Messer H. Torque during canal instrumentation using rotary nickel-

titanium files. J of Endod. 2000; 26 (3): 156-60.

Plotino G, Grande N, Mercade M, Testarelli L, Gambarini G. Influence of temperature on cyclic fatigue Resistance of ProTaper Gold and ProTaper Universal rotary files. J of Endod. 2017; 43 (4): 200-2.

Kwak W, Ha H, Cheung S, Kim C, Kim K. Effect of the glide path establishment on the torque generation to the files during instrumentation: an in vitro measurement. J of Endod. 2018; 44 (6): 496-500.

Liu W, Wu B. Root canal surface strain and canal centre transportation induced by 3 different nickel-titanium rotary instrument systems. J of Endod. 2016; 42 (4): 299-303.

Pedulla E, Grande M, Plotino G, Gambarini G, Rapisarda E. Influence of continuous reciprocating motion on cyclic fatigue resistance of 4 different nickel-titanium rotary instruments. J of Endod. 2013; 39 (3): 258-61.

Pereira S, Singh R, Arias A, Peters A. In vitro assessment of torque and force generated by novel ProTaper Next instruments during simulated canal preparation. J of Endod. 2013; 39 (11): 1615-9.

Gambarini G, Plotino, G, Piasecki L, Sudani, A, Testarelli L, Sannino G. Deformations and cyclic fatigue resistance of nickel-titanium instruments inside a sequence. Annali di Stomatologia. 2015; 6 (1): 6-9.

Gambarini G. Cyclic fatigue of nickel-titanium rotary instruments after clinical use with low- and high-torque endodontic motors. J of Endod. 2001; 27 (8): 772-4.

Peters A, Peters I, Schonenberger K, Barbakow F. ProTaper rotary root canal preparation: assessment of torque and force in relation to canal anatomy. Int Endodo J. 2003; 36 (2): 93-9.

Table (1): Descriptive statistics between the tested groups for torque values in N.cm2

Groups	Sample no.	Minimum	Maximum	Mean	SD	Variance
1A	10	3.1	6.4	4.65	1.15	1.3
1B	10	1.1	3.1	2.08	0.68	0.47
2A	10	2.5	4.3	3.11	0.63	0.4
2B	10	1.1	2.4	1.8	0.46	0.22

1A: Rotation set at 2.5 $N.cm^2$
1B: Rotation set at $1N.cm^2$
2A: Reciprocation set at 2.5 $N.cm^2$
2B: Reciprocation set at $1N.cm^2$

Table (2): Inferential statistics between the tested groups

	Rotation (1) vs Reciprocation (2)
At High torque setting (A)	**Decision: P value = 0.01 (Highly significant)** **t = -3.2455**
At Low torque setting (B)	**Decision: P value = 0.14 (Non significant)** **t = -1.5886**

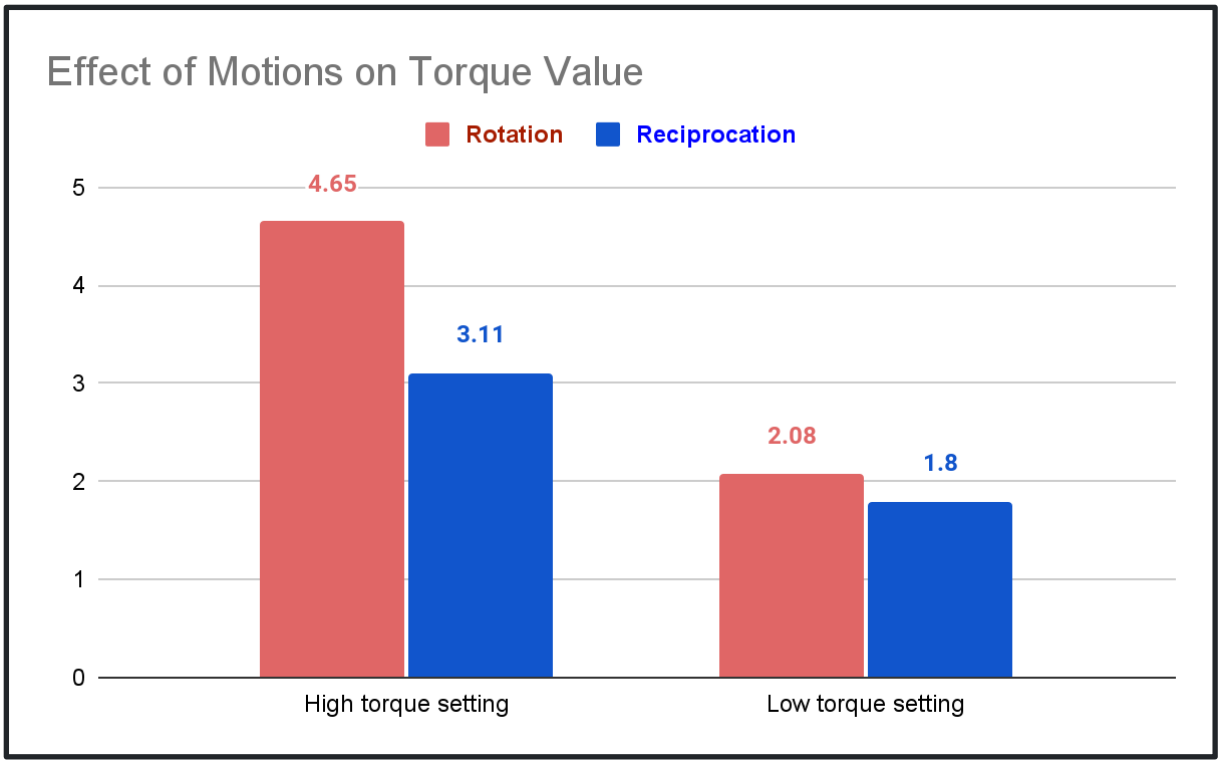

Fig. (1): Differences between the tested groups