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COMPARATIVE EVALUATION OF PRE AND POST STERILIZATION EFFECT ON CYCLIC FATIGUE RESISTANCE OF TRUNATOMY AND ONE G FILES IN A SINGLE CURVED CANAL. AN IN-VITRO STUDY

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Abstract:

AIM : To compare and evaluate the effect of sterilization on cyclic fatigue resistance of TruNatomy and One G glide path files.

MATERIALS AND METHODS: A samples of 20 TruNatomy files and 20 One G Ni -Ti glide path files were taken and then 10 from each group were subjected to glass bead sterilization. All the 40 files were fatigue tested by a custom made cyclic fatigue testing device until fracture. Time to fracture and the number of cycles to failure of each instrument was recorded. Data was statistically analyzed by ANOVA and Post hoc test.

RESULTS: The cyclic fatigue resistance of sterilized TruNatomy was found statistically high compared to non sterilized TruNatomy, non sterilized One G files and sterilized One G files.

CONCLUSION: Within the limitations of the present study, it was concluded that sterilized TruNatomy files were more cyclic fatigue resistant than non sterilized TruNatomy, non sterilized One G files and sterilized One G files.

Key words **- Cyclic fatigue, TruNatomy glide path files, One G glide path files, glass bead sterilization.**

I. INTRODUCTION

An evolution has begun in endodontics with the advancement of nickel- titanium (NiTi) files in the 1980s. The NiTi files grant flexibility and provide convenience in the preparation of curved canals. Apart from advantages, the most important disadvantage is that they fracture unexpectedly due to the repetitive compression and tension stresses when the file is rotated within the curved canals.[1]

The endodontic Glide path is the first most important for radicular rotary safety. The initial phase of chemomechanical preparation is preparing the glide path and is accepted as a crucial point for assessing the root canal anatomy and ensuring the smooth path till the apical portion of the canal.[2]

TruNatomy (Dentsply Sirona, Switzerland) is a newly manufactured file system from a 0.8 mm NiTi wire while other generic files are made of 1.2 mm NiTi wire, followed by special heat treatment. It is claimed that TruNatomy has a reduced risk of separation due to the increased resistance to cyclic fatigue and flexibility.[3]

The One G instrument (Micro-Mega) was introduced in 2015 for glide path enlargement as a single file system. It has a 3% taper with three cutting edges situated on three different radii. The instrument has an ISO size 14 with a non-cutting tip that reduces the risk of ledge formation and it has a variable pitch between the cutting edges which reduces the screwing effect.[4]

Infection control and cross-infections are foremost concerns for both patients and health-care providers, and to prevent the transmission of contagious disease endodontic instruments and files should be sterilized after their use.[5] The oral cavity contains more than 700 bacterial species so, reusable instruments can be a source of infection for the dental professional, and if sterilization and disinfection procedures are improper, then patients may be exposed to an infectious risk. The sterilization methods range from autoclaving process at temperatures ranging between 121° and 135°, the usage of 2% glutaraldehyde, the usage of glass bead

sterilization, to dry heat sterilization.[6] Viana AC et al. in there study concluded that heat sterilization methods could increase Ni-Ti cyclic fatigue resistance.[7]

The aim of the present study was to compare the effect of glass bead sterilization on cyclic fatigue resistance of NiTi rotary glide path files under a dynamic model. The null hypothesis was that there would be no significant differences among the cyclic fatigue resistance of sterilized and non sterilized NiTi rotary glide path files.

MATERIALS AND METHODS:

Files and Sterilization

A total of 40 unused glide path files were used of which 20 TruNatomy(17-0.02)files (fig:1) and 20 One-G (14-0.03) files(fig:2), both of length 25mm. Each set of files were subdivided into 2 sub groups of 10each.
Sub group 1-Sterilized TruNatomy files(n=10)
Sub group 2-Sterilized One G files(n=10)
Sub group 3- Non Sterilized TruNatomy files(n=10)
Sub group 4- Non Sterilized One G files(n=10)

Sub group 1 and 2 were subjected to Glass Bead Sterilization (fig:3) for 15 seconds at 425-475 ºF (218-246 ºC).[8]

Cyclic Fatigue Testing

After finishing the sterilization process all files were subjected to fatigue testing device (fig:4). This device has been specially designed with a 60 degree curvature angle, 5mm curvature of radius with 1.5 mm inner diameter stainless steel artificial canal[2]. To ensure a reproducible three dimensional relationship to the artificial canal in the steel block, an electric rotary handpiece (E-CONNECT) was fixed to the main frame. Each rotary file was mounted in the handpiece and precisely positioned to the same point in the testing block.
The artificial canal has been covered with a transparent plastic sheet for the files from slipping out and it enables the researcher to view the files while it works and when fracture occurs.[8]
According to manufacturer's instructions, the files were rotated using endodontic motor until failure , at 400rpm and 1.2Ncm for One G and at 500rpm and 1.5Ncm, glycerin was used to minimize the friction between the file and artificial canal to ensure the free rotation of files within the canal. The durations until fracture were recorded in seconds.
The number of cycles to failure (NCF) was calculated with the below formula:

NCF = Duration to failure (sec) × rotation speed (rpm)/60

The armamentarium used in this study are -

FIG:1 TRUNATOMY

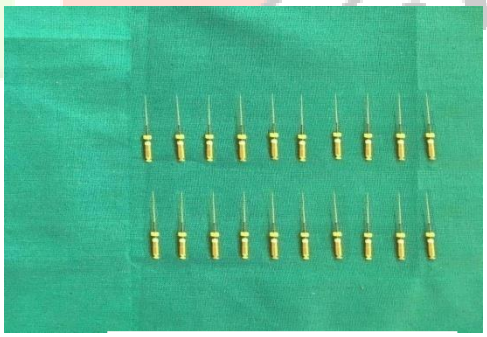


FIG:2 ONE-G FILES

FIG:3 GLASS BEAD STERILIZATION

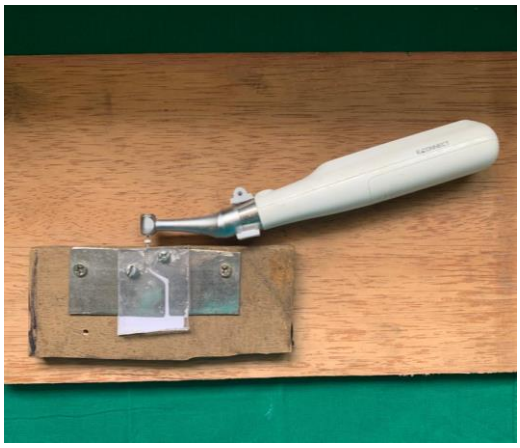


FIG:4 CYCLIC FATIGUE MODEL

STATISTICAL METHOD

Statistical analysis was done using ANOVA TEST .
Post hoc Tukeys was done to evaluate the difference between each of the individual sub group.

RESULTS

The data was entered into an excel sheet and were analyzed using IBM SPSS version 25. ANOVA followed by post hoc was used to test for the difference in 'number of cycles to failure' among the four groups of files.

TABLE 1: ANOVA TO TEST FOR THE DIFFERENCE IN 'NUMBER OF CYCLES TO FAILURE (NCF)' AMONG THE FOUR GROUPS OF FILES.

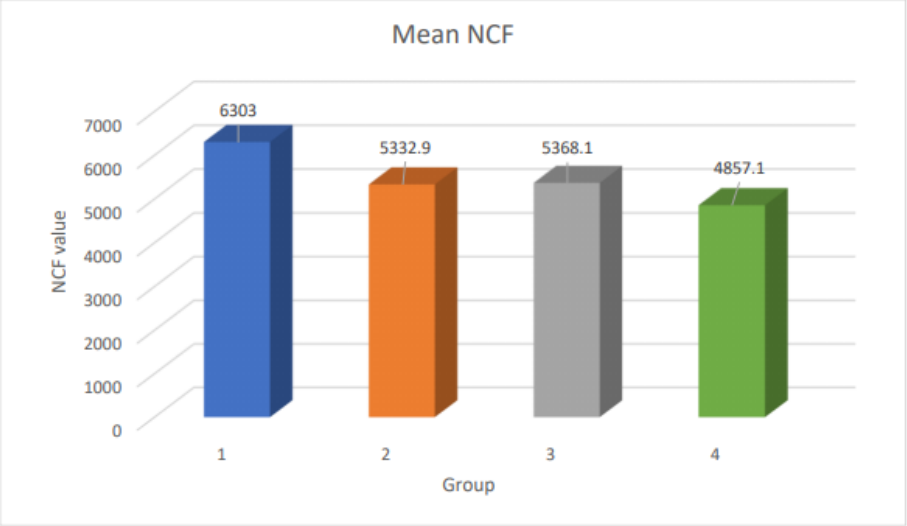
Group	Number	Mean	Std deviation	F statistic	P value
1	10	6303.00	469.865	21.235	.000
2	10	5332.90	438.100		
3	10	5368.10	449.831		
4	10	4857.10	273.450		

Table 2: Post-hoc test to evaluate the difference between each of the individual groups.

Groups compared	Mean difference	Sig
1 * 2	970.100	.000
1 * 3	934.900	.000
1 * 4	1445.900	.000
2 * 3	-35.200	.998
2 * 4	475.800	.067
3 * 4	511.000	.044

Inference: Sterilized TruNatomy files showed the highest mean value than the other three subgroups. There was a significant difference in the NCF values of all four sub groups of files. Post- hoc test revealed that the values for the 1st sub group were significantly greater .

GRAPH: REPRESENTATION OF 'NUMBER OF CYCLES TO FAILURE (NCF)' AMONG THE FOUR SUB GROUPS OF FILES.



DISCUSSION

The present study evaluated the effect of sterilization procedures on root canal preparations with nickel-titanium rotary files from two different manufacturers, and determined cyclic fatigue resistance. Moreover, it has been observed that the properties and performance of NiTi rotary instruments might be affected by sterilization procedures.

A glide path is a smooth radicular tunnel from the canal orifice to the physiological terminus of the root canal. To reduce the fracture of nickel-titanium (NiTi) instruments and root canal aberrations caused by instrumentation, it is recommended that a glide path be created during the initial preparation in contemporary endodontics. Creating a glide path could reduce torsional stress, thereby increasing the lifespan of the rotary instrument used for canal preparation.[9]

Maintaining the original configuration of the root canal system without any iatrogenic events is essential in curved canals.[10] Many studies examining the NiTi files for cyclic fatigue resistance were carried out on the artificial canals, to minimize the anatomic variation, which might arise from the natural teeth, and to maintain a level of standardization. The angle and number of curvatures within the canal are the most important factors while testing the cyclic fatigue resistance of files.[1]

Recently, there have been several studies on the fatigue resistance of TruNatomy. Riyahi et al. reported that TruNatomy files had greater cyclic fatigue resistance than ProTaper NEXT and Twisted files.[3] Elnaghy et al. also reported that TruNatomy was more resistant to cyclic fatigue than the Vortex Blue and Race instruments in single and double curvature canals.[11] TruNatomy files have a square cross-section and an off-centered design, with a variable taper. These files have four times more elasticity and fatigue resistance as compared with the file systems produced with the conventional heat treatment technique due to a new heat treatment procedure used as reported by the manufacturer.

The One G instrument (Micro-Mega) was introduced in 2015 as a single file system for glide path preparation. This NiTi rotary glide path file has a 3% taper with three cutting edges situated on three different radii relative to the canal axis, which according to the manufacturer intensify the cutting action and allows for more room for debris elimination. Ha et al. compared the One G with the G2 file (Micro-Mega) and found that One G had a higher cyclic fatigue resistance.[12] These authors concluded that the increased fatigue resistance and flexibility might enable maintenance of the original canal anatomy during glide path enlargement, as well as a reduced risk of ledge formation or transportation.

Previous studies demonstrated that the cyclic fatigue resistance might be affected by the manufacturing phase of the file or the alloy.[13] When taken together with the results of the current study, TruNatomy has higher cyclic fatigue resistance than One G file as TruNatomy is made by special heat treatment whereas One G is made of conventional NiTi alloy. Keskin NB et al. compared cyclic fatigue resistance of ProTaper Universal and ProTaper Next and concluded that ProTaper Next made by heat treatment is more resistant to cyclic fatigue than ProTaper Universal which is made of conventional NiTi alloy.[14]

According to the results of the present study, the cyclic fatigue resistance of sterilized TruNatomy files was found to be statistically higher than the other three subgroups. For this reason, null hypothesis of the present study was rejected.

CONCLUSIONS

Under the conditions of the present study, it can be concluded that cyclic fatigue resistance is high in TruNatomy sterilized files compared to One G sterilized files and it also supports heat treated files are more resistant to cyclic fatigue than conventional NiTi files.

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