MECHANICAL ANALYSIS FOR PROTAPER AND SAF DURING THE ENDODONTIC TREATMENT IN CURVED CANALS

CHRISTINA MIHAI[1], ANDREI ILIESCU[2]

[1]Medical Centre of Diagnosis and Treatment Bucureşti, [2]"Carol Davila" University of Medicine and Pharmacy Bucureşti

Keywords: *mechanical treatment, curved canals, ProTaper F_2 and SAF*

Abstract: *Objective: This study accomplishes a mechanical analysis for ProTaper (F_2) and SAF during the biomechanical endodontic treatment for curved canals. Materials and methods: By using 46 X-rays of molars (mesiovestibular canal), we create a virtual root canal, with round cross-section and 2 variables: angle and radius of curvature. Also, 2 models were simulated for the ProTaper and SAF instruments according to their configuration. The interaction between the instrument and the walls of the root canal was made and analyzed with AutoCad 2012 program. Results: We found transformations for all studied cases, proving the efficiency of instruments with better results for SAF. Discussions: SAF proves its efficiency especially for canals with an angle of 60^0 and a radius of 5 mm. Conclusions: By its special design, SAF is elastic and compressible, determining an evenly applied force to the root canal walls, presenting a safe and effective processing.*

Cuvinte cheie: *tratament mecanic, canale radiculare curbe, ace ProTaper F_2 si SAF*

Rezumat: *Obiectiv: Studiul realizează o analiză mecanică a comportamentului ProTaper F_2 şi SAF în timpul tratamentului biomecanic endodontic în canale radiculare curbe. Materiale şi metode: Utilizând 46 de radiografii retroalveolare pentru molari (canalul MV) am creat un canal virtual, cu suprafaţa de secţiune rotundă şi 2 parametri variabili: unghiul şi raza de curbură. Instrumentele ProTaper şi SAF au fost simulate în conformitate cu configuraţia lor. Interacţiunea instrument – pereţi canalari a fost reprezentată şi analizată cu ajutorul programului AutoCad 2012. Rezultate: Au fost obţinute transformări în toate cazurile studiate, subliniindu-se eficienţa instrumentelor utilizate, rezultatele obţinute pentru SAF fiind superioare. Discuţii: Instrumentarea cu SAF este mai eficientă, mai ales pentru canalele cu unghi de 60° şi rază de 5 mm. Concluzii: SAF prin designul său special este elastic şi compresibil, determinând o presiune uniformă asupra întregii suprafeţe a pereţilor canalari, astfel, prezentând o prelucrare sigură şi eficientă.*

INTRODUCTION

Complex root anatomy determines different approaches of the biomechanical treatment. The key of the clinical success is to observe the biological principle, to preserve the initial anatomy during the cleaning and shaping of the root canal. The current technology gives the possibility of a good endodontic treatment. The NiTi instruments, by the elasticity of their alloy, are superior to SS (stainless steel) instruments in preserving the location of the root canal axis.

There are studies attesting many problems of NiTi instruments, such as: untouched areas after the mechanical treatment in asymmetrical canals, apical transportation, perforation or even the risk of root fracture, and even the possibility of blocking and fracturing the needle in the canal, frequently for rotary systems.

In these conditions, a new instrument – SAF was created, which is perfectly adapted to any anatomy, is efficient and resistant. Its design provides a 3D biomechanical treatment over the entire surface of the canal walls.

PURPOSE

This study accomplishes a mechanical analysis for ProTaper (F_2) and SAF during the biomechanical endodontic treatment for curved canals.

METHODS

The study was accomplished "in vitro". It was designed to explore the mechanical properties for ProTaper and SAF during the endodontic treatment in curved canals. The virtual root canal model was made according to the dimensions of MV canal measured in 46 XRays of molars. By changing two parameters, angle and radius of curvature, we simulated 12 cases. Images were obtained by using 3D Solid Works program. The cases were represented by canals with the angle of 30^0, 45^0, 60^0 and 90^0, and a radius of 3, 4 and 5 mm.

The configuration of ProTaper F_2 was achieved using the 3D Solid Works program. The images for SAF were obtained with the Adobe program. The interaction between the needle and the root canal walls were simulated and analyzed with AutoCad 2012. The information was organized in a special system and calculated with Excel program.

RESULTS

The configuration of ProTaper F_2 determines an efficient biomechanical endodontic treatment. The area of endodontic space is modified constantly according to the angle and radius of the curvature values. Although the NiTi alloy provides flexibility to the instrument, a relative rigidity appears

[1]Corresponding author: Christina Ramona Mihai, Str. IC Brătianu, Nr. 35, Ap. 10, Sector 3, Bucureşti, România, E-mail: golediana@yahoo.com, Tel:+40740 090060
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at this diameter with repercussions on the external area of the curvature.

Maximum values were obtained for the angle 30^0 and radius 5 mm and a minimum value for an angle of 930^0 and a radius of 4 mm.

Table no. 1. The difference between mechanical ProTaper = SAF

	Radius 3 mm				Radius 4 mm				Radius 5 mm			
30 degrees angle												
D	*32.86*	*35.1*	*2.24*	*6.38176*	*33.78*	*35.84*	*2.06*	*5.74776*	*34.35*	*36.76*	*2.41*	*6.5560*
E	*32.86*	*35.12*	*2.26*	*6.43508*	*33.78*	*35.92*	*2.14*	*5.95768*	*34.35*	*36.85*	*2.5*	*6.7842*
45 degrees angle												
D	*32.46*	*34.42*	*1.96*	*5.69436*	*28.44*	*30.44*	*2.00*	*6.57030*	*30.64*	*32.12*	*1.48*	*4.6077*
E	*32.46*	*34.45*	*1.99*	*5.77648*	*28.44*	*30.48*	*2.04*	*6.69291*	*30.64*	*32.3*	*1.66*	*5.1393*
60 degrees angle												
D	*33.28*	*35.11*	*1.83*	*5.21219*	*32.25*	*34.33*	*2.08*	*6.05884*	*33.28*	*34.96*	*1.68*	*4.8054*
E	*33.28*	*34.88*	*1.6*	*4.58715*	*32.25*	*34.12*	*1.87*	*5.48065*	*33.28*	*34.66*	*1.38*	*3.9815*
90 degrees angle												
D	*35.14*	*36.57*	*1.43*	*3.91030*	*35.84*	*37.21*	*1.37*	*3.68180*	*36.24*	*37.97*	*1.73*	*4.5562*
E	*35.14*	*36.66*	*1.52*	*4.14620*	*35.84*	*37.22*	*1.38*	*3.70768*	*36.24*	*37.98*	*1.74*	*4.5813*

Figure no. 1. Mechanical behaviour of rotary instruments

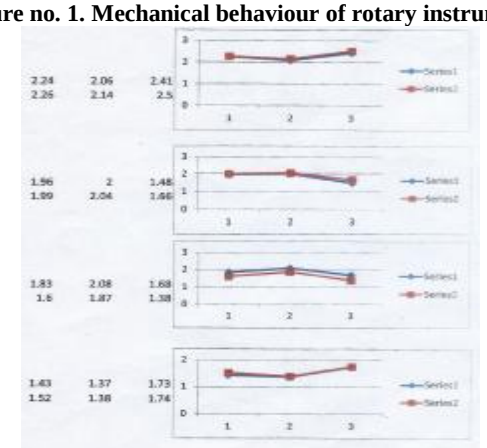

Figure no. 2. The shape of theoretical canals before and after the processing with special alloy needles NiTi - mechanical

Figure no. 3. The shape of theoretical canals before and after the processing with special alloy needles SAF - mechanical

DISCUSSIONS

Major values for endodontic area space after SAF preparation denote a uniform action along the entire walls, comparing with ProTaper F_2, when unprocessed areas may remain and/or associated with surfaces processed in excess. We observed a maximum for the canal with angle 60^0 and radius 5 mm.

Table no. 2. The analysis of ProTaper F_2 – SAF

Angle (degrees)	*Radius (mm)*		
	3	**4**	**5**
30	*0.02*	*0.08*	*0.09*
45	*0.03*	*0.04*	*0.18*
60	*0.20*	*0.21*	*0.30*
90	*0.09*	*0.01*	*0.01*

CONCLUSIONS

SAF, inserted into the canal tends to achieve its original dimensions, applying a constant and uniform pressure over the entire canal walls. It removes dentin, with a back and forth grinding motion, while the needle is adapted both longitudinally and cross-sectionally, maintaining the original anatomy.

ProTaper F_2 acts efficiently, but not uniformly, with only a longitudinal adjustment.

The endodontic treatment with SAF is safer both as it maintains the root canal anatomy and removes uniformly the dentine, eliminating the risk of remaining untouched areas, which can compromise the clinical results.

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