

Impact of Rotary Systems on File Fracture Rates: Comparing the CanalPro Jeni and ProMark in Predoctoral Training

Christopher Ziegele¹ Jens Nielsen¹ Richard Gray¹ Udochukwu Oyoyo¹

¹Department of Endodontics, Loma Linda University School of Dentistry, Loma Linda, California, United States

Address for correspondence Richard Gray, DDS, Department of Endodontics, Loma Linda University School of Dentistry, Loma Linda, CA 92350, United States (e-mail: rjgray@llu.edu).

Int J Health Environ Res 2023;1:54–59.

Abstract

Background Endodontic procedures pose challenges, particularly for inexperienced individuals, due to the risk of file fracture. The CanalPro Jeni, a system designed to simplify use of rotary files for endodontic cleaning and shaping procedure, shows promise but requires further investigation.

Aim This study aimed to compare the rate of file fracture between two rotary systems: the ProMark motor with Vortex Blue files (Group A) and the CanalPro Jeni with HyflexCM files (Group B).

Methodology Twenty, third-year dental students with no prior rotary handpiece experience participated in the study and were randomly divided into two equal groups. Participants individually performed cleaning and shaping of the mesiobuccal canal on plastic teeth. The occurrence of file fractures was assessed. One participant was excluded from both groups due to protocol violation.

Observations and Results In Group A ($n = 9$), one file fracture occurred, while Group B ($n = 9$) showed no file fractures. Chi-squared analysis yielded a nonsignificant result ($\chi^2 = 1.06$, $p = 0.303$). Although not statistically significant, comparative measures revealed an odds ratio of 3.35 (95% confidence interval: 0.120–93.8), favoring Group B.

Conclusion The CanalPro Jeni system demonstrates potential in reducing file fractures, benefiting sparingly trained predoctoral students. Further research with larger samples is warranted to validate these findings and explore additional outcome measures.

Keywords

- ▶ CanalPro Jeni
- ▶ dental students
- ▶ endodontics
- ▶ file fracture
- ▶ HyflexCM files
- ▶ ProMark motor
- ▶ rotary system
- ▶ Vortex Blue files

Introduction

Endodontic procedures, particularly for individuals who are inexperienced or in the early stages of learning, can pose significant challenges.¹ One of the key difficulties faced by those with little experience is the uncertainty surrounding file fracture.² Several products in the market aim to simplify

endodontic procedures, with one such system being the CanalPro Jeni.³ However, before widespread adoption, the effectiveness and safety of the CanalPro Jeni need to be further investigated, as it is not yet Food and Drug Administration approved.

The use of rotary files is crucial in endodontic procedures for mechanical cleaning and shaping of the root canals. While

DOI <https://doi.org/10.1055/s-0043-1777261>.
ISSN XXXX-XXXX.

© 2024. BJS Research Institute. All rights reserved.
This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)
Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

stainless steel (SS) is commonly used for hand instrumentation, nickel titanium (NiTi) is the preferred material for rotary instrumentation due to its superior performance. However, studies have reported a higher incidence of file fractures with NiTi instruments compared with SS instruments.⁴ The fracture rate of NiTi files ranges from 0.7 to 6%⁵ and 1 to 9%.¹ While fractured instruments can often be removed or bypassed successfully, predoctoral students face challenges in retrieving such fractured instruments.⁶ Avoiding file fractures not only saves time but also improves success rates.

The major issue arises when the rotary endodontics is introduced to new dental students, who just have a theoretical knowledge about the system but with no practical experience. The preclinical exercises are thus a part of the training program so as to train the students before they actually start working on patients. Such training of endodontics is usually given on either extracted teeth or simulated plastic teeth/plastic blocks. To enhance the training of predoctoral students and minimize iatrogenic errors, previous research has shown that practicing on plastic teeth does not compromise the quality of endodontic treatment provided to patients.^{2,7}

The endomotor used for performing rotary endodontics has a significant role to play in the success. Finer are the technical settings of speed and torque, better are the results. Also, higher is the accuracy of auto-reverse mechanism, greater are the chances of avoiding instrument fracture. In addition to such technical parameters, an in-built artificial intelligence of an endomotor would certainly be a big asset, which can guide the operator to shape root canals with a higher degree of precision and predictability. The CanalPro Jeni is a system designed to simplify endodontic cleaning and shaping procedures. It incorporates features such as torque control, speed control, and an integrated apex locator. The system functions by applying slight pressure into the canal, with the software dictating the subsequent movements and

power. It also includes a warning system to alert users to change files when a potential separation is detected.

Given the complexities involved in endodontic procedures, particularly for predoctoral students with limited training in rotary file systems, this study aims to investigate and compare the rate of file fracture using two different endomotors and the corresponding rotary files.

Method

The study included a sample of 20 third-year dental students who had no previous experience with rotary handpieces. The participants were randomly assigned to two groups: Group A ($n = 10$) and Group B ($n = 10$).

Group A utilized the ProMark motor (► Fig. 1) with Vortex Blue files (► Fig. 2), while Group B used the CanalPro Jeni system (► Fig. 3) with HyflexCM files (► Fig. 4). The two groups were matched in terms of the shape and system of the files used. Before commencing the procedures, Group A received a brief introduction on how to use the ProMark motor and Vortex Blue files. Subsequently, each participant individually performed cleaning and shaping (► Fig. 5) of the mesiobuccal (MB) canal on a plastic endodontic tooth (Acidental) #19. The teeth were then evaluated for file separation.

Following the evaluation of Group A, Group B received a similar introduction on how to use the CanalPro Jeni system. Each participant in Group B individually performed cleaning and shaping of the MB canal on identical plastic teeth. The teeth were assessed for file separation. One participant was excluded from both Group A and Group B due to a breach in testing protocols, resulting in a final analysis based on data from nine participants in each group.

The data obtained on the rate of file separation for each respective endodontic instrument in the two groups were analyzed for correlation using Jamovi's partial correlation.



Fig. 1 ProMark motor.



Fig. 2 Vortex Blue files.



Fig. 3 CanalPro Jeni system.

The chi-squared test was applied to analyze the association between the type of rotary system used (ProMark motor with Vortex Blue files versus CanalPro Jeni with HyflexCM files) and the occurrence of file fractures.

Results

The study included 20 third-year dental students, with one participant excluded from Group A and Group B due to a breach in testing protocols. Therefore, the final analysis was based on data from nine participants in Group A and nine participants in Group B. In Group A, which utilized the

ProMark motor and Vortex Blue files; one file fracture was observed out of the nine evaluated cases, while the remaining eight cases showed no file fractures. In contrast, Group B, which used the CanalPro Jeni with HyflexCM files, did not exhibit any file fractures among the nine evaluated cases.

A chi-squared test was conducted to assess the association between the type of rotary system used (ProMark motor with Vortex Blue files versus CanalPro Jeni with HyflexCM files) and the occurrence of file fractures. The chi-squared analysis yielded a nonsignificant result ($\chi^2 = 1.06, p = 0.303$), indicating no statistically significant difference in the rate of file fractures between the two groups (→ **Table 1**).



Fig. 4 HyflexCM files.



Fig. 5 Participant performing cleaning and shaping procedure.

Table 1 Statistical analysis evaluating the two groups

Contingency tables		Method		
File separation		Vortex Blue	HyflexCM	Total
Yes	Observed	1	0	1
	Expected	0.500	0.500	1.00
	% within row	100.0%	0.0%	100.0%
	% within column	11.1%	0.0%	5.6%
No	Observed	8	9	17
	Expected	8.500	8.500	17.00
	% within row	47.1%	52.9%	100.0%
	% within column	88.9%	100.0%	94.4%
Total	Observed	9	9	18
	Expected	9.000	9.000	18.00
	% within row	50.0%	50.0%	100.0%
	% within column	100.0%	100.0%	100.0%
χ^2 tests				
	Value	Df	p-Value	
	χ^2	1	0.303	
	χ^2 continuity correction	1	1.000	
	N	18		
Comparative measures				
		95% confidence intervals		
	Value	Lower	Upper	
	Odds ratio	0.120	93.8	

^aHaldane-Anscombe correction applied.

Discussion

Endodontics is an integral and essential component of dental training program, and its preclinical training program holds paramount significance. A lot of procedural errors do happen when the students lay their hand for the first time on rotary endodontic file systems, when working on extracted teeth or simulated root canals in artificial plastic teeth.⁸⁻¹⁰

An intelligent endomotor with in-built artificial intelligence is certainly an asset to the operator as it provides highly accurate control over the sensitive parameters such as speed, torque, auto reverse mechanism or transition between rotating and reciprocating motion as per the canal requirements. All such parameters have a substantial ability to reduce the file separation while performing root canal treatment. Hence this study was undertaken to evaluate the impact of rotary systems on file fracture rates.

Twenty predoctoral students were enrolled in the study and divided into two groups of 10 students each. Two separate endomotors with respective rotary files viz. ProMark motor with Vortex Blue files and CanalPro Jeni with HyflexCM files were used in the study. There was a drop out of total two participants, one from each group as they failed to follow the protocol that was explained to all the partic-

ipants for the respective rotary systems which they were to use.

Contrary to our initial hypothesis, the results of the chi-squared analysis did not show a significant difference in the rate of file fractures between the ProMark motor with Vortex Blue files and the CanalPro Jeni with HyflexCM files. This suggests that the two tested rotary systems may have similar rates of file fractures when utilized by predoctoral dental students.

It is important to interpret these findings cautiously, as the nonsignificant result may be attributed to the limited sample size of the study. However, the comparative measures revealed an odds ratio of 3.35, indicating a higher likelihood of file fractures in Group A (ProMark motor with Vortex Blue files) compared with Group B (CanalPro Jeni with HyflexCM files). The 95% confidence interval for the odds ratio ranged from 0.120 to 93.8, further emphasizing the uncertainty surrounding the true effect size.

The lack of statistical significance in the chi-squared analysis could be attributed to other factors as well, such as potential confounding variables, or inherent variability in the performance of the tested rotary systems. Additionally, the wide confidence interval of the odds ratio indicates a considerable level of uncertainty regarding the true effect size. Overall, although the chi-squared analysis did not yield

a significant difference, the comparative measures and the odds ratio suggest a potential advantage of the CanalPro Jeni system in minimizing file fractures.

While our results did not demonstrate a statistically significant difference, the CanalPro Jeni with HyflexCM files still holds potential advantages in terms of simplifying endodontic cleaning and shaping procedures, as well as controlling torque and speed. The absence of file fractures in Group B suggests that the CanalPro Jeni system may provide a reliable and safe option for predoctoral students, potentially contributing to improved outcomes and increased confidence during endodontic procedures.

It is important to acknowledge the limitations of this study, including the small sample size and the use of plastic teeth as an analogue for clinical practice.

Conclusion

The comparative evaluation when done between the Pro-Mark motor with Vortex Blue files and CanalPro Jeni with HyflexCM files revealed that the latter performed better, although no statistically significant difference was observed. Further research with larger sample sizes and clinical scenarios is warranted to obtain more robust conclusions. Future studies should aim to explore additional outcome measures, such as cleaning and shaping efficiency, postoperative complications, and long-term treatment outcomes, to provide a comprehensive assessment of the tested rotary systems' effectiveness and safety in various clinical settings.

Conflict of Interest

None declared.

References

- 1 Tzanetakakis GN, Kontakiotis EG, Maurikou DV, Marzelou MP. Prevalence and management of instrument fracture in the post-graduate endodontic program at the Dental School of Athens: a five-year retrospective clinical study. *J Endod* 2008;34(06):675–678
- 2 Tchorz JP, Brandl M, Ganter PA, et al. Pre-clinical endodontic training with artificial instead of extracted human teeth: does the type of exercise have an influence on clinical endodontic outcomes? *Int Endod J* 2015;48(09):888–893
- 3 Pirani C, Iacono F, Zamparini F, Generali L, Prati C. Retreatment of experimental carrier-based obturators with the remover NiTi instrument: evaluation of apical extrusion and effects of new kinematics. *Int J Dent* 2021;2021:2755680
- 4 Sonntag D, Guntermann A, Kim SK, Stachniss V. Root canal shaping with manual stainless steel files and rotary Ni-Ti files performed by students. *Int Endod J* 2003;36(04):246–255
- 5 Spili P, Parashos P, Messer HH. The impact of instrument fracture on outcome of endodontic treatment. *J Endod* 2005;31(12):845–850
- 6 Nevares G, Cunha RS, Zuolo ML, Bueno CE. Success rates for removing or bypassing fractured instruments: a prospective clinical study. *J Endod* 2012;38(04):442–444
- 7 Sacha SR, Sonntag D, Burmeister U, Rüttermann S, Gerhardt-Szép S. A multicentric survey to evaluate preclinical education in endodontology in German-speaking countries. *Int Endod J* 2021;54(10):1957–1964
- 8 Algar J, Loring-Castillo A, Pérez-Alfayate R, Martín Carreras-Presas C, Suárez A. A comparative study of two martensitic alloy systems in endodontic files carried out by unskilled hands. *Appl Sci (Basel)* 2022;12(12):6289
- 9 Barakat RM, Matoug-Elwerfelli M, Almohareb RA, Balto HA. Influence of preclinical training on root canal treatment technical quality and confidence level of undergraduate dental students. *Int J Dent* 2021;2021:9920280
- 10 Narayanaraopeta U, Alshwaimi E. Preclinical endodontic teaching. A survey of Saudi dental schools. *Saudi Med J* 2015;36(01):94–100