Comparison of Spreader Penetration during Lateral Compaction of 0.04 and 0.02 Tapered Gutta-Percha Master Cones

M. Saatchi¹, L. Etesami²

¹Assistant Professor, Department of Endodontics, Faculty of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran
²Dentist, Private Practice

Abstract:

Statement of Problem: It has been established that successful root canal treatment depends on the quality of obturation. Deeper penetration of spreaders can improve the apical seal and the quality of the obturation.

Purpose: The aim of this study was to compare the initial penetration depth of spreaders during lateral condensation of 0.04 and 0.02 tapered gutta-percha master cones.

Materials and Methods: In this study, sixty two fresh ly extracted single canal teeth were selected. The crowns were removed and the canals were prepared using the step-back technique. Patency of the apical foramens was maintained. The teeth were divided into 2 experimental groups of 31 teeth each. 0.02 and 0.04 tapered gutta-percha were inserted in the root canals of the first and second groups, respectively. A spreader was then placed next to the master cone and a digital scale was used to measure the force that was applied during spreader placement. An apical force of 1.5kg was employed to place the spreaders. The penetration depth was measured, subtracted from the working length, and recorded. Statistical analysis was performed using t-test.

Results: The mean spreader penetration depth, recorded as distance from working length, was 2.16 (1.03) mm when using 0.02 tapered master cones and 3.52 (1.88) mm following insertion of 0.04 tapered master cones. The difference between the two penetration depths was statistically significant (P<0.01).

Conclusion: The results of this study showed that the spreader penetration using 0.02 tapered master cones was significantly larger than the 0.04 master cones.

Key Words: Gutta-percha; Master cone; Spreader

INTRODUCTION

Successful endodontic therapy requires debridement and sealing of the root canal system to prevent microleakage. This is accomplished by maintaining an aseptic field, mechanical instrumentation, chemical irrigation, intracanal medication when indicated and obturation of the root canal including placement of a coronal restoration. Obturation prevents leakage of micro-organisms and their by-products penetrating the periradicular tissues, therefore it is significant for successful endodontic therapy [1]. One of the most commonly used methods for root canal obturation is lateral compaction (condensation) of gutta-percha [2-4]. When employing this technique, it has been shown that the apical seal is best when the spreader can be placed close to the
working length [5,6]. Gutta-percha is the most popular core material used for obturation and is available in conventional and standardized sizes. The conventional gutta-percha number refers to the dimensions of the tip and body. The size of standardized cones is based on similar size and taper standards as for endodontic files [7]. Manufacturers now supply gutta-percha cones in tapers matching the larger taper instruments (0.04, 0.06, 0.08) [7]. The use of the lateral condensation technique would involve the fitting of a standardized gutta-percha master cone with an apical to coronal taper of 0.02 mm/mm. This is followed by lateral condensation with a spreader and the addition of numerous accessory gutta-percha cones in an attempt to obliterate the space between the master cone and the walls of the prepared canal space [8]. It seems that filling the prepared canal using a master cone with a larger tapering, may be clinically efficient and radiographically acceptable. There are only a few studies on the quality of obturation using larger tapered gutta-percha master cones [9-12]. The purpose of this in vitro study was to compare the penetration depth of spreaders into the canal using 0.02 or 0.04 tapered gutta-percha master cones.

MATERIALS AND METHODS
In this study 62 freshly extracted human teeth with single, straight root canals were used. All specimens were stored in isotonic normal saline after extraction. Before preparation, the samples were treated with 5.25% sodium hypochlorite for 24 hours to disinfect and eliminate surface soft tissues. A length of 17 mm was marked on the teeth and the rest of the coronal portion was removed using a high speed disk (D&Z, Germany). Working lengths were established by inserting a size 15 K-File (Mani, Japan) into the canal until visible at the apical foramen and subtracting 1mm from this length [13]. The root canals were prepared using the step-back technique. Master apical file was a size 40 K-file in all root canals. The coronal half of the root canals were preflared with Gates Glidden drills numbers 2, 3 and 4 (Dentsply, Maillefer, Switzerland). The canals were flared using the step back technique to number 70 k-file and were copiously irrigated with 2ml of normal saline between each file. The patency of the apical foramen was confirmed with a size 10 K-File. To secure the samples in a vertical orientation, each tooth was notched on the buccal and lingual surfaces with a carbide bur, which allowed placement in a metal apparatus (Fig.1A). The apparatus, with the tooth secured, was placed on a digital scale (DSC 6000, Sairan, Iran) to measure the force used during spreader placement. The Apexit sealer (Ivoclar, Germany) was mixed according to the manufacturer’s instructions and was applied to the walls of the canal with a size 35 K-File. The teeth were randomly divided into two groups of 31 teeth. Size 40, 0.02 or 0.04 tapered gutta-percha cones (VDW, Germany) were used as master cones in either group. A size C, stainless-steel, finger spreader (Maillefer, Switzerland) was placed at the same entry point (the buccal or lingual wall) in each root. An apical pressure was then applied and increased without rotation until 1.5kg (±0.05kg) registered on the scale. The rubber stop was placed flush with the occlusal reference surface. The spreader was removed and measured. Measurements were recorded as working length minus the measured length. The spreader penetration into the canal with 0.02 and 0.04 tapered gutta-percha master cones is shown in Figures 1B and C. The collected data were analyzed using $t$-test.

RESULTS
The mean (standard deviations) depths of spreader penetration, recorded as distance from working length, when using 0.02 and 0.04 tapered master cones was 2.16 (1.03) mm.
and 3.25 (1.88) mm, respectively. The minimum depths of penetration in both groups were zero however the maximum depths of penetrations were 4.1 and 7.4 mm in 0.02 and 0.04 tapered groups respectively. The mean depths of spreader penetration when employing 0.02 tapered master cones was larger than 0.04 tapered master cones (P<0.01).

DISCUSSION
The objective of the present study was to compare the penetrating ability of spreaders during lateral condensation with 0.02 and 0.04 tapered gutta-percha master cones. Data obtained from the present study showed that the depth of spreader penetration with the 0.02 was greater than the 0.04 tapered gutta-percha master cones. Extracted teeth were randomly divided between two groups, as a result the anatomical difference in specimens’ size, shape and apical diameters might be balanced. In order to enhance the reproducibility of the investigation, the teeth were prepared by one operator who used the step-back technique. Therefore, tapering of the prepared canals was about 0.05mm/mm which allowed placement of 0.02 and 0.04 tapered gutta-percha master cones in the canals.

Finger spreaders were used in the current study, due to the fact that they can provide better tactile sensation and are less likely to induce root fractures as compared to hand spreaders [14,15]. Spreaders made from nickel-titanium (NiTi) are available and deliver increased flexibility, reduced stress, and deeper penetration in curved canals compared to stainless-steel spreaders [16-17]. However, there is no significant difference in stress induction between stainless-steel spreaders and nickel titanium spreaders, in straight canals [17]. It can be assumed that the less flexible stainless-steel spreaders would penetrate better in a straight canal [18]. Teeth with straight root canals and stainless-steel (SS) spreaders were used in the present study. Application of apical pressure on spreaders to gain close proximity to the apex may lead to vertical root fractures [19]. Spreader loads from 1.5 kg to 7.2 have been shown to produce fractures [20]. Harvey et al [21] reported that the average force used by endodontists during lateral compaction of gutta-percha was between 1.0 and 3.0 kg. In this study a compaction force of 1.5 kg was applied during the use of spreaders. Wilson and Baumgartner [9] demonstrated that the depth of penetration for both NiTi and SS spreaders was significantly less when using.
0.04 versus 0.02 tapered master cones. A similar result has been reported by Nielsen and Baumgartner in 2006 [10]. They compared spreader penetration in root canals using 0.02 or 0.04 tapered gutta-percha cones and using 0.02 or 0.04 tapered resilon cones. They showed in both gutta-percha and resilon cones, spreaders penetrate deeper with 0.02 tapered cones compared to 0.04 tapered cones. Because lateral condensation, unlike vertical condensation, does not create a homogeneous mass of gutta-percha, pools of sealer may be trapped in the filling mass as accessory cones are compacted against each other. Filling with a master cone using a larger taper may be advantageous in that a larger and more uniform mass of gutta-percha is introduced that potentially has less sealer entrapped in the filling mass. However, because of the close approximation of the gutta-percha cone to the prepared canal walls, a disadvantage results from the inability of a spreader to predictably penetrate to within 1 to 2 mm of the working length. This causes inadequate compaction of the master cone (using step back technique) causing a potential deficiency in the seal of the canal. Further investigation is suggested to evaluate the quality of the produced seal.

CONCLUSION
Considering limitations of present study, the use of 0.02 tapered gutta-percha master cones could provide better apical seal compare to 0.04 tapered gutta-percha master cones.

ACKNOWLEDGMENT
Authors would like to acknowledge the financial support of the Research Vice-Chancellor of Isfahan University of Medical Sciences.

REFERENCES
13- Stein TJ, Corcoran JF. Radiographic "working