

Comparison of Obturation Density Using Nickel Titanium and Stainless Steel Spreaders by Lateral Compaction Technique

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Abstract

Background and Aim: The density of Gutta-percha is an important factor in canal seal and root canal treatment success. So, the present study intended to compare the effect of Ni-Ti and S-S spreaders on the intracanal Gutta-percha weight.

Materials and Methods: In this experimental study, 40 simulated canals with 40 degree curvature (group 1 and 2) and 40 simulated canals with 10 degree curves (group 3 and 4) were used. Each block was weighted after cleaning and shaping using Flexmaster rotary instruments. Group 1 and 3 blocks were obturated using Ni-Ti spreaders, while group 2 and 4 blocks were obturated using stainless steel spreaders with Gutta-percha. The simulated canals were again weighted and the difference of the two measurements was calculated as the Gutta-percha weight. The results were analyzed using SPSS software and 2-way ANOVA tests.

Results: The analysis showed that there was no significant difference between the four experimental groups. In addition, the effect of the canal curvature, spreader type and the interaction of the variables was not statistically significant.

Conclusion: The current study showed that different spreader types (Ni-Ti or S-S) do not affect the Gutta-percha weight of the root canal obturation.

Key Words: Gutta percha, Density, Canal obturation, Lateral compaction technique, Stainless steel, Spreader, Nickel-titanium spreader

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Introduction

The objective of root canal treatment is cleaning and shaping, disinfection and appropriate obturation of the root canal system in three apical, coronal and lateral dimensions [1] so that the density of the filling material is distributed uniformly from the apical to the coronal region [2]. The main materials used for root canal obturation are usually solid or semi solid (as paste or softened form) [3]. Solid material have more advantages over semi solid material and are more appropriate.

Although different solid materials have been experimented for canal obturation, only guttapercha has been accepted as the main material used for root canal obturation and is the most accepted and prevalent material for this objective [4].

The selected method for obturation is based on the style and method of the performer (the person filling the tooth), although sometimes in certain circumstances using a specific method is necessary. The most prevalent obturation method

is the lateral compaction technique [5]. This technique may be applied in most conditions, but in exceptional circumstances such as severely curved roots, abnormal shaped canals or canals with internal corrosion it can not be used [6]. One of the very important factors in the treatment outcome of the lateral compaction technique is the selection of a suitable spreader and in order to reach an appropriate obturation, penetration of the utilized spreader into the working length of the root canal is an important criterion. Spreaders are divided into finger and handle types. Finger spreaders are better than the handle types due to their touch sensation, apical seal, the better control of the apparatus and also the less pressure entered to the dentine in the obturation procedure [7-8].

Finger spreaders are available in two types; namely nickel titanium and stainless steel. Lately, nickel titanium spreaders have been introduced, with a lower wedging force in deep penetration due to their flexibility [9]. This indicates that nickel titanium spreaders have deeper penetration and get closer to the working length of the canal [9, 10].

Berry et al. showed that Ni-Ti spreaders have deeper penetration in curved canals in comparison to S-S spreaders and the fluency of S-S spreaders decrease when the canal curvature increases [11]. Schmidt et al. showed that with an equal force, penetration of Ni-Ti spreaders into the working length of the canal was easier in comparison to S-S spreaders, but there was no difference detected in the penetration of the first lateral cone in this study [9].

Sobhi et al. also showed similar results. They mentioned that Ni-Ti spreaders have an easier penetration into the curved canals in comparison to the S-S spreaders and that penetration of S-S spreaders in curved canals is related to the angle of the curvature [12]. In Gharai et al.'s study, there was also no difference detected between microleakage of the teeth which were obturated using Ni-Ti and S-S spreaders by the lateral compaction technique, but the force used to pe-

netrate the S-S spreader was significantly higher compared to the force used to penetrate the Ni-Ti spreader to reach equal working lengths [13]. Xia et al.'s study showed similar results to previous studies demonstrating that in a 2 mm distance from the apex, Ni-Ti spreaders penetrated deeper than the S-S spreaders into the higher curvature canals. In lower than 20 degree curvature canals, there was no difference between the spreaders [14]. In Sadeghi et al.'s study, no difference was detected between the two mentioned spreaders regarding the density of guttapercha [15].

Anyway, the apical seal and the density of root canal obturation between nickel titanium and stainless steel spreaders was evaluated in the lateral compaction technique. There have been no widespread studies conducted regarding this matter and the objective of this experimental laboratory study was to evaluate the obturation density of root canal in the lateral technique using two different spreaders; namely, Ni-Ti and S-S.

Materials and Methods

In this experimental laboratory study, 40 resin blocks with a 10 degree curvature (Nissin Japan) and 40 resin blocks with a 40 degree curvature (VDW, Germany) were selected. The working length of all the canals were measured by number 15 K. type file (Mani, Japan) and were prepared to K. type file number 30. Then the canals were prepared by the step back method using number 1-4 Gates Gldiden (Mani, Japan) and finally by the crown down method using number 25 and 30 Flex Master rotator files (VDW, Germany) with a 0.06 convergence in the coronal region and number 30 file with a 0.04 convergence and number 20 file with a 0.06 convergence along the working length. Rinsing during work was performed by a syringe and water. After rinsing and drying the canal by a paper cone (Gapadent, China), the 40 degree curvature blocks were randomly divided into two groups 1 and 2 and the 10 degree curvature blocks were

divided into two groups 3 and 4 and were then coded and weighed by a Delta Rang digital scale (Mettler PC 440) with an accuracy of 0.001. Afterwards, group 1 and 3 blocks were obturated with guttapercha by the lateral compaction technique using Ni-Ti spreader number 25 (Maillefer, Suisse) and group 2 and 4 blocks were obturated with guttapercha by the lateral compaction technique using S-S spreader number 25 (Maillefer, Suisse) without sealer application to the edge of the block. Finally, the guttapercha excess was cut in the orifice region by a bisturi blade. Obturation of the blocks was carried out by one person with a similar force.

After this stage, the blocks were weighed again and the difference in weight for each block before and after obturation were measured. The difference showed the weight of guttapercha inside the canal. The mean weight of guttapercha was calculated in each group; subsequently, the data were entered into SPSS software and the two groups were compared by ANOVA test.

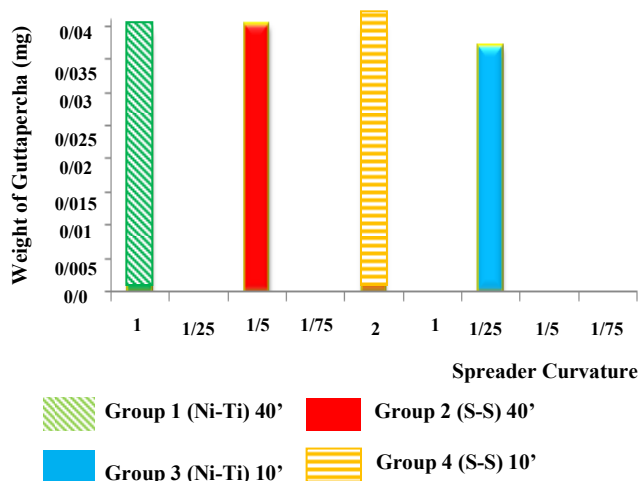
Results

The two sided analysis of variance (ANOVA) showed that the mean weight of the four groups had no significant difference statistically ($p > 0.05$). The results of this test revealed that the canal curvature (10 and 40 degree groups) did not have a significant effect on the weight difference of guttapercha before and after obturation ($p = 0.600$). The use of nickel titanium and stainless steel spreaders did not lead to a significant difference either ($p = 0.560$). The interaction between these two variables (the curvature and the type of spreader) was not statistically significant either ($p = 0.147$).

One sided analysis of variance (ANOVA) was performed between the mean weight before and after obturation in the four groups leading to a nonsignificant difference ($p > 0.465$) (Graph 1).

Discussion

Although the studies show that the methods and materials used in canal obturation are good and



Graph 1: The mean weight before and after canal obturation in the evaluated groups

acceptable, they still are far from ideal and perfect material [16]. Due to the fact that guttapercha does not have the appropriate capability of packability and compressibility, there have been many studies conducted to find a suitable replacement to compensate for the defects of guttapercha [17]. Despite the mentioned facts, guttapercha is still the first choice for canal obturation [18].

The cold lateral compaction technique has been one of the most common root canal filling techniques due to its easy usage, less canal removal during the preparation stage and better control of the working length. Yet, one of the main disadvantages of the lateral compaction technique, especially in high curvature canals is lack of access to a homogeneous volume (19, 20); thus, one of the criteria for the assessment of the quality of obturation and the amount of homogeneity could be the weight of gutta in the canal. On the other hand, as a result of restricted materials for use, the techniques and equipments are more under study.

The results of the current study showed that using Ni-Ti spreader does not lead to difference in the weight of root canal gutta in comparison to S-S spreader. The results of previous studies on clinical advantage and positive effects of Ni-Ti

spreaders on microleakage are still controversial. The current results are similar to Gharai et al.'s study [13]. The mentioned study showed that under similar conditions, there is no significant difference in microleakage after filling molars by these two spreaders. In spite of the stated matter, we should pay attention to the limitations of the mentioned study; in order to equalize the circumstances of the two study groups, both Ni-Ti and S-S spreaders were located in 2 mm distance of the apex tip during canal filling. On the other hand, as it was mentioned before, one of the requirements of access to an appropriate apical seal is placement of the spreader in 1-2 mm distance of the working length during canal filling [21-22].

As it has been proved that Ni-Ti spreaders due to their better flexibility have better ability in penetrating the working length [11, 23], placement of the spreader in 2 mm distance of the apex tip in both groups omits the main superiority of Ni-Ti spreaders over S-S spreaders. In addition, in Gharai et al.'s study, it has been shown that less force is necessary for placement of Ni-Ti spreaders in 2 mm distance of the apex tip in comparison to S-S spreaders. Lopes et al. showed that for penetration, finger Ni-Ti spreaders need more force in comparison to S-S spreaders [24]. In the beginning it may seem that a mean of 1.57 kg for S-S spreaders and 0.81 kg for Ni-Ti spreaders are both low forces compared to the 4.9 kg force that is necessary for vertical root fracture, but according to the extent of forces used in S-S spreaders (which may even reach 7.02 kg) in comparison to Ni-Ti spreaders (in which the highest force reaches 2.71 kg) we may conclude that Ni-Ti spreaders have an important role in preventing vertical fractures. This may lead to decrease in the probability of vertical root fracture (VRF) during root obturation. A common wrong idea among dentists is that stiffness of S-S spreaders causes better exertion of compaction forces to guttapercha. The exertion forces by S-S spreaders not only do not distribute uniformly and increase the probability of

root fracture, but also the inflexibility of this spreader prevents reaching to 1-2 mm distance of the working length. The wrong conception that better compaction is gained by S-S spreaders due to exertion of point force during its utilization [11, 25].

Regarding the influence of canal curvature on the difference between the weight before and after canal obturation, similar to Gound et al.'s study [18] and Sadeghi et al.'s study [15] which reported no significant difference between these two in curved canals and straight canals. Contrary to these results, other studies have reported results other than these results such as Xia et al. who reached the conclusion that Ni-Ti spreaders have a higher penetration and obturation density in comparison to S-S spreaders [14]. Some studies evaluating the microleakage of curved canals compared with straight canals, showed a lower apical seal in obturated curved canals using the lateral compaction technique [26-28]. It may be concluded that although the volume and weight of guttapercha inside the canal determines the quality of obturation, other factors also influence the final outcome.

One of the problems of Ni-Ti spreaders is their higher price in comparison to the similar S-S type. Yet, it should be considered that this is only due to the net price of the device; while, as a higher exertion force is necessary for application of S-S spreaders, especially when the clinician insists reaching the standard 1 mm distance to the apex, a much greater number of these spreaders are bent and thus should be changed. Therefore, practically, the final cost difference between these two devices will be lower [29].

This was an in vitro study and naturally could not simulate the clinical situations. The reason of selecting this study design is the higher control of confounding factors which is difficult especially in root therapy [18]. Similar to previous studies [29-30], we used the weight difference method which is one of the most common and accepted methods used in in-vitro studies on resin blocks.

This method has been structured based on the previous results mentioning that the increased volume of intracanal gutta-percha at the cost of decreased intracanal sealer is one of the most important goals of canal filling, especially during usage of lateral compaction method [30].

Conclusions

According to our results, the use of Ni-Ti and S-S spreaders in curved and straight canals does not have a significant effect on intracanal gutta-percha weight.

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