the Journal of CONTEMPORARY DENTAL PRACTICE at www.thejcdp.com
Volume 10 Number 1 January 1, 2009

Outcome of Root Canal Treatment Using Soft-Core™ and Cold Lateral Compaction Filling Techniques: A Randomized Clinical Trial

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Abstract

Aim: The purpose of this clinical and radiographic investigation was to evaluate the treatment outcomes of endodontically treated teeth obturated with Soft-Core™ versus cold lateral compaction.

Methods and Materials: A total of 98 teeth were endodontically prepared using the Quantec LX rotary system with a crown-down pressureless technique and obturated with either Soft-Core™ or cold lateral compaction. The outcome of treatments were evaluated clinically and radiographically by two blinded evaluators after three years. Statistical analysis was performed using an unpaired t-test and the Mann Whitney test at the level of significance set at 95%.

Results: Regardless of the periapical status of the teeth, no statistically significant difference was found between the two obturation techniques ($p>0.05$). The Kappa value for the interobserver agreement was 0.73.

Conclusion: Within the limits of the study, it is concluded the Soft-Core obturation technique did not result in a significantly different treatment outcome when compared with cold lateral compaction after three years. Further investigations should be carried out on the Soft-Core technique.

Clinical Significance: Using the Soft-Core system reduced working time, and the difference was found to be statistically different ($p=0.00056$) from the working time required for cold lateral compaction. This reduction in

canal filling time holds the potential for cost savings for clinicians while maintaining the quality of the clinical outcome.

Keywords: Cold lateral compaction, *in vivo*, randomized clinical trial, Soft-Core, outcome

Citation: Özer SY, Aktener BO. Outcome of Root Canal Treatment Using Soft-Core™ and Cold Lateral Compaction Filling Techniques: A Randomized Clinical Trial. J Contemp Dent Pract 2009 January; (10)1:074-081.

Introduction

Clinical studies starting with Strindberg[1] as one of the pioneers in such research show a success rate of endodontic treatment to be around 90%. An epidemiological study demonstrated success rates of only 60-75% are commonly found in general practice.[2] The technical quality of a root filling has been extensively documented as an important determinant in the success of root canal treatment.[3-7] However, a problem inherent to epidemiological studies is the assessment of the quality of the root fillings remains as one of the few prognostic factors that can be reliably determined. Other factors that remain unknown are the quality of coronal restorations, treatment routines including antibacterial regimes, quality of canal preparation, and materials used during the treatment.

One of the primary goals of appropriate debridement and shaping of the root canal is to receive an acceptable filling material for obturation. Recently, several root canal obturation techniques have been developed to improve the seal of prepared root canals with a standardized taper. Several aspects of root canal obturation techniques have been tested and reported.[3-11] Gutta-percha is the most widely used obturation material. Cold lateral compaction of gutta-percha has been the most commonly taught method of filling root canals and is widely used by dental practitioners.[8,12,13] Furthermore, it has been used frequently as a basis of comparison for new root canal filling techniques. Its advantages include low cost and the ability to control the length of the filling.[8] However, spaces between the gutta-percha cones which are likely to be filled with sealer can result if preparation of the canal is poor, inadequate condensation pressure is applied, or a mismatch between the tapers of the spreader, gutta-percha cone, and the canal. The cold lateral compaction of gutta-percha process is time consuming and has the potential to place undue force on the root leading to root fracture.[14] As a result of these disadvantages, some investigators have reported the use of warm gutta percha vertical filling techniques were superior to cold lateral compaction in terms of filling the canal completely using minimum amounts of sealer.[3,9]

Thermoplasticized obturation techniques were introduced to improve the homogeneity and surface adaptation of gutta-percha. One of these techniques was introduced by Johnson[15] in 1978. It involved the use of a metal carrier coated with a layer of gutta-percha, that was heated, to permit thermoplasticized canal obturation. The Soft-Core™ System (CMS-Dental Aps, Copenhagen, Denmark) uses a similar strategy to achieve root canal obturation.[16] The Soft-Core obturator consists of two parts: a plastic handle with a metal insertion pin and a plastic core with gutta-percha sized from 20 to 100 in ISO standards which is coated with thermoplastic alpha phase gutta-percha. Obturators are heated in a special Soft-Core oven (CMS-Dental Aps, Copenhagen, Denmark) and then introduced into the root canal to the working length. The metal pin is not permanently attached to the plastic core allowing its removal when the obturator is introduced into the canal by twisting the handle and removing it along with the metal pin (Figure 1).[17] The plastic core and the gutta percha remain in the canal.

Soft-Core offer advantages such as a reduction in chair-side time and rapid set of the gutta percha; but if retreatment becomes necessary, it is difficult to retrieve the plastic core and to remove the thermoplasticized gutta-percha due to its profound adhesion to the root canal walls. Some *in vitro* studies comparing Soft-Core and cold lateral compaction have reported these obturation techniques have similar microleakage results.[4-7]

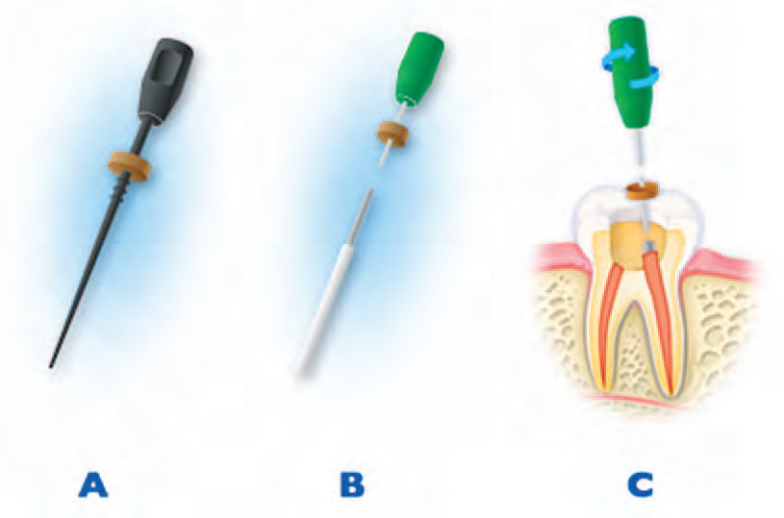


Figure 1. A. Canal size confirmation instrument. **B.** Stock Soft-Core filler. **C.** Warmed Soft-Core gutta perha in place and the plastic handle being removed.

The purpose of this clinical and radiographic investigation was to evaluate the endodontic treatment outcome of teeth filled with cold lateral compaction versus teeth filled with Soft-Core *in vivo*. The average time spent for each technique was also recorded and evaluated.

Methods and Materials

Study Subjects

A total of 98 subjects participated in this investigation at the Ege University Faculty of Dentistry in Izmir, Turkey and were randomized to receive endodontic treatment by the principle investigator between 2001 and 2002. The mean age of the patients was 52 years with 45 of them being female. A total of 98 mandibular first and second molar teeth afflicted with apical periodontitis were included in the study (Table 1).

The inclusion criteria for the study were as follows:

- The patient had no history of marginal periodontitis and the tooth requiring root canal treatment was periodontally healthy
- The patient had a good preoperative periapical radiograph of the tooth requiring root canal treatment that demonstrated the presence of apical periodontitis
- Teeth requiring root canal treatment must be free of canal obstructions like pulp stones and excessive calcification through the root canal.

Twenty-four subjects having acute symptoms suffered from a symptomatic apical periodontitis and were treated in the emergency clinic in the Department of Endodontics. A total of 98 teeth were prepared using a Quantec LX rotary system with a crown-down pressureless technique and then obturated with either Soft-Core or cold lateral compaction gutta percha. A non-eugenol sealer, Diaket (Espe, Seefeld, Germany), was used with both the Soft-Core and cold lateral compaction techniques.

Participating patients were recalled after three years for evaluation of endodontic treatment outcomes. The investigation was initiated with 98 participating patients and of those 80 returned for the recall evaluation. Of the 80 teeth re-examined 40 were obturated using Soft-Core and 40 teeth were obturated using the cold lateral compaction technique (Table 2). A treatment failure was recorded if the endodontically treated tooth had been extracted due to vertical root fracture, periodontal disease, or persistence of a periapical lesion.

Radiographic and Clinical Evaluation

The radiographic examination was performed using the parallel technique. Exposure time and dosage were 0.7 seconds and 0.6 WA for all teeth in order to obtain diagnostic quality of the radiographs. The periapical status of a multi-rooted tooth was graded according to the

Table 1. Number of patients before and after evaluation.

	Soft-Core	Cold LC
Number of patients treated between 2001-2002	49	49
Number of returned patients after 2002	40	40
Drop-outs	9	9

Table 2. Clinical and radiographic status of the endodontically treated teeth.

	Soft-Core n=40 (%)	Cold LC n=40 (%)
Successful	n= 66 (82.5)	
No clinical or radiographic failure	34 (85)	32 (80)
Failures: Clinical Failure Both clinical and radiograph Present radiolucent area, no clinical signs	 2 (5) 1 (2.5) 3 (7.5)	 3 (7.5) 1 (2.5) 4 (10)
Total (1)+(2)+(3)	6 (15)	8 (20)

most severely affected root. It was categorized according to Petersson's criteria as follows:[18]

1. Normal: Normal appearance of the surrounding osseous structure
2. AP: Observation of periapical radiolucency
3. Not classified: Insufficient quality of radiograph to evaluate periapical status

The tooth was considered 'healed' if there was an absence of clinical symptoms such as pain, tenderness to percussion, mobility, and/or soft tissue pathosis (sinus tract infection and abcess). Endodontic treatment was considered successful when it was both healed and exhibited a normal appearance on a radiograph. All cases in which those criteria were not fulfilled were judged as 'unhealed'. The root canal obturation techniques and working time for each was recorded.
The radiographs were analyzed by the same observers under 3.5X magnification.

Statistical Analysis

The Mann Whitney test was used to determine the differences between the success rates of endodontic treatments. In order to assess the significance of working time, an unpaired t test was performed by using the SPSS, Version 10.0 (SPSS, Inc. Chicago, IL, USA) software program. Inter-operator agreement was tested using the Cohen Kappa test.

Results

The study started with 98 patients; after a three year recall, there were 18 drop-outs (Table 1). Among the 40 teeth filled with Soft-Core, 34 were clinically sound and showed no signs and symptoms suggesting failure at the time of the evaluation. The success rate was 85% (Table 2). Six teeth failed due to clinical or radiographic conditions such as pain to percussion and/or the presence of a radiolucency. Among the six teeth (15%) classified as failures, two failed clinically due to tenderness to percussion, three due to the presence of periapical radiolucencies in the recall evaluation radiographs, and one was due to the existence of both of these clinical and radiographic conditions.

Table 3. Time used for filling root canals.

Filling Time (minute)	Soft-Core		Cold Lateral Compaction	
	X	SD	X	SD
	2.9	1.9	14.4***	3.8
*** p=0.00056				

Among 40 study teeth filled with cold lateral compaction, 32 teeth (80%) were classified as successful and eight teeth (20%) were classified as failures (Table 2). One had both clinical and radiographic problems, three were due to the clinical problems, and four were due to radiographically detectable problems.

At the end of the evaluation period, the Soft-Core group had 34 and the cold lateral compaction group had 32 teeth without any evidence of apical periodontitis. The results of the study showed the success rate of endodontic treatment with Soft-Core was 85% compared to 80% for cold lateral compaction. There was no statistical difference between the success rates of the two groups ($p>0.05$) as determined by the Mann Whitney test. There was good agreement between assessors as indicated by a Cohen Kappa statistic of 0.81 (Table 2).

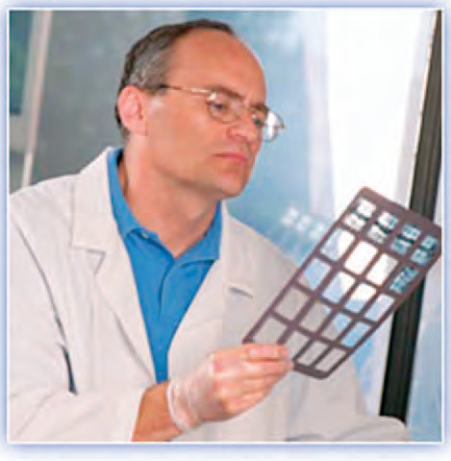
Time needed to complete the whole course of obturation was 2.9 ± 1.9 minutes for Soft-Core and 14.4 ± 3.8 minutes for the cold lateral compaction group, respectively (Table 3). The unpaired t test revealed the statistical significance. The difference was statistically different ($p=0.00056$). On the average, root canal obturation with Soft-Core was about 11 minutes faster than the cold lateral compaction technique.

Discussion

Prevention of periapical disease and healing of the periapical tissues are the expected outcomes of endodontic treatment. A favorable success rate of root canal treatments of 60-85% have been reported in several studies.[2,10,13,18] The present study revealed an overall success rate of 82.5%, which was consistent with outcomes reported by Peak et al.[13] and Petersson et al.[18] The purpose of the study was to assess if Soft-Core has a similar success rate in terms of obturation compared with cold lateral compaction *in vivo*. The treatment outcomes of the two different obturation techniques were found to be similar.

The standardization of the X-ray exposure time and dosage may vary according to tooth type, subject gender, and arch involved. However, this was not the case in the present study which involved only mandibular first and second molars requiring the same exposure time and dosage of 0.7 seconds and 0.6 WA for all teeth in order to obtain consistent diagnostic quality of the radiographs.

To date, a few studies have been conducted on Soft-Core filling materials to evaluate apical or coronal leakeage, material adaptation, or the quality of the filling itself.[4-7,11] Some reports concluded Soft-Core is an acceptable alternative to the cold lateral compaction technique[5,11] whereas others found cold lateral compaction to be superior to Soft-Core.[4-6] Gencoglu[7] reported Soft-Core was superior to cold lateral compaction in terms of leakage. However, all of these studies were performed *in vitro* under varying conditions. The present *in vivo* study is the first to obtain



information on the clinical outcome of using Soft-Core, so these findings could not be compared with the other studies. More clinical treatment outcome studies need to be done on the Soft-Core system.

Besides having an equivalent treatment outcome, an important advantage of the Soft-Core technique is the short time required to fill a prepared canal. This is due to the absence of repeated spreader insertion and application of accessory guta-percha cones. The manufacturer[17] states using Soft-Core decreases the obturation time about 15 minutes. Our findings confirm this statement, with an 11 minute time savings using Soft-Core compared with cold lateral compaction. Another advantage of the Soft-Core technique is the dimensional stability of the material in the root canal. Dimensional changes may be minimized, since much of the root canal space is occupied by the plastic carrier rather than more gutta percha. The microleakage studies confirm these findings.[7,11]

Conclusion

Within the limits of the study, it is concluded the Soft-Core obturation technique did not result in a significantly different treatment outcome when compared with cold lateral compaction after three years. Further investigations should be carried out about the Soft-Core technique.

Clinical Significance

Using the Soft-Core system reduced working time, and the difference was found to be statistically different (p=0.00056) from the working time required for cold lateral compaction. This reduction in canal filling time holds the potential for cost savings for clinicians while maintaining the quality of the clinical outcome.

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