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JUN 80 M WONG, D D PETERS, L LORTON

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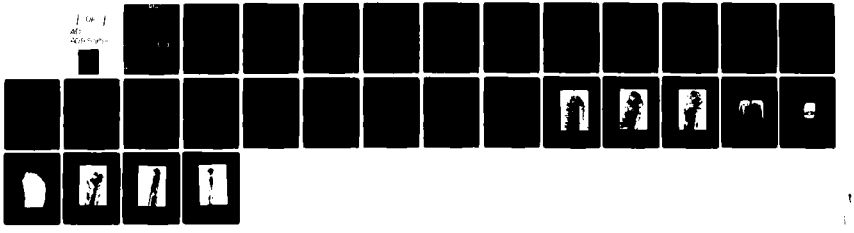

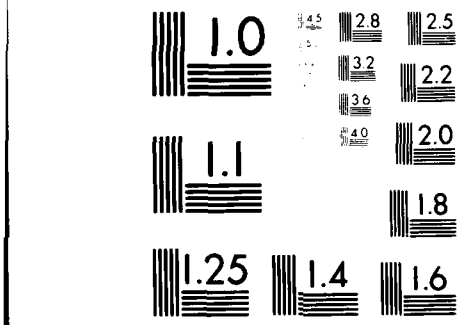

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# COMPARISON OF GUTTA PERCHA FILLING TECHNIQUES. PART 2:

# THREE CHLOROFORM-GUTTA PERCHA FILLING TECHNIQUES

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ABSTRACT

An artificial standard root canal system was used to evaluate the ability of gutta percha filling techniques. No significant difference was noted in the abilities of chloropercha, Kloroperka, and chloroform-dip to replicate the canal system. All three chloroform techniques replicated the system significantly better than lateral condensation.

In volumetric evaluation, the chloropercha fills decreased in volume 12.42% in 2 weeks while Kloroperka decreased only 4.86% and chloroform-dip only 1.40%. How significant the 1.40% shrinkage is in relation to seal is unknown.

## Introduction

The gutta percha filling is preferred by most endodontists as a filling material because of its permanency and capacity to be condensed against the irregularly shaped walls of the canals.[1,2,3] There are many different techniques of filling root canals with gutta percha,[2,3,4] unfortunately, each proponent usually bases the success of his technique on radiographic or clinical evidence alone. Larder and Brayton[5] made a comparative study of three techniques of gutta percha fillings. They concluded that the Kloroperka* fillings were superior to the warm gutta percha or lateral condensation fillings, but only as related to the replication of morphological aberrations. They emphasized that this method could not be expected to indicate the sealing abilities of the three techniques since the shrinkage of the different materials was not evaluated. The method in their study involved dissolving the tooth structure from the gutta percha fillings and comparing the fillings with each other. Therefore, the gutta percha fillings could not be compared to the original canal system. The authors also acknowledged that the reagents used to dissolve the tooth structure possibly could have had an adverse effect on the sealer. Thus, the appearance of the gutta percha fillings could have been distorted.

Goldman[6] made an evaluation of two filling procedures using the same method as Brayton had used. He compared the replication qualities of chloropercha fillings to that of the rosin-chloroform containing Kloroperka* fillings. Chloropercha appeared to replicate the irregularities of the canals better than Kloroperka. The extent of changes in

volume in the gutta percha fillings again could not be determined.

In 1919 Price and Miller[7] placed chloropercha into glass cylinders and observed a 24% decrease in volume after 8 weeks at room temperature and 33.3% decrease after 60 hours at 70°C. McElroy[8] in 1955 was unable to evaluate chloropercha fills of extracted teeth, but he did see large voids after placement in brass rings. McElroy did not note this shrinkage when zinc-oxide was used as a sealer.

The chloroform-dip technique, not usually separated in the literature from the other chloroform techniques, involves dipping the master cone into the chloroform just prior to placement.[9] How much expansion and shrinkage occurred and how it related to other chloropercha techniques needed study.

The purpose of this study was to compare the volume changes of gutta percha fillings fabricated by three chloroform techniques; chloroform-dip, chloropercha and Kloroperka.** The lateral condensation technique was used as a non-chloroform control. The volume changes were correlated with the replication achieved of the interior of a standardized canal and with the time required to perform each technique.

## Methods and Materials

A gold mold, which could be separated into two interlocking vertical halves, was fabricated duplicating an actual root canal system (Fig 1).[10] A total of 64 fillings were made of the artificial root canal. Of the 64 fillings, 16 were made using the chloropercha technique,[6] 16 using the Kloroperka,**[6] 16 using the chloroform-dip,[9] and 16 using the lateral condensation technique.[11] The excess gutta percha was removed with a

warm scalpel so that the coronal end was flushed with the external surface of the mold. All fillings were done by the primary author. Volumetric changes, time and replication properties of the fillings were evaluated in the same manner as previously.[10] This entailed timing the filling procedure, weighing each filling in air and under alcohol immediately following the procedure. All fillings were stored in individual vials in a 37°C incubator*** and after 2 weeks all weighings were repeated. After 3 weeks, using a silicone impression as a standard reference (Fig 2), each evaluator rated the filling into one of four categories: 1-poor (no apical replication, many wrinkles and folds, no fins); 2-acceptable (some apical replication, some wrinkles and folds, no fins); 3-good (good apical replication, few wrinkles and folds, fins); and 4-excellent (excellent apical replication, no wrinkles and folds, fins).

Results

Descriptive statistics of the specimens produced by various techniques are given in Table 1. The chloropercha fillings showed the most volume change with an average shrinkage of -12.42%±2.70%; the Kloropercha fillings showed the second largest volume change of -4.86%± 1.55%; and the chloroform-dipped fillings showed the least amount of shrinkage among the chloroform gutta percha fillings with an average shrinkage of -1.40%±0.57%. Laterally condensed fillings showed a volume change of +1.13%±0.60%. These average percentage volume changes (Δ% vol.) were derived by first making pair-wise comparison for each individual filling volume at the time of fill and again after 2 weeks. Then the changes for all fillings in each group were averaged to get the average percent volume change for each group with its standard

deviation.[12]

The time required for fillings was: lateral condensation, 5.62 minutes (±1.11); chloropercha, 3.71 minutes (±0.55); Kloroperka 4.05 minutes (±0.37); chloroform dip, 3.69 minutes (±0.36).

Qualitative evaluations of the specimens are summarized in Table 2. The evaluators were unanimous in their assignment of categories in 78% of the cases. The remainder were assigned by majority vote. As is obvious from Table 2, the three techniques (Fig 3-5) which utilized chloroform produced good to excellent replication of the test canal. By comparison, the lateral condensation technique (Fig 6) produced poor or just acceptable fillings as judged by the three evaluators.

For statistical purposes, the data were divided into the following categories: Poor vs Acceptable-Excellent, Poor-Acceptable vs Good-Excellent (Tables 3 and 4). In each instance the chloroform techniques were significantly superior to the non-chloroform (lateral) technique ($p$ .00001). Within these categories there was basically no difference between the chloroform techniques.

## Discussion

### Replication properties:

Evaluation 3 weeks after filling showed no significant difference between the replication properties of the three chloroform techniques. In comparison of photographs of the same fillings at 25X taken at the time of filling and at the time of evaluation, only minor change in the basic external appearance could be detected (Fig 4). Even with 12% shrinkage there were no gross changes observed even at a magnification

of 25X. All three chloroform techniques produced fillings that were superior in appearance to those produced by lateral condensation. In point of fact, the chloroform-dip technique produced gutta percha fillings equivalent in replication ability to those of the chloropercha and Kloroperka techniques. In the chloroform-dip technique, the length of the gutta percha master point dipped in chloroform was measured at only 3mm, but in almost all cases, the homogeneity of the final filling was complete. Lateral condensation of the chloroform-dipped master point apparently pushed the softened outer coat of gutta percha coronally, and united all the points into a uniform mass. In regards to the poor appearance of lateral condensation, it must be emphasized that in this study no sealer was used with the lateral condensation technique, and it was included mainly as a standard reference and control for the volumetric and time studies.

Goldman[6] found that the chloropercha technique produced a smoother and more homogeneous filling than the Kloroperka technique. Two possible explanations for this study not confirming Goldman's finding may lie in the differences in evaluators and the evaluation method. Also in Goldman's study reagents, nitric acid and sodium hypochlorite, were used in retrieving the gutta percha fillings from the teeth. These reagents may have adversely affected the Kloroperka sealer, thus producing a roughened appearance. It is also possible that the rosin-containing material may set next to porous dentin differently than it sets next to gold.

Volumetric study:

Price and Miller[7] theorized that if 90% of the pulp chamber were filled with gutta percha cones with the remaining 10% being filled by the gutta percha-in-chloroform sealer, the chamber would be only 96% filled after shrinkage. In this study, after 2 weeks at 37°C, the chloropercha technique produced gutta percha fillings that reduced 12.42% of their original volume. Kloroperka fillings reduced 4.86% of their original volume; chloroform-dip fillings shrank 1.40% of their original volume. The laterally condensed fillings actually showed an increase in volume of 1.11%.

The consistency of chloropercha is variable and dependent on the operator. In this study, the chloropercha was mixed to a consistency similar to that of ZOE sealer; a master cone and accessory cones were placed by lateral condensation until the canal was filled. The Kloroperka was mixed to a similar consistency, and master and accessory cones were placed in the same manner. During condensation of the Kloroperka filling, there appeared to be a rapid evaporation of the chloroform manifested by an apparent "setting-up" of the sealer. It is possible that this rapid evaporation of the chloroform during Kloroperka condensation resulted in a smaller amount of chloroform remaining to be lost later over the two-week period. It is also possible, but not as likely, that the rosin in the Kloroperka technique may, in some manner, release the chloroform more slowly.

With chloropercha, a loss of weight was noted from the first to third readings of initial weighings. The first reading was probably

the more accurate measurement, but an average was taken of three decreasing weight measurements. This error from weight averaging may also contribute to the lower original average weight and volume measurements and its larger deviation. Kloroperka did not show as remarkable a decreasing rate of weight changes during initial weighings.

The chloroform techniques (Figs 3-5) would invariably form large fins comparable to the silicone control (Fig 2). The fin portion did have a tendency to stick to the model. By removing a minimal amount of the fin, the fillings were removed without difficulty. This was done in as consistent a manner as possible. This slight loss of the fins may partially explain why chloropercha was measured as having less volume than lateral condensation; but the gross expansion of the gutta percha dissolved in the chloroform and its rapid evaporation prior to weighing, would be a more logical explanation.

The chloroform-dip technique produced significantly less shrinkage than either chloropercha techniques. Whether a zinc-oxide sealer may counter shrinkage of the chloroform-dipped gutta percha from the walls of the canal has not been studied. Still, if a chloroform technique is to be used, it appears the chloroform-dip, even without sealer, would be the technique of choice.

Price and Miller[7] found that gutta percha in chloroform had a tendency to shrink away from the glass walls of a graduated cylinder. The rosin in chloroform tended to adhere to the glass walls. Whether such adherence is also present to the walls of dentin and whether it improves the sealing properties, are unanswered questions.

The lateral condensation showed no shrinkage, but the replication qualities of the lateral condensation technique was markedly inferior to the chloroform gutta percha techniques (Table 2). Of course, the lack of shrinkage of the lateral condensation technique may compensate for the poorer replication qualities. In fact, the lateral condensation technique did show a tendency to increase in volume with time (+1.1%±0.60). An explanation of this finding may lie in the observation that the accessory cones have a tendency to separate slightly from the master cone over time (Fig 6A, B). Air bubbles may occur in these minute separations which do not allow alcohol to enter during volumetric measurements. This would account for the slight increase in volume over time.

Time Study:

Simulated procedure time studies showed that the chloroform-dip technique required the least amount of time (3.68 minutes), whereas the lateral condensation technique required the most (5.61 minutes). The chloroform techniques had a tendency to require less procedure time than the lateral condensation technique. If operator expertise was the main factor in this difference, it appears that the results should have favored the lateral condensation technique. However, the mechanical compaction technique reported previously was the most rapid, taking an average of only 1.31 minutes.[10]

Although this study indicates a difference in dimensional changes of various types of gutta percha fillings, the difficulty of directly translating such information to assessment of the clinical situation must be recognized. Exactly to what extent similar findings <u>in vivo</u>

would occur is unknown. The procedure of filling canals on a bench will not correspond completely to the technique used clinically. Using a model system without the compressibility of dentin does limit its application to a clinical situation. With the repetition of filling the same canal with a given technique, variation in the operator's ability to fill the canal should be minimized.

Also, the shrinkage of the gutta percha filling on an open laboratory bench is not the same as the shrinkage of a gutta percha filling with sealer in a tooth under clinical conditions. However, if a given technique produces fillings that have superior qualities in vitro, then the technique should deserve serious consideration in vivo.

## Conclusions

The chloroform-dip technique has been suggested as a technique for customizing a master cone. Since just the outer layer of gutta percha is softened, the shrinkage would be expected to be much less than that found in chloropercha techniques. Using an artificial root canal, the replication abilities, volumetric changes and simulated procedure time of this technique, as well as the chloropercha, Kloroperka, and lateral condensation techniques were studied. There were no significant differences in the excellent replication abilities shown by the chloroform-dip, chloropercha, and Kloroperka techniques. The lateral condensation technique produced fillings with poor replication properties. Volumetric studies showed that in 2 weeks chloropercha fillings decreased in volume 12.42%; Kloroperka fillings decreased in volume 4.86%, and chloroform-dip fillings decreased in volume 1.40%. The lateral condensation

technique did not prove significant.

In this study, the excellent replication qualities and low shrinkage characteristic of the chloroform-dip filling have been observed. If a chloroform technique is to be used, the chloroform-dip technique would be the technique of choice.

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*Union Broach Co., Inc., Long Island City, NY

**Kloropercha WBECO, Switzerland

***Hot Pack, Philadelphia, PA

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Table 1. Weighing changes in air and alcohol over a two-week period with percent volume changes(Δ% vol.) and average times for fillings in each group.

| | Original AVG. WT. in Air | Original AVG. WT. in Alcohol | At 2 Week AVG. WT. in Air | At 2 Week AVG. WT. in Alcohol | Δ% Vol. | Time |
|---|---|---|---|---|---|---|
| Lateral | 77.242<br>±1.536 | 54.444<br>±1.093 | 77.950<br>±1.484 | 54.859<br>±1.125 | +1.132<br>±0.606 | 5.616<br>±1.106 |
| Chloroform-Dip | 79.842<br>±1.988 | 56.204<br>1.418 | 79.611<br>1.913 | 56.185<br>1.461 | -1.403<br>±0.569 | 3.685<br>± .363 |
| Kloropercha | 75.509<br>±1.057 | 42.107<br>±0.725 | 53.699<br>±0.973 | 51.383<br>±0.707 | -4.860<br>±1.55 | 4.047<br>±.369 |
| Chloropercha | 60.515<br>±4.067 | 47.839<br>±3.069 | 66.410<br>±4.183 | 46.563<br>±2.964 | 12.423<br>±2.704 | 3.708<br>±.554 |

Table 2. Common rank of each filling. Each evaluated separately by evaluator, but placed into category of common or majority agreement.

| | 1-Poor | 2-Acceptable | 3-Good | 4-Excellent |
|---|---|---|---|---|
| Chloropercha | | 1 | 2 | 13 |
| Kloropercha | | | 4 | 12 |
| Chloroform-Dip | | | 3 | 13 |
| Lateral | 11 | 5 | | |

1-Poor: no apical replication, many wrinkles and folds, no fins.
2-Acceptable: some apical replication, some wrinkles and folds, minimal fins.
3-Good: good apical replication, few wrinkles and folds, fins.
4-Excellent: excellent apical replication, no wrinkles and folds, fins.

Table 3. Rankings combined into Poor and Acceptable to Excellent.

| | Poor | Accept.-Excellent |
|---|---|---|
| Chloropercha | 0 | 16 |
| Kloropercha | 0 | 16 |
| Chloroform-Dip | 0 | 16 |
| Lateral | 11 | 5 |

df=3 $x^2$=39.85 p<0.00001

Table 4. Rankings combined into Poor to Acceptable and Good to Excellent.

| | Poor-Accept. | Good-Excellent |
|---|---|---|
| Chloropercha | 1 | 15 |
| Kloropercha | 0 | 16 |
| Chloroform-Dip | 0 | 16 |
| Lateral | 16 | 0 |

df=3 $x^2$=59.19 p<0.00001

Legends

Fig 1 A. Two halves of the root canal mold. Four hemi-spherical notches (left half) and their positive impression (right half) served as reference points for repositioning the halves of the mold (canal length = 15 min.). B. Two halves held together by clamp.

Fig 2 Silicone impressions of artificial root canal. (25X)

Fig 3 Chloropercha filling. Filling is homogeneous with excellent replication of apical portion and mold interface. (25X)

Fig 4 Kloropercha filling. Filling is homogeneous with excellent replication of apical portion and mold interface. (25X)
A. Immediately after fill. B. Three weeks after fill.

Fig 5 Chloroform-dip filling. Filling is homogeneous with excellent replication of apical portion and mold interface. (25X)

Fig 6 Lateral condensation. Note incomplete replication of apical portion of canal. (25X)
A. Immediately after fill. B. Three weeks after fill.