

An observational study on effect of warm gutta-percha filling with microscopic root canal technique.

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Abstract

Objective: To investigate the effect of warm gutta-percha filling with microscopic root canal technique.

Methods: 120 patients with pulpitis treated in our hospital from February, 2014 to December, 2015 were enrolled and randomized equally into observation and control group. The patients in the control group were treated with traditional root canal therapy, but those in the observation group were treated with warm gutta-percha filling by microscopic root canal technique. The degree of root canal filling and the occurrence of pain were compared between the two groups after operation. **Results** The adequate filling rate was 90.00% in the observation group, obviously higher than that of 67.86% in the control group; the deficient filling rate was 5.00% in the observation group, obviously lower than that of 21.43% in the control group. Both of the adequate and deficient filling differences between the two groups were statistically significant ($P < 0.05$). The no-pain rate was 87.50% in the observation group, obviously higher than that in the control group (73.81%); the mild-pain, moderate-pain and severe-pain rates were obviously higher than those in the control group, respectively. Those differences in post-operative pain rates between the two groups were statistically significant ($P < 0.05$).

Conclusion: When using microscopic root canal technique in warm gutta-percha filling, the degree of root canal filling is improved after operation: the adequate filling rate increases and the deficient filling rate increases; the pain status is good after operation and the no-pain rate increases. Compared with conventional root canal therapy, warm gutta-percha filling with microscopic root canal technique can not only greatly improve the success rate of surgery, but also enable the patients to recover their health in a shorter time, and this technique was universally adaptable for the treatment of diseased teeth in patients, and can treat almost all types of diseased teeth, and has been recognized by surgical patients.

Keywords: Microscopic root canal technique, Warm gutta-percha filling, Efficacy.

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Introduction

In recent years, root canal therapy is often applied for the treatment of pulpitis and periapical disease in clinical practice, achieving a significant therapeutic effect [1]. The key step of this therapy is the effective filling of root canals. Tightly filling cleaned root canals, prevents the invasion of bacteria and microorganisms, and avoiding secondary infection can provide a good biological environment for the quick healing of tooth root apices, and it also promotes the healing and recovery of the adjacent tissues of tooth root apices in a certain extent. At present, cold gutta lateral root canal filling technique is mature, as a standard root canal treatment course, its clinical efficacy is recognized. But the operating procedures are cumbersome, also root canal polymerization shrinkage root canal micro-leakage often affect its clinical treatment effect [2]. Cold gutta lateral compression technique is a classic method of filling, through the side of the root canal filling to make the morphological changes in the gum, get better adhesion to complete the closure of the root canal. However, the deformation ability and lateral compressive strength of the cold gutta-percha are very limited.

Gutta percha cannot form a whole between the main and vice teeth between the plastic tip there will be a certain gap, the gap between the gutta-percha can also occur in the gum tip and root canal contact surface, So the apex 1/3 prone to a larger space and micro-leakage [3,4].

The warm gutta-percha has good fluidity and can completely seal the whole root canal system, including the small curved root canal, the root canal traffic branch and the side accessory root canal, which has an important role in improving the quality of root canal therapy [5]. The warm gutta-percha filling technique is used to heat the gutta-percha during filling, changing the physical properties of the gutta-percha, making it semi-fluidity and obtaining the plasticity and filling capacity required for root canal filling. Filling in the root canal of the gum cooling can form a close whole, so the gums on the root canal wall adhesion was significantly improved, to achieve a good sealing effect, and to reduce the filling between the gum and root canal wall occurred possibility of voids. At the same time, due to increased mobility of gutta-percha heating, the possibility of filling the root canal was increased [6,7].

Compared the warm gutta-percha filling with the lateral cold gutta-percha filling, it has the following advantages: high precision that up to about 0.5 mm apical; Good sealing, it can close the root canal to prevent re-infection; Strong stability, in recent years, it has been widely used in domestic and international root canal filling. Clinical studies have shown that, compared with the lateral cold gutta-percha filling, warm gutta-percha filling in the simulated root canal mass significantly increased, that is, the filling density was significantly higher than that of the lateral cold gutta-percha filling [8,9].

Last century, some researchers presented warm gutta-percha vertical compaction technique. The key of this technique was to make full use of the liquidity of heated gutta-percha and fill gutta-percha into root canals under pressure, in order to keep the shape of root canals and achieve an ideal filling effect [10,11]. Later, with the development of microscopy, microscopic root canal technique was gradually applied in root canal filling with warm gutta-percha. In this study, the effect of warm gutta-percha filling with microscopic root canal technique was studied in the patients with pulpitis treated in our hospital. We hope to provide more effective solutions and methods in clinical root canal therapy by used the warm gutta-percha filling with microscopic root canal technique.

Materials and Methods

General information

A total of 120 patients with pulpitis treated in our hospital from February, 2014 to December, 2015 were enrolled and randomized equally into observation and control group, 60 patients per group. In the control group, there were 26 males and 34 females all of whom aged from 35-64 years old with an average of (38.12 ± 5.47) years old; the 60 patients had 84 affected teeth. In the observation group, there were 29 males and 31 females all of whom aged from 36-55 years old with an average of (38.05 ± 5.91) years old; the 60 patients had 80 affected teeth. There were no significant differences in gender, age or other basic parameters between the two groups ($P>0.05$). The two groups were very comparable.

Inclusion criteria: The patient has been clinically diagnosed as pulpitis; the patient had never received root canal therapy; the patient had no systemic disease [12].

Exclusion criteria: The patient had a severe calcified root canal; the root canal was severely twisted in CT images; periodontal pocket >3 mm; the patient could not cooperate to complete the treatment because of his/her physical conditions [13].

Patients' informed consent as well as the approval of the ethics committee of our hospital were acquired in the study.

Instruments and reagents

Ultrasonic probe; P-Max ultrasonic system (SATELEC, France); ultrasonic tip (ET20, ET25, ET40); DG-16 root canal

probe; Micro- opener (Denstply, Switzerland); Pico PROergo K- (SybroEndo, USA); Dental Surgical Microscopy (Zeiss, Germany); Hand Root Canal Preparation Instrument (Denstply, Switzerland); System-B (SybroEndo, USA); Obtura-); Touch 'n Heat heater (US companies Kerr);Compound Thymol - Formaldehyde Cresol Solution Compound (Shanghai Second Medical Zhangjiang Biological Materials Co., Ltd.); Root canal paste; Standard gutta percha (Meta Dental Medical Devices Co., Ltd.); Non-standard gutta percha (US Kerr company).

Methods

All the patients received routine examinations as well as visual, probing and biting examinations before operation. Their pulps were observed and recorded in real time.

Control group: The routine root canal therapy, lateral compaction technique, was administered. All the patients underwent X-ray photography before operation, so as to fully understand the route of root canal and the severity of pulpitis. Subsequently, opening the pulp, uncovering the pulp roof, pulling out the pulp and expanding the root canal were performed; the necrotic tissue in the root canal was eliminated; the root canal was rinsed and filled.

Observation group: Warm gutta-percha filling with microscopic root canal technique was given. The dentin was removed by ultrasonic tips. The root canal was dredge with pulp probing and pulp cleaning solution so that it could meet required length. The subsequent filling was performed under the assistance of microscope.

Observational parameters

Evaluation criteria for the degree of root canal filling: Filling degree was classified to three levels according to the distance from end of filling substance to the tooth root apex (d): adequate filling $-d \leq 2$ mm; deficient filling $-d > 2$ mm; overfilling - the end of filling substance exceeded the tooth root apex [14-16].

Evaluation criteria for post-operative pain degree: Depending on whether percussion or probing pain appeared or not and the pain degree, pain was classified to 4 levels: no pain - the patient had no percussion or probing pain; mild pain - the patient felt mild percussion pain; moderate pain - the patient felt percussion and probing pains and antibiotics should be given for moderate treatment; severe pain - the patient experienced swollen tooth root apex and severe percussion and probing pains [17-19].

Clinical evaluation criteria: The clinical efficacy was evaluated according to the following criteria: (1) Success: no symptoms, no percussion pain and fistula, good occlusal function, X-ray showed apical normal or apical lesion disappeared, or apical area narrow. (2) Progress: no symptoms and signs, a good dental occlusion function, X-ray showed apical area of reduced disease; (3) failure: clinical symptoms and signs, percussion pain significantly, poor dental occlusion

function, as well as the original apical fistula healed, X-ray showed the original apical lesion unchanged or enlarged. Successful + progressive cases total for the clinical efficacy of satisfactory cases.

Statistical analysis

SPSS18.0 was employed for data analysis. Data were expressed as mean ± standard deviation. Measurement data were compared with t-test. Enumeration data were compared with χ^2 test. Rank data were compared with rank-sum test (Wilcoxon two-sample test). When $P < 0.05$, the difference was statistically significant.

Results

Comparison of root canal filling degree between the two groups

We observed and recorded the root canal filling degree of the observation group and control group, and took it as data, the results showed that the adequate filling rate was 90.00% in the observation group, obviously higher than that of 67.86% in the

control group, the results showed that the warm gutta-percha filling with microscopic root canal technique was better than that of the lateral cold gutta-percha filling in filling effect, the deficient filling rate was 5.00% in the observation group, obviously lower than that of 21.43% in the control group. Both of the adequate and deficient filling differences between the two groups were statistically significant ($P < 0.05$) (Table 1). These results suggest that the warm gutta-percha filling with microscopic root canal technique was better than conventional root canal therapy technique in patients with root canal filling.

Comparison of post-operative pain between the two groups

We observed the postoperative pain and recorded the results of the two groups of patients (Table 2). The data in Table 2 showed that the incidence of pain was significantly different between the observation group and the control group ($P < 0.05$). The pain rate in the observation group was significantly lower than that in the control group. Among them, the no-pain rate was 87.50% in the observation group, obviously higher than that in the control group (73.81%).

Table 1. Comparison of root canal filling degree between the two groups [n (%)].

Group	Number of affected teeth	Adequate filling	Deficient filling	Overfilling
Control group (n=60)	84	57 (67.86)	18 (21.43)	9 (10.71)
Observation group (n=60)	80	72 (90.00)	4 (5.00)	4 (5.00)
χ^2		11.9680	9.5214	1.8332
P value		0.0005	0.0020	0.1757

Table 2. Comparison of post-operative pain between the two groups [n (%)].

Group	Number of affected teeth	No pain	Mild pain	Moderate pain	Severe pain	Incidence of pain
Control group (n=60)	84	62 (73.81)	9 (10.71)	3 (3.57)	10 (11.91)	22 (26.19)
Observation group (n=60)	80	70 (87.50)	3 (3.75)	5 (6.25)	2 (2.50)	10 (12.50)
χ^2		4.8902	2.9305	0.6336	5.3442	4.8902
P value		0.0270	0.0869	0.4260	0.0208	0.0270

Table 3. Comparison of two groups' clinical results after three months.

Group	Cases	Success	Progress	Failure	The clinical results with satisfaction
Control group (n=60)	84	57 (67.86)	18 (21.43)	9 (10.71)	75 (89.29)
Observation group (n=60)	80	68 (85.00)*	10(12.50)*	2 (2.50)*	78 (97.50)*

Note: compared with control group, * $p < 0.05$

In addition, the severe-pain rates in the control group were obviously higher than those in the observation group, in the control group, the rates of mild pain and moderate pain were higher than those in the observation group, but the difference

was not significant. From the above results, we could know that patients who were treated by warm gutta-percha filling with microscopic root canal technique had less postoperative pain than patients who were treated by conventional root canal

therapy technique. This also showed that the warm gutta-percha filling with microscopic root canal technique can greatly reduce the pain of postoperative patients, resulting in fewer adverse effects on the patient's postoperative life (Table 2).

Comparison of two groups' clinical results after three months

The clinical curative effect of the two groups was statistically analyzed after 3 months. Data show that the control group and observation group patients after 3 months of clinical efficacy satisfaction rates were 89.29% and 97.50%, the difference was statistically significant (p<0.05). The failure rate (2.50%) in the observation group was significantly lower than that in the control group (10.71%), the success rate of the observation group was 85.00%, significantly higher than the control group (67.86%). These results suggest that compared with conventional root canal therapy, warm gutta-percha filling with microscopic root canal technique can not only greatly improve the success rate of surgery, but also enable the patients to recover their health in a shorter time. In addition, warm gutta-

percha filling with microscopic root canal technique has been recognized by surgical patients (Table 3).

Treatment failure analysis

We analyzed the reasons for the failure of warm gutta-percha filling with microscopic root canal technique and conventional root canal therapy technique. In the control group, 4 cases of root canal failure were caused by not close, root canal leakage, among which 2 cases were not close and root canal leakage. In the anatomic factors, root canal calcification and apical foramina open 1 case, unknown reason was 3 cases. Observation group, the main cause of failure in the anatomical factors, root canal calcification for 1 case, unknown reason for 1 case. The above results show that, from the conventional root canal therapy treatment efficacy analysis, warm gutta-percha filling with microscopic root the canal technique is universally adaptable for the treatment of diseased teeth in patients, and can treat all types of diseased teeth. But for some aspects, such as root canal calcification or unknown reason aspects, treatment technology needs to be further studied (Table 4).

Table 4. Cause analysis of failure in treatment.

Group	Reason	Anterior teeth	Premolar	Molar
Control group (n=60)	Not close	2	-	-
	Root canal leakage	-	-	2
	Root canal calcification	-	-	1
	Apical foramina open	1	-	-
	unknown reason	3	-	-
Observation group (n=60)	Root canal calcification	-	-	1
	unknown reason	-	-	1

Discussions

In clinic [20], the shape of affected tooth varies among patients. In the traditional root canal therapy, the affected root canal system is understood only by X-ray and the effects of root canal filling is judged only by the treating physician's personal experience, therefore, the uncertainty is obviously enhanced. With the studies from medical researchers, warm gutta-percha filling technique is gradually replacing the traditional therapy. The technique had no the defect of cold lateral compaction. In addition, microscopic root canal technique was introduced into the medical field in 1950s [21], and subsequently dentists applied the technique in the diagnosis and treatment of pulpitis. Compared with ordinary microscope, root canal microscope has more advanced amplification and lighting effects. The exquisite structure of the root canal can be clearly presented through microscopic root canal technique, therefore, the operated location is more accurate, the certainty of the treatment is enhanced, and the therapeutic quality and the patient's health index are improved [22]. In conclusion, by utilizing microscopic root canal

technique in warm gutta-percha root canal filling operation, the root canals missed in the traditional surgical therapy can be found out; the calcification of the root canal can be dredged; the devices broken in the traditional surgical therapy can be cleaned up; the perforation of the root canal wall can be repaired; the fracture section of the tooth root apex can be examined; and finally the success rate of completely curing pulpitis is improved. In this study, the effect of microscopic root canal technique was studied in the 120 patients receiving warm gutta-percha filling in our hospital.

The results of this study showed that the utilization of microscopic root canal technique in warm gutta-percha filling operation significantly improved the filling degree of the root canal compared with the traditional root canal therapy. In the 60 patients receiving microscopic root canal filling technique, 72 teeth were adequate filled among the 80 affected teeth, showing an adequate filling rate of 90.00% and a deficient filling rate of 9.00%; in the 60 patients receiving the traditional root canal filling technique, 57 teeth were adequate filled among the 84 affected teeth, showing an adequate filling rate

of 67.86% and a deficient filling rate of 24.43%. Obviously, the adequate filling rate of warm gutta-percha filling operation was significantly increased, and the deficient filling rate was obviously decreased after the utilization of microscopic root canal technique. Previous studies had reported an adequate filling rate of approximately 80% in affected teeth in their studies [23,24]. Our adequate filling rate was significantly higher after the utilization of microscopic root canal technique in this study than that reported in the related references. Depending on whether percussion or probing pain appeared or not in the affected tooth and the pain degree, an analysis on post-operative pain showed that: the pain degree was significantly improved and 70 teeth had no pain among the 80 affected teeth with a no-pain rate of 87.50% and a pain occurrence of only 12.5% when utilizing microscopic root canal technique; 62 teeth had no pain among the 84 affected teeth with a no-pain rate of 73.81% and a pain occurrence of up to 26.19% when utilizing the traditional root canal therapy. It indicated that the no-pain rate was increased and the post-operative pain degree was significantly improved when utilizing microscopic root canal technique.

In conclusion, the warm gutta-percha filling with microscopic root canal technique was better than conventional root canal therapy technique in patients with root canal filling, the degree of root canal filling is improved after operation when using microscopic root canal technique in warm gutta-percha filling. Patients who treated by warm gutta-percha filling with microscopic root canal technique had better postoperative pain than patients who treated by conventional root canal therapy technique, the adequate filling rate increases and the deficient filling rate decreases. The warm gutta-percha filling with microscopic root canal technique can greatly reduce the pain of postoperative patients, resulting in fewer adverse effects on the patient's postoperative life, pain status is good after operation and the no-pain rate increases. Compared with conventional root canal therapy, warm gutta-percha filling with microscopic root canal technique can not only greatly improve the success rate of surgery, but also enable the patients to recover their health in a shorter time. In addition, warm gutta-percha filling with microscopic root canal technique has been recognized by surgical patients. From the conventional root canal therapy treatment efficacy analysis, warm gutta-percha filling with microscopic root canal technique is universally adaptable for the treatment of diseased teeth in patients, and can treat almost all types of diseased teeth.

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