WHIOCE PUBLISHING PTE. LTD.
PROVIDING FIRST-CLASS SCIENTIFIC INFORMATION FOR TOP SCHOLARS

2025,Volume 10, Issue 2
Advances in Precision Medicine
Online ISSN: 2424-9106
Print ISSN: 2424-8592

Clinical Effect of Microscopic Ultrasound Technology in Special Root Canal Therapy

Saisi Duan, Meiyi Pan*, Jiamin Peng, Yu Liu
Xiangtan Stomatological Hospital, Xiangtan 411100, Hunan, China
**Author to whom correspondence should be addressed.*

Copyright: © 2025 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* To investigate the effect of microscopic ultrasound in special root canal therapy. *Methods:* Sixty patients undergoing root canal therapy in the hospital from April 2023 to December 2024 were selected and grouped by random number chart. In the control group, 30 patients used the traditional method of root canal dredging, and 30 patients in the observation group used the microultrasonic root canal technique for root canal dredging. The dredging success rate was compared with the dredging time, pain degree, patient satisfaction, and complications. *Results:* The success rate and total satisfaction of the observation group were higher than those of the control group, the dredging time was shorter than the control group, and the pain score and complication rate were lower than those of the control group ($P < 0.05$). *Conclusion:* The application of microscopic ultrasound technology in special root canal treatment has a definite therapeutic effect, a high success rate, and a short dredging time, which is conducive to reducing pain, reducing the incidence of complications, and improving patient satisfaction, which is worth being widely used.
Keywords: Special root canal treatment; Microscopic ultrasound technique; Pain degree; Satisfaction; Complications

Online publication: June 28, 2025

1. Introduction

As people diet, living habits change, combined with low oral health consciousness, oral disease incidence increased significantly, pulpitis, periapical inflammation are common disease type, can cause gum redness, pain, odor, if not timely and effective treatment, even lead to loose teeth, affect chewing function, seriously reduce the quality of life in patients [1,2]. Current clinical treatment of pulpitis, apical periodontitis and other oral diseases using root canal treatment, can quickly relieve symptoms in patients, promote chewing function recovery, treatment effect is recognized, but with widely used found that traditional root canal treatment during calcification root canal, apical

barrier, increase the difficulty of treatment, lead to treatment effect is poor [3]. In recent years, the rapid development of oral medicine technology, microscopic ultrasound technology in clinical application, the technology has the dual advantages of microscope and ultrasonic instruments, the former mainly play the role of amplification, lighting, which can play the function of oscillation and cutting, effectively remove foreign bodies, promote the root canal, improve the success rate of treatment, but the related reports are relatively rare [4]. The present study aims to investigate the effect of microultrasound technology in special root canal therapy. The report is as follows.

2. Data and methods

2.1. General data

As approved by the Medical Ethics Committee, 60 patients undergoing root canal treatment in our hospital from April 2023 to December 2024 were selected and grouped by a random number table. In the observation group, 30 patients: 18 male and 12 female; marital status: 14 married, 10 unmarried, divorced, widowed or other 6; age 15–70 years old, mean age (38.71 ± 7.52) years old; disease type: 12, pulpitis, pulp necrosis, 7,11 each; weight 49–82 kg, mean weight (67.53 ± 8.21) kg. In the control group, 30 patients: 16 male and 14 female; marital status: 16 married, 9 unmarried, divorced, widowed or other 5; age 15–70 years old, mean age (38.24 ± 7.37) years old; disease type: pulpitis, pulp necrosis, 14 each, 6 periapical periodontitis; weight 47-85kg, mean weight (67.98 ± 8.52) kg. When the two groups compared the above data, no difference was significant ($P > 0.05$).

2.2. Inclusion criteria

For inclusion criteria: (1) All selected patients were confirmed by imaging and oral examination, and were single tooth lesions; (2) Patients were in good mental state, could understand instructions and cooperate with medical staff; (3) Root canal blurred or no root canal imaging or root tip; (4) Informed the study and signed the consent form. Exclusion criteria: (1) With episodes of acute cardiovascular and cerebrovascular disease; (2) With longitudinal teeth; (3) Could not tolerate the study regimen; (4) With plasticizing treatment; (5) With mental illness or consciousness disturbance; (6) Opening; (7) With understanding and communication skills.

2.3. Methods

All patients should undergo X-ray examination after admission to have a preliminary understanding of the affected teeth, make relevant preparations, and implement anti-infection treatment. Control group adopts the traditional method of dredge root canal, the operation is as follows: using C file with root canal lubricant in conventional field, dredge with angle X-ray observation during the treatment, during the treatment of deviation, side wear need to timely change treatment measures, such as dredging failed to determine the root canal dredge failure, suggest further use of root canal microscope combined ultrasound technology try to dredge. The observation group used microultrasonic root canal technology to dredge the root canal, and the operation was as follows: preoperative routine examination, detailed understanding of calcification, open the pulp after using rubber barrier, build linear access, and pay attention to the preservation of the original form at the bottom of the pulp compartment. Remove calcified tissue with the help of a microscope to ensure complete removal of calcified tissue.

2.4. Observational indicators compare the dredging success rate and dredging time, pain degree, patient satisfaction and complications between the two groups.

(1) Compare the success rate and dredging time between the two groups: the results showed that the root canal reached the apical file, no root canal wall side wear or bypass, and the apical barrier formation was successful; after the review of the X-ray after treatment, the results showed that the root canal was not completely cleared from the apical hole, and the root canal wall side wear or bypass, and no apical barrier was failed.

(2) The patients in both groups were evaluated by visual analogue of pain scoring, which was evaluated by a specially trained investigator holding a ruler. The numbers on the ruler from left to right represent painless to severe pain, and the larger the number, the more obvious the pain. Evaluated before and 1 week after treatment.

(3) Satisfaction: using our homemade satisfaction questionnaire, by specially trained investigators in the form of face to face satisfaction survey, the investigators during the survey, to use unified specification to patients advance the purpose and significance of the survey, charged patients must truthfully fill in the scale, and the survey for anonymous way, don't need to worry about privacy, completed by the patient independent scale survey. The scale includes work attitude, operation professionalism, comfort, etc. The full score is 10, the total score is > 6 is satisfaction, 4–6 is basic satisfaction, and < 4 is dissatisfaction. If the patient cannot write themselves during the investigation, the investigator can dictate the questions and answers, and then the patient gives the investigator will write the answers. During this period, guiding or suggestive language should not be used to ensure the validity of the investigation. Total satisfaction = (satisfaction + basic satisfaction) / total number 100.00%. The Cronbach's α coefficient was 0.875 and the test-retest validity was 0.887.

(5) Complications include occlusal discomfort, red and swollen gums, and pain.

2.5. Statistical analysis

Using SPSS 22.0 statistical analysis software, measurement data in mean ± standard deviation (SD), *t* test; count data in % and χ^2 test; $P < 0.05$ was considered as a statistically significant difference.

3. Results

3.1. Dredge success rate and dredging time

The dredging success rate of the observation group was higher than that of the control group, and the dredging time was shorter than that of the control group ($P < 0.05$). See **Table 1**.

Table 1. Comparison of the dredging success rate and dredging time between the two groups

Group	Undredging success rate (*n*,%)	Unclog time (mean ± SD, min)
Control group ($n = 30$)	21 (70.00)	39.89 ± 8.38
Observation group ($n = 30$)	28 (96.67)	25.62 ± 4.27
χ^2/ *t*	$\chi^2 = 5.455$	*t = 8.310*
P	0.020	0.000

3.2. Pain score

Comparison of pre-treatment pain scores between the two groups ($P > 0.05$); post-treatment pain scores decreased in both groups and were lower in the observation group ($P < 0.05$). See **Table 2**.

Table 2. Comparison of pain scores between the two groups (mean ± SD, component)

Group	Pre-treatment	Post-treatment	*t*	*P*
Control group (*n* = 30)	5.92 ± 1.35	3.71 ± 0.96	7.307	0.000
Observation group (*n* = 30)	5.84 ± 1.41	2.23 ± 0.68	12.631	0.000
t	0.225	6.891		
P	0. 823	0.000		

3.3. Satisfaction

The satisfaction degree of the observation group was higher than that of the control group ($P < 0.05$). See **Table 3**.

Table 3. Comparison of the two groups, *n* (%)

Group	Satisfied	Basically satisfied	Unsatisfied	Total satisfaction
Control group (*n* = 30)	10 (33.33)	12 (40.00)	8 (26.67)	22 (73.33)
Observation group (*n* = 30)	18 (60.00)	11 (36.67)	1 (3.33)	29 (96.67)
χ^2				4.706
P				0.030

3.4. Complications

The observation group had less complications than the control group ($P <0.05$). See Table 4.

Table 4. Complications, *n* (%)

Group	Bite discomfort	Gingival redness and swelling	Pain	Total effective
Control group (*n* = 30)	2 (6.67)	5 (16.67)	3 (10.00)	11 (36.67)
Observation group (*n* = 30)	0 (0.00)	2 (6.67)	1 (3.33)	3 (10.00)
χ^2				5.963
P				0.015

4. Discussion

The incidence of oral diseases such as pulpitis and periapical inflammation is high, and the formation mechanism is

complex and diverse. The specific reasons are still not completely clear. It is clinically believed to be related to various factors such as oral hygiene habits, chemical stimulation and microbial infection, which seriously affect the oral health of patients [5]. Oral disease species, complex disease, treatment is difficult, high recurrence rate, early patients and no obvious discomfort, but as the progress will appear obvious gum pain, bleeding symptoms, even lead to loose teeth, adverse effects on chewing function, but also reduce the tooth beauty, bring inconvenience to patients with daily life. In recent years, with the continuous improvement of living standards, people pay more and more attention to oral health problems and their external beauty. Once oral diseases are found, they should choose more active treatment to control the progress of the disease, improve the related symptoms, and promote the recovery of patients [6]. Clinical treatment of pulpitis, periapical inflammation and other oral disease method is more, the root canal treatment with chemical therapy, mechanical treatment, root canal treatment can effectively remove pollutants in the pulp cavity, and stimuli, eliminate inflammation, prevent infection, then the root canal filling, crown closed, can effectively reduce the risk of recurrence, treatment effect is good [7].

Dodonitis, periapical periodontitis and other oral diseases have accurate root canal treatment effect, which can retain the affected teeth without the need to remove the affected teeth, resulting in less damage, which is more conducive to maintaining the tooth integrity and beauty, promoting the recovery of chewing function, and the risk of reinfection after treatment is low, greatly reducing the recurrence rate [8]. However, the traditional root canal treatment depends on the experience of the operator to complete the operation, there is some blindness, sometimes the root canal access cannot be accurately established, and even cause the root canal wall to wear or form steps, affect the subsequent operation, and even lead to treatment failure [9]. In addition, the root is not fully developed, root tip mouth horn or root canal lower wall parallel, root canal treatment is difficult to form good apical closed, and treatment, calcified root canal is due to tooth aging, caries, wear, inflammation, pulp tissue defensive reaction, some protective tissue components formed in the root canal wall, pulp cavity, root canal wall thickening, originally smooth root canal obstruction, calcified root canal treatment instruments difficult to reach the full length of the root canal, unable to clear blocked root canal infection, may lead to the reduction of the success rate of root canal treatment [10].

In this case, the ultrasound device can effectively remove the calcified root canal, but the ultrasonic device cleaning is only blind, unable to accurately judge the direction of the root canal, and side wear or other complications are easy to occur, which affects the overall treatment effect. Oral microscope can present a clear field of vision, clinicians broke through the traditional pulp treatment visual limitations and sensory dependence, provide accurate, predictable operation, reduce the traditional root canal treatment caused by uncertainty and damage such as root canal treatment in the process of supercharge, the broken instruments, side wear such as iatrogenic factors [11]. The results of this study showed that the success rate and total satisfaction of the observation group were higher than that of the control group, the dredging time was shorter than that of the control group, and the pain score and complication rate after treatment were lower than that of the control group ($P < 0.05$). It shows that the application of microultrasound technology in special root canal treatment has a definite therapeutic effect, a high success rate and a short dredging time, which is conducive to the reduction of pain, reducing the incidence of complications, and improving patient satisfaction, which is worthy of wide application. Microscopic ultrasound technology can provide a good operating field through the microscope, clearly show the situation in the root canal, facilitate the operator to operate accurately, and greatly reduce the occurrence of accidental injury. In addition, the ultrasound device can completely remove the calcified tissue, improve work efficiency, thoroughly dredge the root canal, and obtain the ideal therapeutic effect [12].

5. Conclusion

To sum up, the application of microultrasound technology in special root canal treatment has a definite effect, a high success rate of dredging and a short dredging time, which is conducive to reducing pain, reducing the incidence of complications and improving patient satisfaction, and is worth widely used.

Disclosure statement

The author declares no conflict of interest.

References

[1] Hu H, Chen Z, Liang H, 2022, Effects of Ultrasound Root Canal Preparation on Periodontal Index and Pain in Children With Chronic Pulpdonitis. Journal of Changchun University of Traditional Chinese Medicine, 38(12): 1396–1399.

[2] Liu X, Feng F, Yang Q, et al., 2022, Effect of Er: YAG Laser Endodontic Washing Technique on Apical Microleakage After Root Canal Filling. Chinese Journal of Geriatric and Oral Medicine, 20(5): 257–260.

[3] Zou F, Zhao L, Hu R, 2022, Combination of Mechanical Nittitanium Instrument and Ultrasonic Endodonwash on Fistula Chronic Periapical Inflammation. Hebei Medicine, 44(15): 2333–2335 + 2339.

[4] Wang Z, Wu L, Xue M, 2023, Microultrasound Combined With Cannula Technique for the Treatment of the Mandibular First Molar in a Case Report. Chinese Journal of Practical Stomatology, 16(3): 381–384.

[5] Janabi A, Tordik P, Griffin I, et al., 2021, Accuracy and Efficiency of 3-Dimensional Dynamic Navigation System for Removal of Fiber Post From Root Canal-Treated Teeth. Journal of Endodontics, 47(9): 1453–1460.

[6] He H, Song T, Liu Y, 2024, Efficacy of Microultrasound Technique Combined With Type C Pioneer File for Elderly Curved Calcification Obstructed Root Canal. Journal of Clinical Stomatology, 40(6): 343–346.

[7] Melilli D, Russo R, Gallina G, et al., 2021, Diagnosis and Treatment of Dens Invaginatus With Open Apex in a Young Adult Patient by Using Cone-Beam Computed Tomography and Operative Microscope. European Archives of Paediatric Dentistry, 22(1): 15–18.

[8] Huang D, Zhao S, 2021, Evaluation of the Clinical Efficacy of Root Canal Microscope Combined With Ultrasound Concussion in Root Canal Therapy. Oral Medicine Research, 37(8): 737–740.

[9] Peng H, Gong N, Xu J, 2023, Comparison of Pulp Calcification Combined With Cone Beam CT or X-Ray Tablets. Chongqing Medical, 52(18): 2785–2788.

[10] Jiang Y, Shi L, Cai J, 2024, Evaluation of the Effect of Ultrasound Irrigation Combined With Chlorhexidine in Pulpdonitis. Shanghai Stomatology, 33(2): 170–174.

[11] Lan X, Qi L, Liang H, et al., 2021, Effect of Oral Surgery Microscope Combined With Ultrasound Technology in Root Canal Retreatment. Armed Police Medicine, 32(6): 500–503 + 509.

[12] Zheng G, Xiang K, Li Y, et al., 2024, A Retrospective Analysis of the Near and Distal Middle Root Canal in the First Permanent Molar. Journal of Periodontology, 29(8): 462–465 + 470.

Publisher's note

Whioce Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.