

Original Article

Efficacy of root canal therapy combined with basic periodontal therapy and its impact on inflammatory responses in patients with combined periodontal-endodontic lesions

Fang Fang¹, Bo Gao¹, Tianrong He¹, Yunqi Lin²

¹Department of Stomatology, Chinese PLA General Hospital, Beijing 100000, China; ²Department of Head and Neck Surgery, Shengli Clinical Medical College of Fujian Medical University, Fujian Provincial Hospital, Fuzhou 350001, Fujian Province, China

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Abstract: Objective: To investigate the effect of root canal and basic periodontal therapies on the efficacy and inflammatory response in patients with pulpal-periodontal disease. Methods: Clinical data of 103 patients with combined periodontal-endodontic lesions were retrospectively analyzed. The patients were divided into a control group (n=50, treated with conventional root canal therapy) and an observation group (n=53, treated with root canal and basic periodontal therapies). The clinical efficacy after treatment, as well as the probing pocket depth (PD), periodontal indices, inflammatory factors release, and pain level (visual analogue scale) before and after treatment were compared between the two groups. The status of diseased teeth and adverse reactions after treatment were recorded. Results: After 1 month of treatment, the observation group had lower incidences of loosening of teeth, periodontitis and total adverse reactions, as well as higher tooth retention rate and effective rate as compared with the control group (all $P < 0.05$). The PD, BI, PLI, GI and serum levels of interleukin-6 (IL-6) and interleukin-1 β (IL-1 β) all decreased in both groups after 1 month of treatment, and the decreases were more in the observation group than those in the control group (all $P < 0.05$). Compared with before treatment, scores of visual analogue scale decreased in both groups 48 hours after the drug was sealed and 1 month after treatment, and the decreases were more in the observation group than those in the control group (all $P < 0.05$). Conclusion: Root canal and basic periodontal therapies can significantly reduce the pain, control the progression of oral inflammation, improve periodontal health and increase the retention rate of affected teeth in patients with combined periodontal-endodontic lesions, showing safety and efficacy.

Keywords: Combined periodontal-endodontic lesions, root canal therapy, basic periodontal therapy, efficacy, inflammatory response

Introduction

Combined periodontal-endodontic lesions refer to lesions in both pulp and periodontal tissues of the same tooth. Products of inflammation such as bacteria and toxins can impact on periodontal tissue through lateral canal or dentinal tubule and damage the periodontal ligament and alveolar bone. On the one hand, the disease has periodontal tissue lesions, such as deep periodontal pockets, extensive gingival redness and pus. On the other hand, because of deep caries, tooth fold or deep wedge-shaped defects, the pulp lesions may occur and lead to apical tissue inflammation [1].

Combined periodontal-endodontic lesions have a long onset of cycle and complicated etiology, and are difficult to treat and affect the quality of life of patients. In recent years, the incidence of combined periodontal-endodontic lesions have gradually increased, which is closely related to people's weak awareness of tooth protection and eating habits [2]. The pathogenesis of this disease is complex. Secondary pulp lesions developed from periodontal disease are one of the important causes [3]. Drainage through or incision drainage from the periodontal pocket and local drug dressing can control the inflammatory response to a certain extent. After the control of inflammation, pulp treatment is nec-

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essary to be carried out with the periodontal treatment. In addition, periodontal flap surgery should be performed when necessary for complete debridement [4]. Root canal therapy can completely remove the source of infection in the root canal and promote the healing around the root tip, but with a poor efficacy. Pathogenic microbial infection is one of the main factors causing periodontitis and pulpitis, and timely removal of pathogenic microorganisms can help control the progress of inflammation [5]. Since the occurrence of the disease is related to periodontal disease, periodontal basic treatments such as subgingival scaling and root planning can more effectively remove the cementum lesions, so as to completely remove the source of infection and improve the treatment efficacy [6]. Therefore, this study explored the efficacy of root canal and basic periodontal therapies on combined periodontal-endodontic lesions and analyzed their effect on the body's inflammatory response.

Materials and methods

General data

Clinical data of 103 patients with combined periodontal-endodontic lesions in our hospital from January 2019 to January 2020 were retrospectively analyzed. Patients were divided into a control group (n=50, treated with conventional root canal therapy) and an observation group (n=53, treated with root canal and basic periodontal therapies) according to the treatment methods. Patients were included if they had complete relevant clinical data, met the diagnostic criteria for combined periodontal-endodontic lesions according to *Standardized diagnosis and treatment of combined periodontal-endodontic lesions*, had obvious symptoms of periodontitis and pulpitis, and were aged 35 to 70 years old [7]. Patients were excluded if they had other oral diseases, received antimicrobial therapy within 1 month before our treatment, had severe hypertension, diabetes, malignant tumors or other serious medical diseases, were allergic to our study drugs, or were participating in another research project. The study was approved by the Medical Ethics Committee of our hospital (approval No. K2018-12-002).

Methods

Patients in the control group were given conventional root canal therapy. Firstly, the pulp

was opened after local anesthesia to measure the length of the root canal, and corresponding root canal was prepared. Secondly, the oral cavity was washed repeatedly with 0.9% sodium chloride injection to thoroughly clean the necroses in the root canal. Routine disinfection was then performed, and the root canal was wiped clean. Lastly, gutta percha point and paste were used as filler to fill the root canal. The filling process was conducted with assistant X-ray to ensure a promising result. The observation group received additional basic periodontal therapy [8]. Firstly, supragingival cleansing, subgingival scaling and root planning, etc. were carried out. Supragingival cleansing refers to use cleansers to remove dental calculus and plaque on the gingival and to polish the tooth surface, so as to delay plaque and dental calculus redeposition and reduce tooth sensitivity after cleaning. Subgingival scaling is to clean the dental calculus, subgingival plaque and inflammatory granulation tissue in the periodontal pocket underneath the gingiva. A spoon shaped scaler with fine precision was used to enter the periodontal pocket and scrape away the plaque and dental calculus deep in the periodontal pocket, so as to eliminate subgingival inflammation and recover the attachment of the gingiva. Root planning is to continue to scrape away the diseased tissue and remaining calculus plaque on the root surface, so that the gingiva can reattach to the root, the periodontal pockets disappear, and the inflammatory tissue on the root surface is removed. Secondly, the root surface was explored with a curved probe to ensure that the surface was smooth and that the tarts were not missed. Lastly, 0.9% sodium chloride injection was used to repeatedly wash the teeth after scaling, and routine antibiotics were used to prevent infection. After operation, the teeth were still sensitive in days, so over hot, cold, sour or sweet food should be avoided. The two groups of patients were disseminated about oral hygiene knowledge and asked for reexamination in one month.

Outcome measures

There were 4 main outcome measures. (1) The clinical efficacy was evaluated after one month of treatment according to the *Standardized Diagnosis and Treatment of Combined periodontal-endodontic lesions* [7]. It was seen as effective if the patients had no clinical symptoms of periodontitis and pulpitis, successful

reconstruction of alveolar bone shown in X-ray image, no apical translucency lesions, no loosened tooth and (mostly) recovered periodontal pockets. It was seen as improved if the patients had improved clinical symptoms, increased density of alveolar bone, and reduced apical translucency lesions, looseness of teeth and depth of the periodontal pockets. It was seen as ineffective if the patients did not meet the above criteria. Overall response rate = (case of effective + case of improved)/total number of cases *100%. (2) The changes of the probing pocket depth (PD) before and 1 month after treatment were compared between the two groups. PD refers to the distance from the gingival margin to the pocket base or the bottom of the gingival sulcus. The physician used a periodontal probe (modified pen grip) for the detection, with the surface of the adjacent teeth or the lip at the proximal incisor edge of the mouth as the fulcrum and a probing force of about 20-25 g. The probe should be parallel to the long axis of the teeth. (3) The changes in periodontal indices before and 1 month after treatment were compared between the two groups [9]. The periodontal indices including Mazza bleeding index (BI), plaque index (PLI) and gingival index (GI). BI was evaluated with a total score of 5 points: 0 point: gingival margin and papillae gingiva looked healthy, no bleeding after light probing at the gingival sulcus; 1 point: gingival margin and gingival papilla showed mild inflammation, and no bleeding was found after light probing at the gingival sulcus; 2 points: the gingiva showed mild inflammation, color change, no swelling or edema, with dotted hemorrhage after probing; 3 points: gingiva showed moderate inflammation, color change and mild edema, with blood showing in the gingiva sulcus after probing; 4 points: gingiva showed severe inflammation, color change, obvious swelling, with blood spilling over the gingival sulcus after probing; 5 points: gingiva showed color change, marked swelling and sometimes ulceration, with self-bleeding or bleeding after probing. PLI was evaluated with a total score of 3 points: 0 point: there was no plaque in gingival margin; 1 point: there was a thin layer of plaque on the gingival margin, but it was only visible when tooth surface was scraped with the tip of the probe; 2 points: there was moderate amount of plaque at or adjacent to the gingival margin; 3 points: there was a lot of soft scale in the sulcus or gingival

margin area and adjacent surface. GI was evaluated with a total score of 3 points: 0 point: the gingiva was healthy; 1 point: the gingiva showed mild inflammation, slight changes in gingival color and mild edema, no bleeding after probing; 2 points: the gingiva showed moderate inflammation and looked red, with edema and bleeding after probing; 3 points: the gingiva showed severe inflammation and looked marked red, with swelling, ulceration and a tendency of self-bleeding. For the 3 indicators above, higher score indicates more serious periodontal bleeding, dental plaque, or periodontitis, respectively. (4) The concentrations of inflammatory factors were compared before and 1 month after treatment. About 5mL of fasting venous blood was collected and separated for serum after centrifugation. The serum levels of interleukin-6 (IL-6) and interleukin-1 β (IL-1 β) were examined by Elisa.

There were 3 secondary outcome measures. (1) The visual analogue scale (VAS) was used to assess the pain level of the two groups of patients before treatment, 48 hours after the drug was sealed and 1 month after treatment [10]. The VAS was scored from 0-10, and higher score indicates severer pain. (2) The conditions of teeth after treatment, such as loosening of teeth, percussion pain, periodontitis and tooth retention, were compared between the two groups. (3) The incidence of adverse reactions, such as periodontal swelling pain and local foreign body sensation, was compared between the two groups.

Statistical analyses

SPSS 20.0 was used for data processing. The count data were expressed as (n, %) and processed using χ^2 test. The measurement data conforming to the normal distribution were represented by ($\bar{x} \pm sd$) and were compared before and after treatment within the group by paired t test, between the two groups by independent sample t test. A difference of $P < 0.05$ was considered statistically significant.

Results

Baseline data

There was no significant difference in general data between the two groups (all $P > 0.05$), so the two groups were comparable. See **Table 1**.

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Table 1. Baseline data of two groups of patients (n, $\bar{x}\pm s$)

	Observation group (n=53)	Control group (n=50)	t/ χ^2	P
Sex (n)			0.104	0.747
Male	25	22		
Female	28	28		
Age (years old)	44.4 \pm 4.9	45.1 \pm 5.2	0.702	0.484
Type of lesion (n)			0.033	0.855
Primary	20	18		
Secondary	33	32		
Course of disease (years)	3.38 \pm 1.02	3.73 \pm 1.27	1.536	0.128

and 2 cases of ineffective, with a total effective rate of 96.23%. The control group showed 20 cases of effective, 22 cases of improved and 8 cases of ineffective, with a total effective rate of 84.00%. The effective rate was higher in the observation group than in the control group ($P<0.05$). See **Figure 1**.

Changes in PD

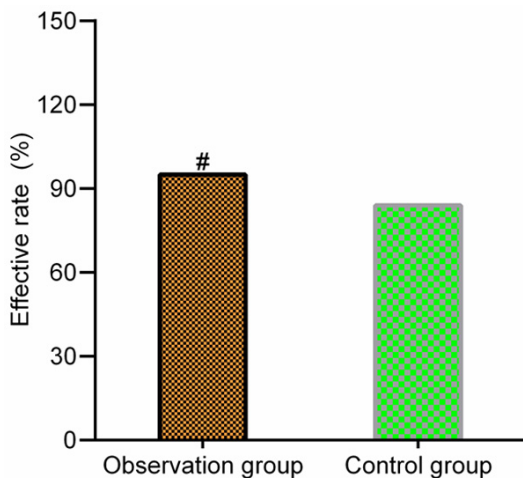


Figure 1. Comparison of clinical efficacy between two groups. Compared with control group, # $P<0.05$.

The PD before treatment was (6.50 \pm 1.20) mm in the observation group and (6.24 \pm 1.04) mm in the control group. After 1 month of treatment, the PD was (2.88 \pm 0.91) mm and (3.55 \pm 1.13) mm, respectively. The PD decreased in both groups after 1 month of treatment, and the decrease was more in the observation group than that in the control group (all $P<0.05$). See **Figure 2**.

Periodontal indices

After treatment, the BI, PLI and GI decreased in both groups, and the decreases were more significant in the observation group than in the control group (all $P<0.05$). See **Table 2**.

Inflammatory factors

After treatment, the serum levels of IL-6 and IL-1 β decreased in both groups, and the decreases were more in the observation group than that in the control group (all $P<0.05$). See **Table 3**.

VAS score

Compared with before treatment, the VAS scores 48 hours after the drug was sealed and one month after treatment were significantly decreased, and the decreases were more in the observation group than in control group. (All $P<0.05$). See **Table 4**.

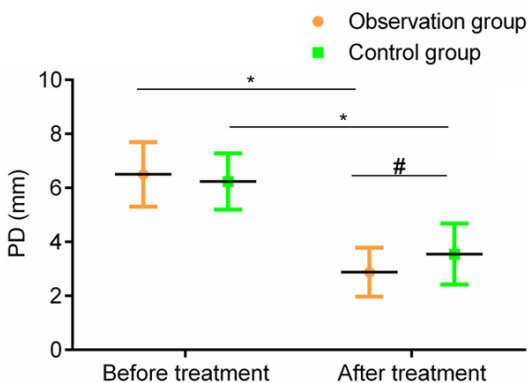


Figure 2. Comparison of PD before and after treatment between the two groups. Compared with before treatment, * $P<0.05$; compared with control group, # $P<0.05$. PD: probing pocket depth.

Condition of affected teeth after treatment

After 1 month of treatment, the observation group had 1 case of loosening of teeth, 2 cases of percussion pain, 1 case of periodontitis and 51 cases of tooth retention. The control group had 7 cases of loosening of teeth, 5 cases of percussion pain, 7 cases of periodontitis and 42 cases of tooth retention. The obser-

Clinical efficacy

After treatment, the observation group showed 26 cases of effective, 25 cases of improved

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Table 2. Changes in periodontal indices in the two groups before and after treatment ($\bar{x} \pm sd$, points)

Group	BI		PLI		GI	
	Before treatment	1 month after treatment	Before treatment	1 month after treatment	Before treatment	1 month after treatment
Observation group (n=53)	3.90±0.94	1.48±0.38*	2.04±0.88	1.02±0.42*	2.19±0.50	0.90±0.29*
Control group (n=50)	3.87±0.93	2.15±0.88*	2.10±0.79	1.66±0.70*	2.10±0.44	1.41±0.36*
t	0.163	4.964	0.365	5.585	0.971	7.889
P	0.871	<0.001	0.716	<0.001	0.338	<0.001

Note: Compared with before treatment, *P<0.05.

Table 3. Comparison of the levels of inflammatory factors between the two groups before and after treatment ($\bar{x} \pm sd$, ng/L)

Group	IL-6		IL-1 β	
	Before treatment	1 month after treatment	Before treatment	1 month after treatment
Observation group (n=53)	7.03±1.11	2.11±0.94*	7.85±1.27	2.99±1.03*
Control group (n=50)	7.10±1.27	3.98±1.03*	8.01±1.30	4.10±1.02*
t	0.297	9.607	0.631	5.494
P	0.767	<0.001	0.529	<0.001

Note: Compared with before treatment, *P<0.05.

Table 4. Comparison of VAS scores before and after treatment between the two groups ($\bar{x} \pm sd$, point)

Group	Before treatment	At drug sealing	48 h after sealing	1 month after treatment
Observation group (n=53)	4.04±0.97	3.88±0.76	1.98±0.89*	1.24±0.34*
Control group (n=50)	4.26±0.79	4.01±0.91	2.44±0.70*	1.40±0.40*
t	1.258	0.789	2.904	2.191
P	0.211	0.432	0.005	0.031

Note: Compared with before treatment, *P<0.05. VAS: visual analogue scale.

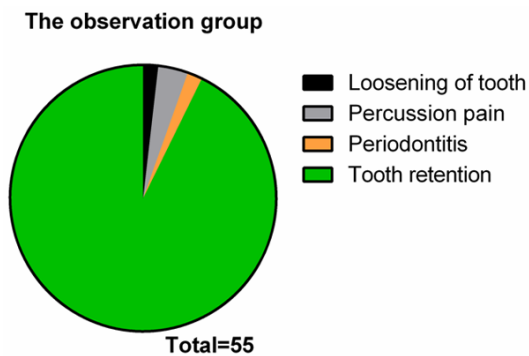


Figure 3. Condition of affected teeth in the observation group.

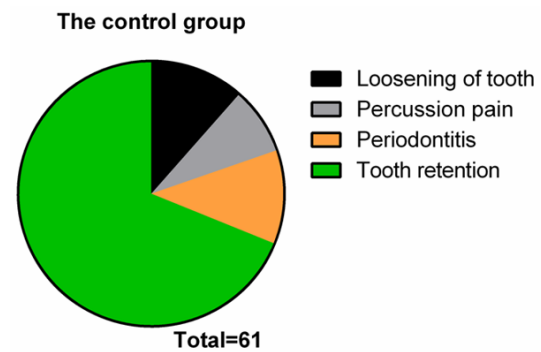


Figure 4. Condition of affected teeth in the control group.

observation group showed lower incidences of loosening of teeth and periodontitis ($\chi^2=5.270$, $P=0.022$) as well as higher tooth retention rate ($\chi^2=4.387$, $P=0.036$) as compared with the control group. See **Figures 3, 4**.

Adverse reactions

The incidence of total adverse reactions in the observation group was lower than that in the control group ($P<0.05$). See **Table 5**.

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Table 5. Comparison of the incidences of adverse reactions between the two groups (n, %)

Group	Periodontal swelling pain	Local foreign body sensation	Total incidence
Observation group (n=53)	2 (3.77)	1 (1.89)	3 (5.66)
Control group (n=50)	5 (10.00)	5 (10.00)	10 (20.00)
χ^2	1.575	3.087	4.797
P	0.210	0.079	0.029

Discussion

Both periodontitis and pulpitis are common oral diseases. They affect each other in combined periodontal-endodontic lesions, increase the difficulty of treatment and the relapse rate. Necrotizing inflammation and tooth loss can happen in severe cases without timely treatment [11]. Root canal therapy is commonly used for this disease, because it removes a wide range of root canal infection sources and promotes the healing of lesions, but some patients showed poor efficacy with the single therapy [12, 13].

Secondary pulpal disease caused by periodontal disease is one of the important factors leading to the occurrence of the disease. Therefore, complete elimination of the source of infection and active treatment of pulpal and periodontal diseases are the main treatment principles for the disease [14]. Verrusio et al. found that reasonable periodontal treatment could increase the tooth retention rate of patients [15]. Supragingival cleansing, subgingival scaling and root planning are the main measures of basic periodontal treatment, which effectively remove plaque microorganisms and tartar on root surface, control the source of infection, promote the reconstruction of periodontal tissues and improve periodontal health [16, 17]. The results of this study showed that compared with before treatment, the VAS scores 48 hours after the drug was sealed and were significantly decreased one month after treatment, and the decreases were more significant in the observation group than in control group. In addition, the observation group showed lower PD, BI, PLI and GI after 1 month of treatment and higher efficiency (96.23% vs. 84.00%) as compared with the control group. It is suggested that root canal and basic periodontal therapies can more significantly reduce the pain, as well as improve periodontal health and overall efficacy in patients with combined periodontal-endodontic

lesions. Monje et al. found that root canal and basic periodontal therapies were better than single root canal therapy in improving periodontal indices in patients with combined periodontal-endodontic lesions, which is consistent with the results of this study [18]. Possible reasons are as follows: after chemical and mechanical preparation, the possible infection source in the root canal can be effectively eliminated. The subsequent filling of the root canal can prevent further periapical lesions. Moreover, basic periodontal therapy can remove the calculus, plaque microbial membrane and diseased cementum to the maximum extent. The combination of the two can then eliminate the pathogenic factors and inhibit the progression of the disease.

IL-6 is a multifunctional cytokine that can accumulate and activate inflammatory cells, promote mass release of tumor necrosis factor α and other inflammatory mediators, and aggravate periodontitis and pulpitis inflammation [19, 20]. IL-1 β is a specific index for inflammatory response in acute phase, which promotes the proliferation and activation of lymphocytes, stimulates the expression of adhesion molecules, and further aggravates the inflammatory response [21]. Root canal therapy prepares root canal *via* mechanical method to remove pathogenic microorganisms in the root canal, and then filling the root canal to prevent periapical lesions and promote its healing [22]. Supragingival cleansing and subgingival scaling are commonly used basic dental treatments. However, after subgingival scaling, the surface of the root is rough and uneven, which is easy to cause the formation of plaque and calculus on the root surface. Root planning is then used to smooth the root surface by continuing to scrape the lesioned tissue and remove the remaining calculus plaque, so that the gingiva can re-attach to the root, the periodontal pockets are gone, and the inflammatory tissue on the root surface is removed. Therefore, supragingival cleansing, subgingival

scaling and root planning can effectively eliminate plaque microbial membrane and tartar on root surface, remove diseased cementum, thereby reducing inflammation and controlling disease progression [23, 24]. The results of this study showed that the serum levels of IL-6 and IL-1 β decreased in both groups after treatment, and the observation group showed more decreases than the control group. It is suggested that root canal and basic periodontal therapies can more significantly control oral inflammation response and inhibit the progression of inflammatory response in patients with combined periodontal-endodontic lesions, which is consistent with the results of Manresa et al. [25]. This study also found that after 1 month of treatment, the observation group had lower incidences of loosening of teeth and periodontitis, lower incidence of total adverse reactions and higher tooth retention rate as compared with the control group. It is suggested that root canal and basic periodontal therapies can more obviously improve the tooth condition and lead to fewer adverse reactions in patients with combined periodontal-endodontic lesions. However, this is a single-center study with limited sample size and short follow-up time. Therefore, a multi-center large sample study may still be needed in the future.

In conclusion, root canal and basic periodontal therapies can significantly reduce the pain, control the progression of oral inflammation, improve periodontal health and increase the retention rate of affected teeth in patients with combined periodontal-endodontic lesions, which are safe and efficient for the combined therapies.

Disclosure of conflict of interest

None.

Address correspondence to: Yunqi Lin, Department of Head and Neck Surgery, Shengli Clinical Medical College of Fujian Medical University, Fujian Provincial Hospital, No. 134 East Street, Gulou District, Fuzhou 350001, Fujian Province, China. Tel: +86-0591-88217120; E-mail: 1472669253@qq.com

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