

Effects of periodontal initial therapy combined with orthodontic treatment on anterior tooth function and inflammatory factors in gingival crevicular fluid in patients with periodontal disease induced anterior tooth displacement

Yan Liu¹, Xie Shi²,
Gengbing Lin³, Nan Guo⁴

ABSTRACT

Objective: To evaluate the effects of periodontal initial therapy combined with orthodontic treatment on anterior tooth function and inflammatory factors in gingival crevicular fluid in patients with periodontal disease induced anterior tooth displacement.

Methods: This was a clinical comparative study. A total of 140 patients with anterior teeth displacement caused by periodontal disease in Fujian University of Traditional Chinese Medicine from May 2020 to May 2022 were selected and randomly divided into two groups. Patients in the control group received periodontal initial therapy, and those in the study group were provided with orthodontic treatment on the basis of initial therapy. Further comparative analysis was performed focusing on the clinical effects of the two groups, the changes of probing depth, anterior overjet degree, oral function and inflammatory factors in gingival crevicular fluid before and after treatment.

Results: The efficacy of the study group was significantly higher than that of the control group ($p=0.00$). After treatment, the probing depth, the anterior overjet degree and the rate of bleeding on probing in the study group were significantly lower than those in the control group ($P=0.00$). Furthermore, the proportion of tooth mobility degrees I, II and III in the study group was significantly lower than that in the control group after treatment ($P<0.05$). The levels of post-treatment inflammatory factors in the study group were significantly lower than those in the control group ($p=0.00$).

Conclusion: Periodontal initial therapy combined with orthodontic treatment has a significant effect on anterior teeth displacement caused by periodontal disease, which deserves promotion clinically.

KEYWORDS: Periodontal initial therapy, Orthodontics, Periodontal disease, Anterior tooth displacement.

doi: <https://doi.org/10.12669/pjms.39.6.7135>

How to cite this: Liu Y, Shi X, Lin G, Guo N. Effects of periodontal initial therapy combined with orthodontic treatment on anterior tooth function and inflammatory factors in gingival crevicular fluid in patients with periodontal disease induced anterior tooth displacement. *Pak J Med Sci.* 2023;39(6):1620-1625. doi: <https://doi.org/10.12669/pjms.39.6.7135>

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

It has a serious impact on the gingiva and periodontal tissue of patients. Periodontitis is the most common periodontal disease, and it has been confirmed by multiple clinical studies that its onset is related to bacterial infection.^{1,2} It is a chronic inflammatory oral disease in which pathogenic bacteria invade periodontal supporting structure and cause periodontal tissue destruction. The destruction of periodontal tissue is mainly caused by excessive host response to produce cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor (TNF)- α .^{3,4} It plays an extremely important role in chronic inflammatory reactions such as periodontitis; and it can act on immune cells to induce tissue destruction and bone absorption.⁵

Periodontal initial therapy has been considered as an important therapeutic option for periodontitis and is widely used clinically. As suggested by Manresa et

Note: Yan Liu and Xie Shi are both considered as first author.

Correspondence:

Nan Guo,
Department of Stomatology,
Fujian Provincial People's Hospital,
Affiliated People's Hospital of Fujian University
of Traditional Chinese Medicine,
No.602, 817 Middle Road,
Fuzhou 350005,
Fujian, China.
Email: fz_implant@126.com

- * Received for Publication: September 16, 2022
- * 1st Revision Received: February 21, 2023
- * 2nd Revision Received: July 31, 2023
- * Final Revision Accepted: * August 5, 2023

al.⁶, after the completion of periodontal initial therapy and the cessation of inflammation, further supportive periodontal treatment should be adopted to reduce the possibility of reinfection and disease progression. At present, there is a continuous development of orthodontic treatment technology, which provides a new direction for the treatment of anterior tooth displacement caused by periodontal disease. Our objective was to evaluate the effects of periodontal initial therapy combined with orthodontic treatment which was applied to treat patients with anterior tooth displacement caused by periodontal disease.

METHODS

This was a clinical comparative study. A total of 140 patients with anterior teeth displacement caused by periodontal disease who were admitted to Fujian University of Traditional Chinese Medicine from May 2020 to May 2022 were selected and randomly divided into two groups, with 70 cases in each group. There was no significant difference in general data between the two groups, suggesting the comparability between groups (Table-I).

Ethical Approval: The study was approved by the Institutional Ethics Committee of Affiliated People's Hospital of Fujian University of Traditional Chinese Medicine (No: 202287; Date: December 09, 2021), and written informed consent was obtained from all

participants.

Inclusion criteria:

- Patients who met the diagnostic criteria for periodontal disease;⁷
- Patients with displacement of anterior teeth, protrusion of anterior teeth, widening of interdental space or loose teeth;
- Patients who were sensitive to initial treatment of periodontal disease and showed improvement after treatment;
- Patients with complete medical history and high compliance;
- Patients who agreed to the study protocol and signed the consent form by themselves or their families.

Exclusion criteria:

- Patients with cognitive dysfunction or mental diseases;
- Patients with poor oral hygiene habits;
- Patients with hyperthyroidism, diabetes, tuberculosis, coagulation dysfunction, etc.;
- Patients with severe heart, liver and kidney dysfunction;
- Patients with severe malnutrition.

Patients in the control group received periodontal initial therapy, including oral hygiene, supragingival scaling and subgingival scaling. Meanwhile, the residual calculus in the periodontal pocket was removed

Table-I: Comparison of general data between the study group and the control group ($\bar{x}\pm s$).

| Indexes | Study group(n=70) | Control group(n=70) | t/c ² | P |
|--------------------------------|-------------------|---------------------|------------------|------|
| Age(years) | 41.50±8.26 | 42.02±8.31 | 0.37 | 0.71 |
| Male(n %) | 34(48.6%) | 42(60%) | 1.84 | 0.18 |
| Course of disease(d) | 5.73±1.68 | 5.58±1.43 | 0.59 | 0.57 |
| BMI(kg/m ²) | 25.36±4.32 | 25.82±4.30 | 0.64 | 0.53 |
| Complication | | | | |
| Dental caries | 42(60%) | 40(57%) | 0.12 | 0.73 |
| Pulpitis | 15(21.4%) | 17(24.3%) | 0.16 | 0.69 |
| Dental trauma | 9(12.9%) | 8(11.4%) | 0.06 | 0.80 |
| Opsigenes | 4(6%) | 5(7%) | 0.12 | 0.73 |
| Bad habits | | | | |
| Smoking history | 36(51.4%) | 38(54.3%) | 0.11 | 0.74 |
| Fond of uncooked and cold food | 22(31.4%) | 30(42.9%) | 1.96 | 0.16 |
| High-fat diet | 26(37.1%) | 21(30%) | 0.81 | 0.37 |
| Previous treatment | | | | |
| Root canal therapy | 20(28.6%) | 23(32.9%) | 0.30 | 0.58 |
| Repair of tooth defect | 32(45.7%) | 34(48.6%) | 0.11 | 0.74 |

P>0.05.

Table-II: Comparative analysis of clinical effect between the two groups ($\bar{x}\pm S$).

| Groups | Significant effective | Effective | Ineffective | Effective rate |
|---------------------|-----------------------|-----------|-------------|----------------|
| Study group(n=70) | 61 | 4 | 5 | 65(92.8%) |
| Control group(n=70) | 10 | 24 | 36 | 34(48.5%) |
| χ^2 | | | | 33.41 |
| P | | | | 0.00 |

p<0.05.

postoperatively to make the gums and tooth surfaces fit. Patients in the study group were provided continuously with orthodontic treatment on the basis of the treatment in the control group. The specific method was to implement orthodontic treatment when the periodontal symptoms were significantly improved and stabilized. The edgewise appliance was used for correction, with the adjustment of the orthodontic force properly to keep an appropriate strength. The orthodontic treatment lasted generally 6-12 months. After orthodontic treatment, patients were instructed to wear bite guard to reduce the recurrence of anterior tooth displacement.

Outcome measures:

Clinical effects: Significant effective: restoration of the anterior teeth to a beautiful appearance, normal masticatory function and the tooth mobility degree of below Grade-I, and disappearance of periodontitis symptoms. Effective: restoration of the anterior teeth to a beautiful appearance, the tooth mobility degree of Grade-I~II, and disappearance of periodontitis symptoms to some extent. Ineffective: no improvement of the anterior tooth displacement, weak teeth, the tooth mobility degree of Grade-I~II, and obvious periodontitis symptoms. The effective rate=(cases of significant effective+effective)/100.

Periodontal tissue recovery: Including probing depth, anterior overjet degree, alveolar bone height, and rate of bleeding on probing.

The tooth mobility degree was observed. Before treatment and 12 months after treatment, dental function was compared by the Behavioral Assessment Scale of Oral Functions prepared by Stratton.⁸ A higher score might indicate a better functional status.

Inflammatory factors in gingival crevicular fluid: The levels of inflammatory factors such as TNF- α and IL-6 were detected by enzyme-linked immunosorbent assay(ELISA) in the venous blood samples collected from the enrolled patients.

Statistical analysis: All data of this study were statistically analyzed with SPSS 20.0 software, and the measurement data were expressed in ($\bar{x}\pm S$). Two independent sample t-test was used for inter-group data analysis, paired t-test for intra-group data analysis, and χ^2 test for rate comparison. The confidence interval is 95%. P<0.05 was considered to indicate a statistically significant difference.

RESULTS

The efficacy of the study group was significantly higher than that of the control group(p=0.00) (Table-II). After treatment, the probing depth, the anterior overjet degree and the rate of bleeding on probing in the study group were significantly lower than those in the control group(P=0.00) (Table-III). The proportion of tooth mobility degrees I, II and III in the study group was significantly lower than that in the control

Table-III: Comparative analysis of periodontal tissue recovery between the two groups($\bar{x}\pm S$).

| Outcome measures | | Study group(n=70) | Control group(n=70) | t/ χ^2 | p |
|---------------------------------|------------------|-------------------|---------------------|-------------|------|
| Probing depth(mm) | Before treatment | 5.73 \pm 1.20 | 5.68 \pm 1.13 | 0.25 | 0.80 |
| | After treatment* | 3.78 \pm 1.04 | 4.63 \pm 1.25 | 4.37 | 0.00 |
| Anterior overjet degree(mm) | Before treatment | 5.27 \pm 2.06 | 5.18 \pm 2.03 | 0.26 | 0.78 |
| | After treatment* | 2.36 \pm 1.87 | 4.03 \pm 2.34 | 4.66 | 0.00 |
| Alveolar bone height(mm) | Before treatment | 5.17 \pm 0.46 | 5.13 \pm 0.38 | 0.56 | 0.58 |
| | After treatment* | 5.03 \pm 0.44 | 5.12 \pm 0.28 | 1.44 | 0.15 |
| Rate of bleeding on probing (%) | Before treatment | 87% | 85% | 0.16 | 0.68 |
| | After treatment* | 7% | 21% | 8.14 | 0.00 |

P>0.05.

Table-IV: Comparative analysis of tooth mobility between the two groups before and after treatment ($\bar{x}\pm S$).

| Outcome measures | | Study group(n=70) | Control group(n=70) | t/c ² | p |
|------------------|------------------|-------------------|---------------------|------------------|------|
| Degree I | Before treatment | 16(22.8%) | 18(25.7%) | 0.24 | 0.62 |
| | After treatment* | 0 | 11(15.7%) | 11.64 | 0.00 |
| Degree II | Before treatment | 41(58.5%) | 40(57.1%) | 0.08 | 0.77 |
| | After treatment* | 2(2.9%) | 16(22.9%) | 17.68 | 0.00 |
| Degree III | Before treatment | 13(18.7%) | 12(17.2%) | 0.14 | 0.71 |
| | After treatment* | 3(4.3%) | 9(12.9%) | 5.21 | 0.02 |

*p<0.05.

group after treatment (degrees I and II, p=0.00; degree III, p=0.02) (Table-IV).

After treatment, the masticatory function, fixation, aesthetics and comfort of the study group were significantly better than those of the control

group(P=0.00) (Table-V). After treatment, TNF- α and IL-6 in both groups were lower than those before treatment(p=0.00). Besides, the post-treatment levels of TNF- α and IL-6 in the study group were significantly lower than those in the control group(p=0.00) (Table-VI).

Table-V: Comparative analysis of oral function between the two groups before and after treatment ($\bar{x}\pm S$).

| Outcome measures | | Study group(n=70) | Control group(n=70) | t | p |
|----------------------|------------------|-------------------|---------------------|------|------|
| Masticatory function | Before treatment | 2.62 \pm 0.36 | 2.73 \pm 0.41 | 1.68 | 0.09 |
| | After treatment* | 4.33 \pm 0.52 | 3.47 \pm 0.53 | 9.69 | 0.00 |
| Fixation | Before treatment | 2.31 \pm 0.50 | 2.34 \pm 0.28 | 0.44 | 0.65 |
| | After treatment* | 3.12 \pm 0.48 | 2.63 \pm 0.62 | 5.23 | 0.00 |
| Aesthetics | Before treatment | 2.85 \pm 0.46 | 2.79 \pm 0.42 | 0.81 | 0.42 |
| | After treatment* | 4.43 \pm 0.32 | 3.85 \pm 0.77 | 5.82 | 0.00 |
| Comfort | Before treatment | 2.63 \pm 0.51 | 2.60 \pm 0.46 | 0.37 | 0.72 |
| | After treatment* | 3.75 \pm 0.68 | 3.18 \pm 0.53 | 5.53 | 0.00 |

p>0.05.

Table-VI: Comparative analysis of changes in inflammatory factors between the two groups before and after treatment ($\bar{x}\pm S$).

| Indicators | | Study group*(n=70) | Control group*(n=70) | t | p |
|----------------------|------------------|--------------------|----------------------|-------|------|
| TNF- α (ng/L) | Before treatment | 28.03 \pm 6.33 | 27.82 \pm 7.02 | 0.58 | 0.42 |
| | After treatment* | 14.36 \pm 3.71 | 23.48 \pm 3.63 | 15.10 | 0.00 |
| | t | 17.46 | 14.28 | | |
| | p | 0.00 | 0.00 | | |
| IL-6(ng/L) | Before treatment | 11.56 \pm 2.37 | 11.35 \pm 2.54 | 0.38 | 0.62 |
| | After treatment* | 6.73 \pm 1.75 | 8.81 \pm 2.28 | 3.74 | 0.00 |
| | t | 14.37 | 11.60 | | |
| | p | 0.00 | 0.00 | | |

*p<0.05.

DISCUSSION

In our study, the efficacy of periodontal initial therapy combined with orthodontic treatment was significantly higher than that of periodontal initial therapy alone, suggesting a significant effect of orthodontic treatment on anterior teeth displacement. And the probing depth, the anterior overjet degree and the rate of bleeding on probing of patients in the study group were significantly lower than those in the control group. It supports a reduced potential risk of traumatic occlusion and improved periodontal condition of the anterior teeth after restoration of the anterior teeth with orthodontic treatment. Generally, orthodontic treatment is based on the slow reconstruction of alveolar bone around the root. Therefore, it is important to follow the correct biological force during orthodontic treatment to strengthen the teeth and reduce the degree of root absorption.⁹

In our study, there was an improvement in tooth mobility to certain extent in patients. Our study indicated that the proportion of tooth mobility degrees I, II and III in the study group was significantly lower than that in the control group after treatment. Simultaneously, the post-treatment masticatory function, fixation, aesthetics and comfort of the study group were evidently better than those of the control group. All these findings suggest that there will be obvious changes of periodontal tissue and alveolar bone after orthodontic treatment than that before treatment, which creates beneficial conditions for periodontal tissue regeneration.

Periodontal disease is an oral disease that has a high incidence clinically. Periodontitis is the most common form that accounts for >95% of the total number of patients with periodontal disease.¹⁰ Its specific pathogenesis is related to immune system disorders and microbial infections. The main clinical symptoms of periodontitis are gingival inflammation, gingival bleeding, periodontal pocket formation, alveolar bone absorption, tooth loosening, etc. Tooth displacement can be induced by periodontal tissue destruction, bite force change, etc. Anterior tooth displacement is common in clinical practice, and in serious cases, it even shifts and falls off, which seriously affects the patients' normal life and interferes with the appearance.¹¹

Periodontal initial therapy has been regarded to be the basic treatment of periodontitis.¹² Periodontal initial therapy can effectively remove subgingival plaque calculus and diseased cementum, so as to keep the root surface smooth and prevent plaque reattachment.¹³ But it cannot fundamentally improve the oral condition of patients, especially those with loose teeth and displaced anterior teeth. Orthodontic treatment offers another feasible therapeutic option for treating the symptoms of anterior teeth displacement and tooth loosening caused by periodontal disease. It has been documented that after orthodontic treatment, periodontal tissue and

alveolar bone showed obvious changes compared with that before treatment, creating favorable conditions for periodontal tissue regeneration.¹⁴

According to previous research,^{15,16} periodontal infection has a mutual relationship with systemic diseases. Prior study has detected the significantly increased levels of IL-6, IL-8 and TNF- α in the serum and gingival crevicular fluid of patients with periodontitis.^{17,18} In our study, the levels of serum inflammatory factors IL-6 and TNF- α in the enrolled patients were improved after 12 months of treatment compared with those before treatment, with more significant decrease in the study group than those in the control group. As reported by Zasciurinskienė et al.¹⁹ orthodontic treatment has a significant effect on the periodontal status of periodontitis patients with dental plaque, and can obviously improve the probing depth. Verrusio et al.²⁰ also discovered in their research that periodontal indices increased after orthodontic treatment, accompanied by the accumulation and composition of subgingival microbiota, thus reducing inflammation and enhancing tooth firmness. Collectively, it is speculated that through orthodontic treatment, the impact of traumatic occlusion can be eliminated, and the gingival inflammation can be alleviated.

Limitations: It includes the smaller sample size and relatively shorter period of follow-up. Our future research will be continued based on the expanded sample size and prolonged period of follow-up, so as to elaborate the defects and long-term effects of the proposed treatment scheme comprehensively.

CONCLUSION

In conclusion, periodontal initial therapy combined with orthodontic treatment has a significant effect on anterior teeth displacement caused by periodontal disease, which deserves promotion clinically.

Source of funding: This study was sponsored by Fujian Provincial Educational Research Project for Young and Middle-aged Teachers (Science and Technology) (JAT210129); Special scientific research project of National Clinical Research Base of Traditional Chinese Medicine (No. JDZX201903); Fujian Medical Innovation Project of Fujian Provincial Health Commission (No. 2021CXA036); Fujian Natural Science Funds (No.2022J01766).

Conflicts of interest: None.

REFERENCES

1. Carrizales-Sepúlveda EF, Ordaz-Farías A, Vera-Pineda R, Flores-Ramirez R. Periodontal Disease, Systemic Inflammation and the Risk of Cardiovascular Disease. *Heart Lung Circ.* 2018;27(11):1327-1334. doi: 10.1016/j.hlc.2018.05.102
2. Wahid A, Chaudhry S, Ehsan A, Butt S, Ali Khan A. Bidirectional Relationship between Chronic Kidney Disease & Periodontal Disease. *Pak J Med Sci.* 2013;29(1):211-215. doi: 10.12669/pjms.291.2926

3. Nazir M, Al-Ansari A, Al-Khalifa K, Alhareky M, Gaffar B, Almas K. Global Prevalence of Periodontal Disease and Lack of Its Surveillance. *Sci World J.* 2020;2020:2146160. doi: 10.1155/2020/2146160
4. Czesnikiewicz-Guzik M, Osmenda G, Siedlinski M, Nosalski R, Pelka P, Nowakowski D, et al. Causal association between periodontitis and hypertension: evidence from Mendelian randomization and a randomized controlled trial of non-surgical periodontal therapy. *Eur Heart J.* 2019;40(42):3459-3470. doi: 10.1093/eurheartj/ehz646
5. John V, Alqallaf H, De Bedout T. Periodontal Disease and Systemic Diseases: An Update for the Clinician. *J Indiana Dent Assoc.* 2016;95(1):16-23.
6. Manresa C, Sanz-Miralles EC, Twigg J, Bravo M. Supportive periodontal therapy(SPT) for maintaining the dentition in adults treated for periodontitis. *Cochrane Database Syst Rev.* 2018;1(1):CD009376. doi: 10.1002/14651858.CD009376.pub2
7. Sedghi LM, Bacino M, Kapila YL. Periodontal Disease: The Good, The Bad, and The Unknown. *Front Cell Infect Microbiol.* 2021;11:766944. doi: 10.3389/fcimb.2021.766944
8. Beus C, Safavi K, Stratton J, Kaufman B. Comparison of the effect of two endodontic irrigation protocols on the elimination of bacteria from root canal system: a prospective, randomized clinical trial. *J Endod.* 2012;38(11):1479-1483. doi: 10.1016/j.joen.2012.07.005
9. Zhang B, Cai M, Ruan F, Chen Z. Study on the Effects of Orthodontics on Anterior Tooth Displacement in Patients. *Evid Based Complement Alternat Med.* 2022;2022:6544895. doi: 10.1155/2022/6544895
10. Guan J, Zhang D, Wang C. Identifying periodontitis risk factors through a retrospective analysis of 80 cases. *Pak J Med Sci.* 2022;38(1):293-296. doi: 10.12669/pjms.38.1.5205
11. Graziani F, Karapetsa D, Alonso B, Herrera D. Nonsurgical and surgical treatment of periodontitis: how many options for one disease? *Periodontol 2000.* 2017;75(1):152-188. doi: 10.1111/prd.12201
12. Suvan J, Leira Y, Moreno Sancho FM, Graziani F, Derks J, Tomasi C. Subgingival instrumentation for treatment of periodontitis. A systematic review. *J Clin Periodontol.* 2020;47 Suppl 22:155-175. doi: 10.1111/jcpe.13245
13. Huang YZ, Zhu YR, Yan Y. A retrospective study of orthodontic treatment on anterior tooth displacement caused by periodontal disease. *Medicine(Baltimore).* 2021;100(13):e25181. doi: 10.1097/MD.00000000000025181
14. Konermann A, Al-Malat R, Skupin J, Keilig L, Dirk C, Karanis R, et al. In vivo determination of tooth mobility after fixed orthodontic appliance therapy with a novel intraoral measurement device. *Clin Oral Investig.* 2017;21(4):1283-1289. doi: 10.1007/s00784-016-1881-5
15. Hou J, Qian Y, Ma G, Gao H, Yang J, Fan J. Effect of Orthodontic Treatment on Anterior Tooth Displacement in Patients with Periodontal Disease: A Meta-Analysis. *J Healthc Eng.* 2021;2021:8761215. doi: 10.1155/2021/8761215
16. Cardoso EM, Reis C, Manzanares-Cespedes MC. Chronic periodontitis, inflammatory cytokines, and interrelationship with other chronic diseases. *Postgrad Med.* 2018;130(1):98-104. doi: 10.1080/00325481.2018.1396876
17. Sridhar M, Sai Sankar AJ, Sankar KS, Kumar KK. Accidental displacement of primary anterior teeth following extraction of neonatal teeth. *J Indian Soc Pedod Prev Dent.* 2020;38(3):311-314. doi: 10.4103/JISPPD.JISPPD_48_20
18. Kaur S, Bansal Y, Kumar R, Bansal G. A panoramic review of IL-6: Structure, pathophysiological roles and inhibitors. *Bioorg Med Chem.* 2020;28(5):115327. doi: 10.1016/j.bmc.2020.115327
19. Zasiurinskienė E, Basevičienė N, Lindsten R, Slotte C, Jansson H, Bjerklind K. Orthodontic treatment simultaneous to or after periodontal cause-related treatment in periodontitis susceptible patients. Part I: Clinical outcome. A randomized clinical trial. *J Clin Periodontol.* 2018;45(2):213-224. doi: 10.1111/jcpe.12835
20. Verrusio C, Iorio-Siciliano V, Blasi A, Leuci S, Adamo D, Nicolo M. The effect of orthodontic treatment on periodontal tissue inflammation: A systematic review. *Quintessence Int.* 2018;49(1):69-77. doi: 10.3290/j.qi.a39225

Authors' Contributions:

YL and **NG**: Carried out the studies, participated in collecting data, drafted the manuscript, are responsible and accountable for the accuracy and integrity of the work.

GL: Performed the statistical analysis and participated in its design.

XS: Participated in acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript.

Authors:

1. Yan Liu
2. Xie Shi
Department of Orthodontics,
Fujian Key Laboratory of Oral Diseases &
Fujian Provincial Engineering Research Center of
Oral Biomaterial & Stomatological Key lab of
Fujian College and University,
School and Hospital of Stomatology,
Fujian Medical University & Institute of Stomatology,
Fujian Medical University,
Fuzhou 350002, Fujian, China.
3. Gengbing Lin
4. Nan Guo
- 1,3,4: Department of Stomatology,
Fujian Provincial People's Hospital,
Affiliated People's Hospital of Fujian University of
Traditional Chinese Medicine,
Fuzhou 350005,
Fujian, China.