

Effects of combining CBCT technology with visual root canal recurrence in treatment of elderly patients with dental pulp disease

J.-J. CUI, B. PENG, W. LIN

Department of Endodontics, Hospital of Stomatology, Wuhan University, Hongshan District, Wuhan, Hubei, China

Abstract. – OBJECTIVE: The aim of this study is to analyze the effects of combining cone beam computed tomography (CBCT) technology with visual root canal recurrence in the treatment of elderly patients with dental pulp disease.

PATIENTS AND METHODS: 56 cases of elderly patients with dental pulp disease were contiguously selected, and randomly divided into the control group (70 teeth from 27 patients) and the observation group (77 teeth from the rest 29 patients). We adopted CBCT technology combined with conventional root canal therapy in control group and CBCT technology combined with visual root canal recurrence in observation group to compare the clinical effects.

RESULTS: It was found that there was no statistical difference in duration of operation between the two groups ($p>0.05$). The operation times and the VAS during and after operation of the observation group were significantly less than that of the control group ($p<0.05$). The duration of follow-up of the two groups was both about 18 months. Successful rates of treatment for 6 months and by the end of follow-up visit in the observation group were both significantly higher than those in the control group ($p<0.05$). The correct filling rate, good filling rate and fair filling rate in the observation group were significantly higher than those of the control group ($p<0.05$).

CONCLUSIONS: CBCT technology combined with visual root canal recurrence can significantly improve the near and long-term treatment effects of elderly patients with dental pulp disease.

Key Words:

Cone beam computed tomography, Visual root canal recurrence, Dental pulp disease in the elderly.

Introduction

The incidence rate of dental pulp disease in the elderly is as high as about 15% to 30%; the

manifestations of the disease mainly include: toothache, cracked tooth, tooth wear, tooth fracture and tooth loss. It seriously influences patients' chewing and pronunciation function, and reduces their life quality. It is an important reason for oral infection¹. Studies have indicated that the incidence of the disease may also be related to chronic gastritis and Alzheimer's disease². The aims of treatment are mainly to preserve the teeth and restore function. Root canal recurrence is currently recognized as the most effective and thorough method³. But due to senile dental pulp disease has unique characteristics such as dental crown getting shorter, brittleness and increasing hardness of dental enamel, dentin exposure, gingival atrophy, calcium and deposition of minerals in dental pulp matrix, increasing smallness of the volume and even blocking of pulp cavity and root canal, distance of pulp chamber from the top to the bottom becoming smaller, medullary angle getting lower, root canal getting thinner, apical foramen getting narrower, etc. In such conditions, the effect of the treatment is often poor^{4,5}. Studies pointed out that the efficiency rate for 1 year of conventional root canal treatment of elderly patients with dental pulp disease is 60%-75%, the efficiency rate for 2 years 40%-65%, 5 years 30%-50%⁶. Conventional root canal recurrence with ordinary X-ray examination is used to determine the location of the root canal and the size of padding, which cannot provide multi-angle imaging⁷. According to hand feeling, cutting dentin and color of flushing fluid, the effect of root canal filling is judged, which is strongly blind and empirical⁸. Cone beam computed tomography (CBCT) technology can provide a clearer and accurate three-dimensional imaging and visual root canal recurrence with the aid of micro operation can significantly improve the filling effect.

Patients and Methods

Patients

We consecutively selected 56 cases of elderly patients, admitted to our hospital from October 2013 to October 2014, who were diagnosed with dental pulp disease by X-ray or CBCT. Exclusion criteria were patients with genuine teeth, false teeth, carcinoma of gingiva and other oral diseases, hypertension with other diseases, diabetes and heart disease, not suitable for surgery and incomplete clinical data. The research was accepted by the Ethics Committee in our hospital and empowered the right of informed consent by the patients and their families. According to the sequence of admission, the patients were randomly divided into the control group (70 teeth from 27 patients) and the observation group (77 teeth from 29 patients). In the control group, there were 15 cases of men and 12 cases of women with an age range of 62 to 75, with an average age of 66.8 ± 9.3 years. The disease duration was 1 month to 1 year, and median time was 4.5 months. There were 6 cases of acute pulpitis, 16 cases of chronic pulpitis, 2 cases of acute apical periodontitis, and 3 cases of chronic periapical periodontitis. There were 16 anterior teeth, 22 premolars, and 32 molars. In the observation group, there were 16 cases of men and 13 cases of women with an age range of 60 to 77 and an average age of 68.2 ± 7.7 years. The disease duration was 1 month to 1.5 years, and median time was 4.9 months. There were 5 cases of acute pulpitis, 18 cases of chronic pulpitis, 2 cases of acute apical periodontitis, and 4 cases of chronic periapical periodontitis. There were 17 anterior teeth, 25 premolar, and 35 molars. The differences of gender, age, disease duration, disease types and locations of the teeth in the two groups had no statistical significance ($p > 0.05$).

Methods

All patients were examined by CBCT (3D PROMAX imaging system produced by Planmeca Company, Helsinki, Finland). The information of teeth such as number, location, trend of root canal, etc. was recorded, and the teeth were well prepared after disinfection and anti-inflammation. The control group received conventional root canal recurrence. The mouth and teeth of patients were cleaned, the medullary cavity was opened to extract the dead pulp. Afterwards, the root canal was flushed and expanded conventionally. The length of the root canal was measured by electronic apex locator. The root canal was kept in pre-

paration by step-back technique. The root canal was flushed repeatedly with saline and chloramines, subsequently, the root canal was dried with absorbent paper or cotton twist. Afterwards, the root canal was partly filled with gutta-percha, by adding root canal paste to fill and seal the pulp cavity and the root canal orifice.

The observation group received visual root canal recurrence. It ensured to leave certain space between the lens and the teeth under the microscope. The focal length was adjusted until the emergence of a clear field of vision (according to the actual situation, adjust the magnification timely to form the best field of vision, namely eyepiece and objective lens are at an angle of 45°). The focal length was re-adjusted when washing and locating the teeth or changing the lens. With a clear field of vision, we used instruments (such as the long stem root canal instrument) to flush and fill the dental pulp of different diseased teeth. Patients in two groups were rechecked the effect by CBCT after treatment and receive several rounds of root canal therapy.

Observational Indexes

The duration of operation, times of operation, the intraoperative and postoperative visual analogue score (VAS), the success rates of treatment, filling satisfaction rates of the two groups were compared. The success rate of treatment was defined as significant relieve of pain. With the aid of CBCT, it turned out that filling density of tooth root was appropriate without overfilling or underfilling and periapical shadow completely disappears after the treatment for 6 months. Otherwise, the treatment was regarded as a failure. The images were reconstructed by 3D CBCT and make such stipulations as follows. If the distance of the filler in the root canal from the apical foramen was longer than 2 mm, it was underfilled. If the distance was within 2 mm, it was correctly filled. If the filler goes beyond the apical foramen, it was overfilled. If the filler in the root canal was closely joined with the root canal wall and distributed evenly without gap, it was good. If the filler in the root canal is distributed unevenly, or if there are no more than 2 gaps at one-thirds of the apex foramen, it was fair. If the filler in the root canal was distributed unevenly, and there were obvious gaps between the lateral wall and the apical foramen, it was considered as poor.

Statistical Analysis

SPSS 20.0 statistical software (SPSS Inc., Chicago, IL, USA) was used for statistical record and

Table I. Comparisons of duration of operation, times of operation and VAS.

| Group | Duration of operation (min) | Times of operation (time) | VAS before operation (score) | VAS after operation (score) |
|--------------------------|-----------------------------|---------------------------|------------------------------|-----------------------------|
| Observation group (n=27) | 46.7±10.5 | 1.6±0.5 | 3.5±0.7 | 3.1±0.8 |
| Control group (n=29) | 50.3±13.6 | 1.1±0.3 | 2.2±0.6 | 1.4±0.3 |
| <i>t</i> | 0.634 | 4.478 | 4.965 | 5.532 |
| <i>p</i> | 0.552 | 0.039 | 0.036 | 0.027 |

Table II. Comparison of the success rates.

| Group | Treatment for 6 months | End of follow-up |
|--------------------------|------------------------|------------------|
| Control group (n=27) | 18 (66.7) | 15 (55.6) |
| Observation group (n=29) | 26 (89.7) | 24 (82.8) |
| χ^2 | 4.389 | 4.894 |
| <i>p</i> | 0.036 | 0.027 |

analysis and data was expressed as mean ± standard deviation. The comparison between groups was made by *t*-test. The enumeration data were expressed by percentage (%). The comparison between groups was made by χ^2 -test. *p*<0.05 was considered to be statistically significant.

Results

Comparisons of Duration of Operation, Times of Operation and VAS

The comparison of operation duration for the two groups did not represent any statistical significance (*p*>0.05). The times of operation and VAS before and after operation of the observation group were significantly less than those of the control group (*p*>0.05) (Table I).

Comparison of the Success Rates

Duration of follow-up to patients in two groups was both about 18 months. By the treatment for 6 months and up to the end of follow-up, the success rates of the observation group was significantly higher than those of the control group (*p*<0.05) (Table II).

Comparison of Filling Satisfaction Rates

The correct filling rate, good filling rate and fair filling rate in the observation group were significantly higher than those of the control group (*p*<0.05) (Table III).

Discussion

Compared with conventional X-ray film, CBCT can provide the high-resolution three-dimensional images (sagittal, axial, and coronary) to carry out diagnosis analysis of anatomic images of any interested area from different angles and levels. It helps to show the anatomical structure of pulp cavity clearly and observe root canal morphology from different thickness of fault and different angles according to the need. Especially for elderly patients with complicated root canal systems, CBCT can identify the morphology, the number and the trend of the root canal and whether the location of the root canal in the mesial apex is fused on the three-dimensional image, etc. CBCT can provide more image information for preoperative and intra-operative clinical root canal treatment and provide an important guidance to the diagnosis and treatment of complicated dental pulp diseases^{10,11}. For the elderly, the distance between the dentine-cementum boundary and the anatomical apex of the root increased, it even increased to 3-4 mm¹². Also, due to the teeth root of the elderly is fragile, the variation of root canal system was larger, the bending and stenosis of root canal are more complex, etc., the length of work time requires special attention when preparing root canal for the elderly¹³. The distance between the roof and floor of elderly pulp chamber was small and the canal was fine. As a result of the reparative dentin deposition, it was not easy to detect root canal orifice and it's not easy for

Table III. Comparison of filling satisfaction rates.

| Group | Tooth (num) | Underfilling | Correct filling | Overfilling | Good filling | Fair filling | Bad filling |
|-------------------|-------------|--------------|-----------------|-------------|--------------|--------------|-------------|
| Control group | 70 | 8 (11.4) | 51 (72.9) | 11 (15.7) | 30 (42.9) | 28 (40.0) | 12 (17.1) |
| Observation group | 77 | 4 (5.2) | 69 (89.6) | 4 (5.2) | 50 (64.9) | 22 (28.6) | 5 (6.5) |
| F | | | 6.983 | | | 4.066 | |
| p | | | 0.030 | | | 0.044 | |

Note: *refers to $p < 0.05$ when compared with Group C at same times.

root canal preparation equipment to enter the root canal directly¹⁴. CBCT can provide more valuable information before and during operation, which improves the accuracy of root canal treatment.

The microscope in visualization technology is mainly composed of the microscope eyepiece, bracket, light source, method system, objective, etc. Corresponding parameters can be adjusted (magnification in 2-30 times) according to different types of microscopes clinically. Positioning, cleaning and forming root canal through visual root canal recurrence can provide medical staff with the emission images which are clear and not distorted. But only the angle of mouth lens needs to be adjusted during the process of operation and there is no need to move the microscope¹⁵. Visual root canal recurrence includes a conveyor. The existence of the conveying device can accurately convey the flush fluid to the workspace to complete ultrasonic root canal irrigation, remove the pollutants, calcification, plastic compound or broken equipment of the pulp chamber and root canals, etc., and make conditions for three-dimensional filling of root canal¹⁶. For the elderly whose tooth root canal is small and bending even blocked, use the flexible nickel-titanium instrument combined with the root canal lubricant (the main ingredient is ethylene diamine tetraacetic acid) and microscopic ultrasonic technology. By modified double-flared technique, step-down technique under the crown and balance force method to prepare a root canal, we can significantly improve the efficiency and effects of root canal preparation, improve the success rates of root canal treatment, reduce the complications after treatment and dive satisfactory clinical results in treating the partial closure root canal or tiny calcified root canal^{17,18}.

The results of the research indicated that: there was no statistically significant difference when comparing the duration of operation of the two groups. The times of operation and intraoperative and postoperative VAS of the observation group were significantly less than those of the control

group; the difference had statistical significance. The success rates of the observation group in 6 months' treatment and 18 months of follow-up were significantly higher than those of the control group. The correct filling rate, good filling rate and fair filling rate of the observation group were significantly higher than those of the control group; the difference was statistically significant.

Conclusions

To sum up, CBCT technology combined with visual root canal recurrence can improve the short-term and long-term therapeutic effects of elderly patients with dental pulp disease.

Conflict of interest

The authors declare no conflicts of interest.

References

- 1) BANE K, CHARPENTIER E, BRONNEC F, DESCROIX V, GAYE-N'DIAYE F, KANE AW, TOLEDO R, MACHTOU P, AZÉRAD J. Randomized clinical trial of intraosseous methylprednisolone injection for acute pulpitis pain. *J Endod* 2016; 42: 2-7.
- 2) ZHRABIAN VM, SONICK M, HWANG D, ABRAHAMS JJ. Dental implants. *Semin Ultrasound CT MR* 2015; 36: 415-426.
- 3) DHINGRA A, NAGAR N, SAPRA V. Influence of the glide path on various parameters of root canal prepared with WaveOne reciprocating file using cone beam computed tomography. *Dent Res J (Isfahan)* 2015; 12: 534-540.
- 4) HOPPE CB, BÖTTCHER DE, JUSTO AM, SÓ MV, GRECCA FS. Comparison of curved root canals preparation using reciprocating, continuous and an association of motions. *Scanning* 2016; 38: 462-468.
- 5) CHOI MR, MOON YM, SEO MS. Prevalence and features of distolingual roots in mandibular molars analyzed by cone-beam computed tomography. *Imaging Sci Dent* 2015; 45: 221-226.

- 6) BELLI S, ERASLAN O, ESKITASCIOGLU G. Effect of root filling on stress distribution in premolars with endodontic-periodontal lesion: a finite elemental analysis study. *J Endod* 2016; 42: 150-155.
- 7) LU Z, LIU X, WANG D, LI X. Cone-beam CT assisted to localize outside root canal instruments separation in a case. *Zhonghua Kou Qiang Yi Xue Za Zhi* 2015; 50: 530.
- 8) VENA DA, COLLIE D, WU H, GIBBS JL, BRODER HL, CUNRO FA, THOMPSON VP, CRAIG RG; PEARL Network Group. Prevalence of persistent pain 3 to 5 years post primary root canal therapy and its impact on oral health-related quality of life: PEARL Network findings. *J Endod* 2014; 40: 1917-1921.
- 9) AHMED HM, KHAMIS MF, GUTMANN JL. Seven root canals in a deciduous maxillary molar detected by the dental operating microscope and micro-computed tomography. *Scanning* 2016; 38: 554-557.
- 10) DHINGRA A, DAYAL C, SINGH A, BHARDWAJ N. Pre-termination of root canal lengths in molar teeth: a comparison between radio visiography and two-dimensional and three-dimensional measurements using cone-beam computed tomography. *Indian J Dent* 2015; 6: 195-198.
- 11) SACCUCCI M, CIPRIANI F, CARDERI S, DI CARLO G, D'ATTILIO M, RODOLFINO D, FESTA F, POLIMENI A. Gender assessment through three-dimensional analysis of maxillary sinuses by means of cone beam computed tomography. *Eur Rev Med Pharmacol Sci* 2015; 19:185-193.
- 12) MICHETTI J, BASARAB A, TRAN M, DIEMER F, KOUAME D. Cone-Beam Computed Tomography contrast validation of an artificial periodontal phantom for use in endodontics. *Conf Proc IEEE Eng Med Biol Soc* 2015; 2015: 7905-8.
- 13) ZHENGYAN Y, KEKE L, FEI W, YUEHENG L, ZHI Z. Cone-beam computed tomography study of the root and canal morphology of mandibular permanent anterior teeth in a Chongqing population. *Ther Clin Risk Manag* 2015; 12: 19-25.
- 13) FARAJ S, BOUTSIUKIS C. Observer variation in the assessment of root canal curvature. *Int Endod J* 2017; 50: 1213-1214.
- 14) RELVAS JB, DE CARVALHO FM, MARQUES AA, SPONCHIADO EC JR, GARCIA LDA F. Endodontic treatment of maxillary premolar with three root canals using optical microscope and NiTi rotatory files system. *Case Rep Dent* 2013; 2013: 710408.
- 15) KARUMARAN CS, GUNASEELAN R, KRITHIKADATTA J. Microscope-aided endodontic treatment of maxillary first premolars with three roots: a case series. *Indian J Dent Res* 2011; 22: 706-708.
- 16) YOSHIMINE Y, ONO M, AKAMINE A. The shaping effects of 3 nickel titanium rotary instruments in simulated S-shaped canals. *Endodont* 2005; 31: 373-375.
- 17) GUTARTS R, NUSSTEIN J, READER A, BECK M. In vivo debridement efficacy of ultrasonic irrigation following hand-rotary instrumentation in human mandibular molars. *J Endod* 2005; 31: 166-170.