Preservation and Clinical Study on Involved Teeth with Jaw Cyst

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Research article

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Abstract

Background

To assess the efficacy of modified surgery in the preservation of tooth pulp affected by jaw cyst.

Methods

Fifty-four impacted teeth in 16 cases of jaw cyst treated by our department were selected between September 2015 and October 2016. We observed the pulps' activity in the involved teeth and the efficacy of surgery.

Results

Out of 54 impacted teeth in 16 patients, after 12-24 months' follow-up,45 affected teeth recovered well, whereas nine teeth showed adverse symptoms such as redness and swelling in the apical area, fistula, and pain. These symptoms resolved after postoperative root canal therapy. Chewing function was restored well. The bone cavity gradually reduced and finally disappeared, and bone density returned to normal after long-term follow-up.

Conclusion

Preservation of the involved tooth pulp for the treatment of jaw cyst by performing an improved operation method was effective.

Background

Jaw cystic lesion is the most common disease of the oral and maxillofacial region, which mainly includes odontogenic cyst, non-odontogenic cyst, vascular extravasation cyst, keratocystic odontogenic tumor, and unicystic ameloblastoma. Surgery remains the major therapeutic method for jaw cyst. For keratocystic odontogenic tumor and unicystic ameloblastoma, good results are obtained in the preservation of jaw tissue and involved teeth with fenestration decompression. However, the conventional surgical methods for jaw cyst, at present, are cyst curettage and apicoectomy of the involved teeth. As long as the apical area is exposed in the cystic lesion by preoperative X-ray, regardless of the pulp vitality, .root canal therapy is performed before surgery, and the cystic lesion tissues as well as intracavitary apical tissue should be removed during the operation[1].

Root canal therapy and apicoectomy, as a treatment method for odontogenic cyst, have been widely accepted. Many scholars have found necrosis of the dental pulp and decreased pulp vitality in or surrounding jaw cyst due to inflammatory factors[2] and compression of cystic exudation in the process of cyst formation. In addition, a tooth with its apex located in the cyst cavity may have chronic pulpitis. If root canal therapy and apicectomy are not performed, it may lead to abnormal healing or postoperative cyst recurrence [3]. A pathogenic tooth with an odontogenic cyst often changes color, the apical foramen

enlarges or is absorbed, and the pulp vitality test will show no response in clinical practice. In addition to the pathogenic tooth, the roots of some teeth are often located in the cavity of the cystic capsule. Although the crown color might be normal, X-ray shows no absorption of the apex, and a pulp vitality test will demonstrate normal or insensitive. This tooth is called the affected tooth. Moreover, these phenomena also extensively exist with a non-odontogenic cyst, when the tooth is not directly related to the lesion, but the root is surrounded or oppressed during the cyst expansion process. Yet, whether these affected teeth require root canal therapy and apicoectomy is still inconclusive.

In this study, we removed the apical alveolar bone and tried to preserve the roots and pulp tissue of the involved teeth with jaw cyst. After curettage and apicoectomy, we observed the recovery from jaw cyst and the prognosis of the involved teeth postoperatively.

Methods

Clinical samples

Sixteen patients treated in our department were selected between September 2015 an October 2016, including 11 males and five females. The age of the included patients with jaw cyst in our study ranged from 21 to 49 years. In total, 54 involved teeth from 16 patients were included in this study. Inclusion criteria consisted of:

 A jaw cystic lesion involved at least two teeth (Fig. 1).

 Clinical examinations such as a preoperative clinical exam, dental radiograph, or cone beam computed tomography (CBCT) identified the pathogenic teeth and affected teeth.

 The pathogenic teeth had had completed root canal filling before surgery.

 The involved teeth did not have an enlarged apical foramen, showed no root resorption on X-ray film or CBCT, and reacted normally or insensitively in a pulp vitality test.

 Written informed consent was obtained from each patient. If a patient had any postoperative discomfort, root canal therapy would be given.

 During the operation, the roots of the involved teeth were reconfirmed to have exposed roots in the cystic cavity.

Experimental facilities

Panoramic tomography, cone beam computed tomography, Neosono Co-Pilot Pulp Vitality Tester, conventional surgical instruments for maxillofacial surgery.

Treatment process

First, the involved tooth should be diagnosed by X-ray (Fig. 2-3), CBCT, and a pulp vitality test before surgery. After considering pathological scope and location, jaw cystic lesion resection should be conducted under local or general anesthesia (Fig. 4). Next, a routine trapezoidal or angular incision should be performed on the labial mucosa to expose the labial lesions. If the labial bone plate is in the process of resorption, a complete removal of cystic lesions should be done. First, the cystic lesion area should be stripped to keep it away from the teeth. It must be removed carefully under direct vision around the area of the involved tooth. Performing a complete removal of the fiber lining is not suggested, so as not to pose an impact on the blood supply and nerve fibers of the involved teeth. Finally, treatment for the involved tooth should be carried out thoroughly around its roots.

A high-frequency electrotome is used to scratch and burn adhesion of the capsule wall and then the root tips are removed 3 mm by round burs while the involved tooth is well protected. If the labial bone plate exists, chisel the apical alveolar bone 5 mm above the root tip of the involved tooth to remove any intact jaw cystic lesion. Treatments for the root apex of both pathogenic teeth and involved teeth are as previously described. After that, we irrigated the chamber with sterile saline solution, ensuring sterile conditions and non-inflammatory factors in the cystic space. The root tip should be covered with a gelatin sponge. If the size of the cavity is less than three tooth positions, suture it after debridement. If it is larger than four teeth positions, fill the hole with iodoform gauze and then suture wound.

Patients whose preoperative diagnosis tended to be of a non-odontogenic cyst were treated the same as those with an odontogenic cyst. In this circumstance, if the root apex of the involved tooth was not exposed in the cavity, only the cyst itself would be completely removed during the operation. On the contrary, if there was only an adjacent relationship between the walls and the involved teeth, the capsule wall would be stripped and the roots of the involved tooth would require no treatment.

Pathology results

Radicular cyst in five cases; periapical granulomas in five cases; dentigerous cyst in four cases; odontogenic squamous intraepithelial lesion in two cases.

Postoperative evaluation

Postoperative follow-up was conducted for 12 to 36 months. The patients underwent a pulp vitality test at one week, one month, three months, six months, and 12 months postoperatively and underwent X-ray radiography at three months, six months, and 12 months after surgery (Fig. 5). The criteria for protecting the pulp of the involved tooth successfully were as follows.

 The incision has healed well and there is no inflammation in the surgical area.

 The occlusion of the involved teeth is functioning well without any discomfort.

 The pulp vitality of the involved teeth has returned to normal after the operation.

 The scope of the lesion has gradually narrowed and the bone density has gradually increased.

If any of the following symptoms appeared within one year after surgery, preservation of the involved tooth was considered a failure.

 The patient experiencing toothache or any discomfort should be given root canal therapy.

 The mucosa of the surgical area showed redness, swelling, and pus. After root canal therapy, inflammatory reaction disappeared.

 There was no cystic space reduction or enlargement around the involved tooth in an X-ray.

Results

According to the 12–36 month follow-up of 54 involved teeth from 16 patients, 45 of them recovered well, after surgery, and nine teeth caused discomfort (Table 1). Among them, five involved teeth in four patients presented redness and fistula on the labial mucosa, and four involved teeth in two patients presented postoperative pain. After four weeks observation, the discomfort in these six cases was not relieved. After root canal therapy, the patients became symptom-free two weeks later. The integrity of the 54 involved tooth roots was preserved well, and the pulp vitality of 45 of the involved teeth was restored and they recovered. 36 months after surgery, the area of the jaw cystic lesion had decreased significantly, and no recurrence or discomfort appeared (as shown in Fig. 5).

Table 1
Follow-up of 54 involved teeth from 16 patients

54 involved teeth in 16 patients	Red and swollen gums*	Sensitive percussion of involved teeth#	Decreased pulp vitality#	Normal pulp vitality#	Cystic space reduction*
Preoperative	5	0	43	11	0
After 1 week	2	3	41	13	0
After 3 months	4	6	37	17	7
After 6 months	0	0	26	28	16
After 12 months	0	0	23	31	16
*Number of cases; #Number of teeth.					

Discussion

The objectives of jaw cystic lesion resection are to terminate the pathological process, promote the restoration of jaw bone tissue, and restore the anatomical and physiological functions of the teeth in the lesion area. According to traditional surgical methods, root canal therapy and apical resection should be adopted as long as the tooth can be retained, regardless of the pulp activities in the cystic area[2]. Although this surgical method decreased the possibility of postoperative infection in the lesion area, it also destroys the anatomical structure and pulp activity of the teeth, consequently reducing the stability and physiological function of involved teeth, despite that the pulp vitality of involved teeth generally does not have inflammation. We also found that growth of the bone around the involved teeth in the cavity is accompanied by the reconstruction of bone around the root apex and recovery of pulp activity after the fenestration. Therefore, if the involved tooth apex is properly preserved and treated, the integrity of tooth and pulp activity of the involved tooth will be well protected and restored[4].

In this study, to protect the root integrity and pulp activity of the involved teeth during operation, the following improvements of surgical methods were made.

 The involved tooth and pathogenic tooth should be diagnosed before surgery, and root canal therapy should not be performed on the involved tooth.

 The upper boundary of chiseling of the apical area of the alveolar bone should be 5 mm above the root tip of the involved tooth to protect the nerve and blood supply of the apex and to preserve the integrity and activity of pulp stem cells and periodontal ligament cells.

 Only the epithelial lining of the capsule wall and part of the fiber lining is cut under direct vision in the area around the involved tooth. The fiber lining can be partially retained to avoid posing a threat to papillary stem cells, multifunctional pulp stem cells, periodontal stem cells, and blood vessels in the root tip.

 During the operation, the cystic lesions and the root tips of the diseased teeth are completely removed, but those of the involved teeth are not excised or cauterized. Then, irrigation of the chamber with sterile saline solution ensures sterile conditions and non-inflammatory factors in the cystic space.

 The root tips of the involved teeth should be covered with some blood clots, which would facilitate development of a physiological basis for the regeneration of normal tissues around the area and the restoration of blood vessels and nerves in the pulp.

In the clinical research, we found that the root and pulp vitality of the involved teeth located in a jaw cystic lesion could be effectively preserved; meanwhile, the anatomical and physiological functions of the teeth would not be affected if the inclusion criteria and standard surgical methods are strictly followed and performed. (The root integrity of the 54 teeth and pulp vitality of the 45 teeth were well preserved.) Currently, dental pulp revascularization, that is, a process of tissue regeneration in an inactive tooth, has gained increasing recognition since Lwaya et al. [5] first put forward this technology in 2001. Dental pulp revascularization takes advantage of the endodontic blood channel in vitro, letting the dentin in the root

canal of the permanent tooth continue its generation, thus leading to the closure of the apical pore and the growth of the root[6]. Neha et al.[7] deduced that if a sterile tissue matrix can be provided for the growth of new cells, viable pulp can regenerate, and dental pulp revascularization is the result of replantation or allograft of dead teeth. This result suggests that if a sterile tissue matrix is provided for the growth of new cells, these cells could grow in the root canal and help rebuild the blood supply to the pulp, gradually replacing the diseased tissue[8–9]. Studies of dental pulp revascularization on chronic periapical periodontitis and tooth trauma in young permanent teeth are quite common, and many animal experiments and clinical studies, both domestic and overseas, have shown good results[10–11].

Some animal and clinical trials of dental pulp revascularization have changed our understanding of endodontic preservation[12]. Through a large number of clinical observations, we find that most of the pulp of the affected teeth is free of inflammation, and the blood flow and nerve activity of the affected pulp in jaw cyst treated by fenestration decompression can be preserved and restored. The endodontic vessels and nerves are abundant; in addition to the apical vessels, the endodontic vessels can communicate with the periodontal ligament and some accessory root canals[13]. Endodontic nerves are divided into myelinated fibers that conduct pain and some non-myelinated fibers nerves that regulate vasoconstriction and relaxation. Myelinated nerve fibers that conduct pain are also divided into Aδ fibers and C fibers. The pulp vitality test does not accurately reflect endodontic blood flow and nerve condition of affected teeth. Involved teeth with jaw cyst have more complete pulp tissue structure and activity. Therefore, the blood flow and nerves of affected teeth should be easier to preserve and regenerate.

Through improvement of this surgical method, anatomical structure and vitality of the involved teeth in the cystic lesion can be preserved well. This surgical method is worth being developed and popularized in clinical work because not only does it reduce the cost and time of treatment for patients, it also preserves the physiological and anatomical functions of patients' teeth. However, due to the limitation of postoperative observation, the obtained data cannot accurately reflect the situation of vascular and nerve functions of the pulp after surgery. We will investigate the activity of nerves and blood vessels in the pulp of involved teeth further, and we expect that more scientific and accurate data will be obtained to provide a more effective method for the treatment of involved teeth in jaw cyst.

Conclusion

Our results showed that preservation of the involved tooth pulp for the treatment of jaw cyst by this improved operation method was effective.

Abbreviations

CBCT cone beam computed tomography

Declarations

Ethics Approval and consent to participate

This study was approved by the Institutional Review Board of Hospital of Stomotology, Fujian Medical University, and written informed consent was obtained from each participant. The study was carried out in accordance with the guidelines for the care and use of human specimens and animals, including in the approved protocol.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing interests:

The authors declare no potential competing interests.

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Authors' contributions

All authors read and approved the final manuscript. All authors have made a sufficient contribution to the work. Concept and design: YGL and GN. Experiments and procedures: NG, YGT, JJL, LSL. Data analysis: NG, QLL, YGT, JJL, LSL, YGL. Writing and editing the article: NG, QLL and YGL.

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Figures

Figure 1

Representative image of the intraoral view of the patients. Patient A, male, 30 years old, with a chief complaint of an abscess with pain and oozing pus in his maxillary anterior teeth for more than one year. The arrow shows that 12 is the focal tooth, and 11, 13, 14, and 15 are the involved teeth.

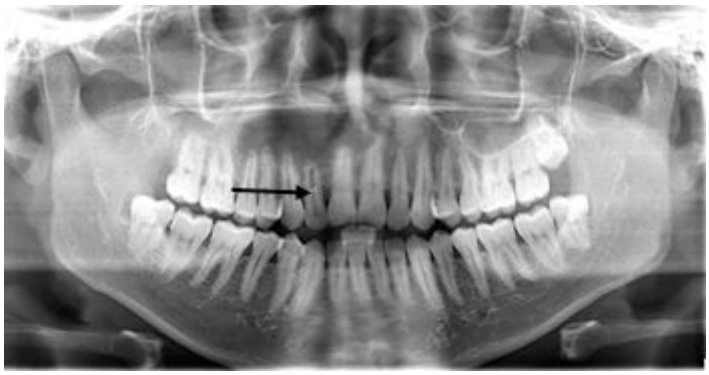

Figure 2

Panoramic radiograph of patient A taken before surgery. The arrow shows that 12 is the focal tooth; 11, 13, 14, and 15 are the involved teeth.

Figure 3

Panoramic radiograph of patient B (male, 46 years old, with a chief complaint of swelling in the right maxillary for one week) taken before surgery; 11, 21, and 22 are the involved teeth, and the vitality test of these teeth was dull.

Figure 4

Intraoral view of patient B during the surgery; 11, 21, and 22 are the involved teeth, which have no color change.

Figure 5

Panoramic radiograph of patient A taken at 36 months after surgery. The cyst was healing well and the three involved teeth were preserved.