ISSN 2706-6819 Vol.4, Issue 10: 62-67, DOI: 10.25236/IJFM.2022.041010

Research progress in the treatment of odontogenic jaw cysts

Lan Xue, Maimaitituxun Tuerdi*

Orthognathic and Trauma Department of Oral &Maxillofacial Surgery, the First Affiliated Hospital (Stomatological Hospital) of Xinjiang Medical University, Urumqi, 830054, Xinjiang Uygur Autonomous Region, China
**Corresponding author: maimaitituxun@aliyun.com*

Abstract: *Odontogenic jaw cysts are clinically common benign lesions of the jaw. Traditional treatment modalities mainly include root canal therapy (RCT), marsupialization, cyst fenestration and drainage, scaling and partial jaw resection. Because of its different indications and advantages and disadvantages, there is still a need for improvement in traditional treatment modalities. Recently, the improvement of fenestration drainage, the combination of platelet-rich concentrates and bone filling materials, and the resection of odontogenic jaw cysts with deep location and difficulty in exploration under minimally invasive assisted techniques provide some reference for the treatment of jaw cystic lesions. This article reviews the various treatment methods and advantages and disadvantages of odontogenic jaw cysts in recent years.*

Keywords: *Odontogenic, Jaw cyst, Treatment methods*

1. Introduction

Odontogenic jaw cysts are benign lesions of the jaw that develop from odontoblastic tissue and the epithelium and residual residues, mostly in adolescents. Because they are usually slow-growing and asymptomatic, cysts are very large at the time of discovery and are often accompanied by displacement or even destruction of surrounding structures causing facial asymmetry, secondary infection, concomitant root resorption, and nerve damage or pathology Fractures etc [1] [2]. True cysts are defined as epithelial-lined lumen, while pseudocysts lack epithelial lining [3]. The old classification mainly includes: root end cyst, primordial cyst and dentigerous cyst. According to the fourth edition of the 2017 World Health Organization classification of odontogenic lesions, odontogenic keratocyst (OKC) are officially classified as odontogenic jaw cysts [4]. This article summarizes the latest methods for the treatment of odontogenic jaw cysts by scholars from various countries in recent years.

2. Conventional treatment

2.1. Conservative treatment

At present, the common conservative treatment methods in clinic mainly include RCT, marsupialization and decompression. Root canal therapy is often selected clinically for root cysts with a diameter of ≤ 1 mm. After the pulp is opened, cleaned and shaped, the root filling material is used for tight filling, leaving no space for bacterial growth. Cysts can gradually shrink in size on their own until they close [5]. In the face of larger cysts, marsupialization is often used. The principle is to make a larger window on the surface of the cyst wall, so that the size of the cyst cavity is slowly reduced, and the remaining tissue is sutured to the oral mucosa. The communication between the oral cavity and the cyst will reduce the internal pressure of the lesion, release the pressure in the cyst, reduce the compression on the surrounding bone wall, and promote the formation of new bone [6]. However, due to the direct communication between the cyst and the oral cavity, the risk of secondary infection in the cyst is relatively increased. And fenestration decompression can make up for some of the deficiencies brought about by marsupialization. A window is opened on the cyst wall, and the continuous opening of the window by placing iodoform gauze, making a Cyst stopper, or placing a drainage tube reduces the pressure in the cyst cavity, thereby promoting the growth of new concentric bone. Its advantages are mainly in that it can save operation time, avoid damage to important tissues and structures around the

ISSN 2706-6819 Vol.4, Issue 10: 62-67, DOI: 10.25236/IJFM.2022.041010

cyst, and can effectively promote the formation of new bone and reduce the volume of the cyst [7] [8] [9] [10]. However, due to the long treatment cycle and strong patient compliance with this technique, a small number of potentially malignant cystic epithelial residues may cause disease recurrence, and the rate of cyst volume shrinkage during fenestration is not constant. So, in the later stage of the disease, secondary surgery is often required to completely remove the cyst [11]. Therefore, immediate bone grafting is often used to seal the bone cavity during surgery, including the transplantation of autologous ribs, ilium, and fibula.

2.2. Surgical treatment

Scaling and curettage for odontogenic jaw cysts with a diameter of ≤4cm is still a widely used treatment method in clinical practice. A method of curing cysts by removing the diseased bone in the cyst cavity and scraping the capsule in the cyst wall. However, cysts with larger diameters have a wider range of lesions, more bone defects and adjacent important tissues and organs, and the residual bone cavity after curettage is larger, which is often prone to pathological fractures. For some odontogenic keratocysts or ameloblastomas with a diameter of ≥4 cm, strong invasiveness, and easy recurrence, partial jaw resection can be used clinically. Among them, in order to achieve the purpose of radical cure, it is often necessary to excise the normal 0.5cm tissue around the jawbone. Due to the strong invasiveness of this operation, it is easy to cause tissue damage, and patients are often accompanied by various complications such as facial deformity asymmetry, decreased occlusal function, decreased masticatory function, and pathological fractures [12].

3. Application of new assistive technologies

3.1. Improvement of fenestration decompression

Traditional cyst fenestration decompression mostly uses passive drainage, which takes up to 1 year to heal. This undoubtedly increases the number of patient visits, and also puts forward higher requirements for patient compliance. [13] The odontogenic cyst evacuator (Evocyst), a closed drainage device with active negative pressure, can solve these problems well. The principle is to insert a decompression tube and a flushing tube into the cyst cavity, and connect a negative pressure device outside the mouth to form a negative pressure in the cyst cavity [14]. Relevant experimental studies have shown that the device has a high rate of new bone formation within 3 months [14]. Local application of negative pressure can effectively reduce local edema, stimulate blood vessel formation, enhance blood flow, and partially affect wound healing [15] The other is a self-suction decompression device, which achieves the effect of negative pressure in the cyst cavity through the patient's self-sucking method, opens holes in various types of Cyst stopper devices, and indwells a tube that communicates with the outside world in the cyst cavity. The length of the pipe is suitable for the maximum diameter of the cyst cavity, and the opening is fixed to the adjacent teeth near the cyst cavity. The patient is asked to suck on his own every day to reduce the internal pressure of the cyst cavity, thereby increasing the rate of new bone formation and effectively reducing the number of patient visits [16]. It is not difficult to see that the active decompression of the remaining cysts can better achieve the purpose of treatment, and at the same time, it has a certain promotion effect on reducing the number of patient visits, saving time and cost, reducing patient compliance, and accelerating the formation of concentric bones.

3.2. Combined Application of Platelet Rich Concentrate and Bone Synthetic Materials

Clinically, immediate bone grafting is often used to close the remaining bone cavity after excision of large jaw cysts, while smaller odontogenic jaw cysts are often filled with natural blood clots, which have a certain self-healing ability. However, related experiments have shown that bone grafting can better promote bone formation [17]. Therefore, the need for bone grafting for odontogenic jaw cyst bone defects has been controversial, and there is no result yet [18]. Bone filling materials from different sources have different bone regeneration potentials [19]. Among them, autologous bone transplantation is still the gold standard among various bone filling materials. The risk of immune rejection is basically zero and the success rate is as high as 95% [20]. However, because it is easy to cause secondary trauma and may even affect the health of the whole body, it is not the most Good choice. Other methods have some limitations in the transplantation process, such as increased risk of disease transmission, high absorption rate, high immune rejection, technological complexity, poor mechanical properties, chemical properties, and poor biocompatibility, etc. Therefore, a near-perfect bone filling material has not yet appeared. In recent years,

ISSN 2706-6819 Vol.4, Issue 10: 62-67, DOI: 10.25236/IJFM.2022.041010

with the help of the combination of medicine and industry, bone cavity filling materials based on various cell growth factors, gene-modified drugs and other mixed forms have gradually emerged to replace the shortcomings of the original filling materials [21] [22]. Platelet-rich plasma (PRP) or the use of platelet-rich fibrin (PRF) combined with artificial bone meal to fill residual bone cavity has attracted much attention. Platelet-rich plasma (PRP) is a platelet concentrate obtained by centrifuging whole blood [23]. Tissue repair is initiated by the release of multiple bioactive factors including growth factors, cytokines, lysosomes, and adhesion proteins following injection of platelet concentrates at the injury site, which are responsible for initiating the hemostatic cascade, new connective tissue synthesis, and revascularization [24]. Over the past 20 years, platelet concentrates have evolved from a first-generation product, platelet-rich plasma (PRP), to a second-generation product, such as leukocyte-platelet-rich fibrin (PRF), which is comparae to the first generation. has the characteristics of lower cost and faster production efficiency. Mainly used in the field of oral surgery to accelerate tissue defect regeneration and vascular reconstruction [25]. Some studies have shown that mixing PRF gel with Bio-oss bone powder to fill jaw defects can promote the proliferation of artificial bone powder osteoblasts, and the effect is much better than simply using Bio-oss bone powder for filling [26].

3.3. Application of microinvasive technique in the treatment of odontogenic jaw cyst

The operation of maxillofacial surgery has the characteristics of high risk, many intraoperative and postoperative complications, and high complexity. With the help of various micro-invasive techniques, it can help clinical operators to find the primary lesion faster and more accurately, remove all kinds of jaw tumors, and reduce intraoperative and postoperative complications. For example, endoscope, ultrasonic osteotome and digital positioning guide are used clinically to assist in the removal of deep and difficult to explore jaw tumors [27]

3.3.1. Piezosurgery

Piezosurgery is a modern and new type of bone cutting tool, which cuts the bone surface through high-frequency vibration. Compared with traditional cutting instruments, ultrasonic osteotome has a wider range of indications and is widely used in oral and maxillofacial surgery, ENT, neurosurgery, ophthalmology, trauma and orthopedics [28]. Its main advantages include pressurized irrigation and cavitation effect on the surgical area to provide a clearer view, and a single selective cutting of hard tissue can avoid damage to surrounding adjacent tissues[29]. A study has shown that Piezosurgery in the treatment of jaw cysts can improve the efficiency of treatment while reducing intraoperative blood loss, pain, recurrence and infection [30]. Therefore, the application of Piezosurgery in the field of maxillofacial surgery can not only provide operators with more efficient, safe and convenient conditions, but also can effectively reduce intraoperative and postoperative complications of patients.

3.3.2. Endoscope

Endoscope is a kind of sophisticated optical auxiliary instrument with complex composition, through which it can directly visualize the smaller incisions during the operation, providing the surgeon with a better field of view and more precise operating conditions[31].Due to the complexity of the anatomical structure of the maxillofacial region and the high degree of aesthetic requirements of patients, large surgical incisions should not be made directly on the face, and if the design of the intraoral incision is so deep that conventional instruments cannot enter normally, it will seriously affect the operation. The operating environment of the patients resulted in more intraoperative complications. By using an endoscope, the scope of the surgical area can be clearly defined, a relatively non-invasive surgery can be performed, and more surrounding tissue can be preserved, which is a better choice [32]. Endoscopic treatment of odontogenic jaw cysts is common in otolaryngology. Because maxillary cysts are adjacent to important anatomical structures such as the maxillary sinus and nasal cavity, the traditional surgical method of incision through the vestibular groove in the mouth is more traumatic, resulting in postoperative infection, facial more likely to swell[33].However, endoscopic-assisted surgical treatment of maxillary cysts can reduce the surgical trauma to a certain extent, and can help the operator to determine whether the residual tissue in the cyst has been removed cleanly, avoiding damage to the surrounding important god-level tissues [34]. It effectively saves the operator's operation time [35].

3.3.3. 3D printed surgical guide

Three-dimensional (3D) printing is an additive manufacturing technique that enables the fabrication of 3D structures from medical images of the patient's own body, such as computed axial tomography (CAT) and magnetic resonance imaging (MRI)[36].With the development of 3D manufacturing, it has now gone from simple anatomical models to patient-specific implants, including cutting or drilling

ISSN 2706-6819 Vol.4, Issue 10: 62-67, DOI: 10.25236/IJFM.2022.041010

guides, occlusal splints, bone plates, bone reconstruction components, etc [37]. The 3D printing surgical guide is an auxiliary oriented additive tool designed based on the patient's preoperative image data and then produced by 3D printing technology, which belongs to an application in the 3D printing manufacturing industry [38]. Before surgery, the patient needs to take a cone beam CT (CBCT), and then print it with the help of 3D printing technology. The customized positioning guide can design individual incisions according to different patients during the operation, which effectively improves the accuracy of the operation and the safety of the patients [39]. In the face of odontogenic jaw cyst surgery, only about 4mm of bone needs to be removed to achieve the required operating space and field of view to ensure the normal operation of the operation, and can effectively reduce bleeding, edema and patient pain [40]. Therefore, the 3D printing surgical guide has the characteristics of speed, precision and convenience, which enables the visualization of complex lesions in the maxillofacial region. It is convenient for communication and discussion between doctors to further improve the surgical plan. At the same time, its precise and minimally invasive features not only save the doctor's operation difficulties, but also improve the comfort of patients during the treatment process [41].

4. Summary

Odontogenic jaw cyst is a common disease in oral and maxillofacial surgery, and we often adopt different surgical plans according to its size, location, and type. Among them, the conventional treatment methods mainly include RCT, marsupialization, decompression, curettage and partial jaw resection. However, no matter which treatment method has its own advantages and disadvantages, for example, RCT can achieve good results for radicular cysts with small diameters, while the treatment of medium and large odontogenic jaw cysts often needs to consider the location and surrounding of the cyst. The structure of adjacent tissues, intraoperative and postoperative complications, and the management of residual bone cavity after operation. Cyst decompression plasty is an ideal surgical mode, which can avoid damage to the surrounding important tissue structures and at the same time make the cyst cavity form negative pressure to facilitate the formation of new bone. But it takes up to a year or so to heal. While increasing the number of patient visits, it also puts forward higher requirements for patient compliance. In recent years, the application of some new technologies has strengthened some deficiencies of traditional treatment methods, such as improved decompression with self-priming or negative pressure devices, so that the negative pressure of cysts can be changed from passive to active, which can be maintained. Generate negative pressure to accelerate the formation of centripetal bone. In the fields of biomedicine and biomaterials, the combined use of platelet-rich fibrin (LPF) and bone meal promotes the proliferation of osteoblasts, and at the same time makes up for some of the drawbacks brought about by the use of bone meal fillers alone. Reduce the risk of disease transmission and avoid high absorption rates and high immune rejection. With the assistance of minimally invasive techniques, endoscopes, ultrasonic osteotome, and 3D printed surgical guides can better help the operator find the specific location of the lesion, improve the operator's field of vision and maneuverability, and effectively reduce intraoperative bleeding and edema and helps to reduce the recurrence rate after surgery. However, the application of new assistive technologies has some corresponding shortcomings, such as high technical requirements for operators, strict application conditions, and high operating costs. Therefore, the current surgical plan for odontogenic jaw cysts should also be individually designed according to the patient's own conditions. How to choose a more efficient, convenient, safe, precise, economical, and least painful surgical method needs to be further discussed.

Acknowledgements

The manuscript was totally drafted and written by the authors, without including any external individual.

References

[1] Manor E, Kachko L, Puterman M B, et al. Cystic lesions of the jaws-a clinicopathological study of 322 cases and review of the literature [J]. International journal of medical sciences, 2012, 9(1): 20.
[2] Park H S, Song I S, Seo B M, et al. The effectiveness of decompression for patients with dentigerous cysts, keratocystic odontogenic tumors, and unicystic ameloblastoma [J]. Journal of the Korean Association of Oral and Maxillofacial Surgeons, 2014, 40(6): 260.
[3] Lalwani A. CURRENT Diagnosis and Treatment in Otolaryngology--Head and Neck Surgery: Head

ISSN 2706-6819 Vol.4, Issue 10: 62-67, DOI: 10.25236/IJFM.2022.041010

and Neck Surgery: Head and Neck Surgery [M]. McGraw-Hill Professional, 2007.
[4] Soluk-Tekkeşin M, Wright J M. The World Health Organization classification of odontogenic lesions: a summary of the changes of the 2017 (4th) edition [J]. Turk Patoloji Derg, 2018, 34(1): 1-18.
[5] Zhou Jian, Du Ruohong. Treatment of jaw cyst and its clinical application [J]. Journal of Oral and Maxillofacial Surgery, 2012, 22(04): 229-232.
[6] Zhao Y, Liu B, Han Q B, et al.Changes in bone density and cyst volume after marsupialization of mandibular odontogenic keratocysts (keratocystic odontogenic tumors) [J]. Journal of oral and maxillofacial surgery, 2011, 69(5): 1361-1366.
[7] Marin S, Kirnbauer B, Rugani P, et al. The effectiveness of decompression as initial treatment for jaw cysts: A 10-year retrospective study [J]. MedicinaOral, Patologia Oral y Cirugia Bucal, 2019, 24(1): e47.
[8] Schlieve T, Miloro M, Kolokythas A. Does decompression of odontogenic cysts and cystlike lesions change the histologic diagnosis? [J]. Journal of Oral and Maxillofacial Surgery, 2014, 72(6): 1094-1105.
[9] Carter L M, Carr P, Wales C J, et al. Customised stents for marsupialisation of jaw cysts [J]. British Journal of Oral and Maxillofacial Surgery, 2007, 45(5): 429-431.
[10] Rehman K U, Opie N, Parmar S, et al. The oral grommet[J]. British Journal of Oral and Maxillofacial Surgery, 2008, 46(8): 692-693.
[11] Chen Yue, Ding Xu, Hu Jian. CBCT analysis of influencing factors and volume change of fenestration decompression for large cystic lesions of the jaw [J]. Oral Biomedicine, 2020, 11(02): 116-119+124.
[12] Nyimi B F, Yifang Z, Liu B. The Changing landscape in treatment of cystic lesions of the jaws [J]. Journal of International Society of Preventive & Community Dentistry, 2019, 9(4): 328.
[13] Castro-Núñez J. Active intracystic negative pressure could induce osteogenesis [J]. Journal of Craniofacial Surgery, 2018, 29(4): e370-e371.
[14] Castro-Núñez J, Rey D, Amaya L. An innovative intracystic negative pressuresystem to treat odontogenic cysts [J]. Journal of Craniofacial Surgery, 2017, 28(7): 1883-1884.
[15] Castro-Núñez J. Distraction sugosteogenesis: its biologic bases and therapeutic principles [J]. Journal of Craniofacial Surgery, 2018, 29(8): 2088-2095.
[16] Zhou Zhenggen, Ji Jianming, Wan Zhiqun, Cao Huizhen. Effect of auto-suction assisted fenestration decompression on cyst volume and area in patients with large odontogenic jaw cyst [J]. Contemporary Medicine, 2021, 27(11): 159-160.
[17] Wang Lina, Wang Enqun. Comparison of the effect of spontaneous bone regeneration and Bio-Oss graft bone regeneration after odontogenic jaw cyst [J]. Medical Information, 2022, 35(05): 91-93.
[18] Buchbender M, Neukam F W, Lutz R, et al. Treatment of enucleated odontogenic jaw cysts: a systematic review [J]. Oral surgery, oral medicine, oral pathology and oral radiology, 2018, 125(5): 399-406.
[19] Bauer T W, Muschler G F. Bone graft materials: an overview of the basic science [J]. Clinical Orthopaedics and Related Research®, 2000, 371: 10-27.
[20] Sakkas A, Wilde F, Heufelder M, et al. Autogenous bone grafts in oral implantology—is it still a "gold standard"? A consecutive review of 279 patients with 456 clinical procedures [J]. International journal of implant dentistry, 2017, 3(1): 1-17.
[21] Tovar N, Jimbo R, Gangolli R, et al. Evaluation of bone response to various anorganic bovine bone xenografts: an experimental calvaria defect study [J]. International journal of oral and maxillofacial surgery, 2014, 43(2): 251-260.
[22] Titsinides S, Agrogiannis G, Karatzas T. Bone grafting materials in dentoalveolar reconstruction: A comprehensive review [J]. Japanese dental science review, 2019, 55(1): 26-32.
[23] Everts P A M, Knape J T A, Weibrich G, et al. Platelet-rich plasma and platelet gel: a review[J]. The Journal of extra-corporeal technology, 2006, 38(2): 174.
[24] Everts P, Onishi K, Jayaram P, et al. Platelet-rich plasma: new performance understandings and therapeutic considerations in 2020[J]. International journal of molecular sciences, 2020, 21(20): 7794.
[25] Caruana A, Savina D, Macedo J P, et al. From platelet-rich plasma to advanced platelet-rich fibrin: biological achievements and clinical advances in modern surgery [J]. European journal of dentistry, 2019, 13(02): 280-286.
[26] Wang Lina, Wang Enqun. Comparison of the effect of spontaneous bone regeneration and Bio-Oss graft bone regeneration after odontogenic jaw cyst [J]. Medical Information, 2022,35(05):91-93.
[27] Tan Guilian, Liu Aipeng, Zhao Yaqin, Yang Kaiwen, Li Hongyu, Wang Zhuli, Deng Wenzheng. Research progress on application of minimally invasive assistive technology in surgery of jaw cyst [J]. China Journal of Modern Medicine, 2021, 23(12): 101- 105.
[28] Pavlíková G, Foltán R, Horká M, et al. Piezosurgery in oral and maxillofacial surgery [J].

ISSN 2706-6819 Vol.4, Issue 10: 62-67, DOI: 10.25236/IJFM.2022.041010

International journal of oral and maxillofacial surgery, 2011, 40(5): 451-457.
[29] Aly L A A. Piezoelectric surgery: Applications in oral & maxillofacial surgery [J]. Future Dental Journal, 2018, 4(2): 105-111.
[30] Jia Xi.Clinical efficacy of fenestration decompression and ultrasonic osteotome resection of jaw cysts in children with mixed dentition [J]. Harbin Medicine, 2022, 42(04): 76-77.
[31] Hakim M A, McCain J P, Ahn D Y, et al. Minimally invasive endoscopic oral and maxillofacial surgery [J]. Oral and Maxillofacial Surgery Clinics, 2019, 31(4): 561-567.
[32] Kishimoto T, Sukegawa S, Ono S, et al. Endoscope-assisted enucleation of mandibular dentigerous cysts [J]. Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology, 2021, 33(2): 126-130.
[33] Huang Zhiai, Li Peng. Clinical observation of endoscopic treatment of maxillary cyst [J]. Lingnan Journal of Emergency Medicine, 2017, 22(02): 187-188.
[34] Abdelwahab M, Abd Elfattah A M, Khafagy Y W, et al. Endoscopic enucleation of large jaw cysts: Promising outcomes [J]. Auris Nasus Larynx, 2018, 45(3): 578-584.
[35] Lysenko A, Razumova A, Yaremenko A, et al. The use of augmented reality navigation technology in combination with endoscopic surgery for the treatment of an odontogenic cyst of the upper jaw: A technical report [J]. Imaging Science in Dentistry, 2022, 52.
[36] Liaw C Y, Guvendiren M. Current and emerging applications of 3D printing in medicine [J]. Biofabrication, 2017, 9(2): 024102.
[37] Louvrier A, Marty P, Barrab é A, et al. How useful is 3D printing in maxillofacial surgery? [J]. Journal of stomatology, oral and maxillofacial surgery, 2017, 118(4): 206-212.
[38] Hu Min, Tan Xinying, Yan Rongzeng, Liu Changkui, Li Xiaofeng, Liu Can. Application progress of 3D printing technology in the field of oral and maxillofacial surgery [J]. Chinese Journal of Practical Stomatology, 2014, 7(06): 335-339.
[39] McAllister P, Watson M, Burke E. A cost-effective internal positioning and cutting guidance system for orthognathic surgery [J]. Journal of Oral and Maxillofacial Surgery, 2018, 17(1): 112-114.
[40] Qiu Xiaoling, Lin Guizhen, Jia Bo, Li Xin, Xing Yundi, Chen Lei. Clinical application of 3D printing surgical guide assisted microscopic apical surgery [J]. Journal of Sun Yat-Sen University (MedicalEdition), 2018, 39(04): 636-641.
[41] Li Jiayang, Niu Chenguang, Chen Dong, Wei Xiaoling. A controlled clinical study on the accuracy of digital guide-assisted microscopic apical surgery [J]. Stomatology, 2021, 41(04): 323-327.