

Research progress on the application of dentin bone meal in mandibular impacted tooth extraction

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Abstract: Dentin bone meal has gradually become an economical and effective material for repairing bone defects. The distal bone defect of the second molar caused by the removal of mandibular impacted third molar is a common occurrence. In this study, the complications after extraction of impacted third molar and the osteogenic effect of autogenous bone powder were discussed. Autogenous tooth bone (autogenous tooth bonegraft material AutoBT) as a new type of bone graft material, have good osteogenesis, bone induction and bone conduction activity, because of its composed of autologous abandoned teeth processing, so no immunogenicity, and abundant source, simple preparation. After a series of animal tests and clinical studies confirmed that AutoBT does have a good osteogenic effect.

Keywords: Mandibular impacted third molar, Dentin bone meal, Postoperative complications

1. Introduction

Impacted teeth are teeth in the jaw due to improper placement, most commonly impacted third molars in the lower jaw^[1]. The impacted teeth and the underlying gums are prone to accumulate dirt and dirt, resulting in the growth of bacteria, causing dental decay, bad breath and other symptoms^[2]. The extraction of mandibular impacted third molar, especially the middle and low impacted third molar, is a complicated operation in the oral surgery clinic. Postoperative wound bleeding, pain, swelling, infection, and restricted mouth opening are common complications after tooth extraction, which can occur after any tooth extraction, especially after mandibular impacted third molar extraction with a higher incidence^[3].

Studies have shown that there are many methods to prevent complications after tooth extraction^[4-7], but few use autogenous bone meal to prevent complications after tooth extraction. The traditional method to reduce the incidence and degree of postoperative complications is facial cold compress^[8]. This paper aims to study the complications after extraction of impacted third molar teeth and the effect of autodontic osteogenesis.

2. Complications after extraction of impacted teeth

2.1. Bleeding after tooth extraction

Postoperative hemorrhage is the primary complication after mandibular impacted third molar extraction, and it is also a common case in the department of stomatology. Local factors are often the main reasons, such as gingival tear, improper use of denture or dental forceps leading to damage and rupture of small blood vessels in alveolar fossa after surgery; large alveolar fossa making blood clots difficult to attach and then fall off; alveolar bone fracture, vascular damage in alveolar fossa, incomplete removal of granulation tissue and inflammatory tissue all cause bleeding after tooth extraction^[9]. In addition to suture and compression for hemostasis, local tamponade of various hemostatic materials has been applied more and more. During the operation, it was found that blood clots would still form after removing the blood clot in the tooth extraction wound, but the healing was delayed. It was speculated that the quality and structure of blood clot played a regulating role in the healing of the tooth extraction wound. Therefore, protecting blood clots and ensuring the quality of blood clots are of great significance in promoting the healing of tooth extraction wounds.

The diagnostic criteria for bleeding after tooth extraction^[10]: (1) Obvious bleeding: all the sterilized cotton rolls are soaked with blood, blood gushes out in the tooth extraction wound of the patient, and there is blood clot in the saliva. (2) Small amount of bleeding: the part of the disinfection cotton roll was soaked with blood, the blood in the tooth extraction wound of the patient oozed, and there were more blood streaks in the saliva. (3) No bleeding: a small amount of disinfection cotton is soaked with blood, there is no blood leakage in the tooth extraction wound, and there is a small amount of blood or no blood in the saliva. Both significant and minor bleeding are considered bleeding.

2.2. Swelling after extraction

Postoperative swelling is mostly caused by the turbine boneless heat production during the operation and the injury of the dividing teeth. In addition, excessive soft tissue stretching and even soft tissue tearing in order to obtain a clear operating field during the operation can lead to postoperative swelling. Its pathological basis is: in the case of trauma and inflammation, lymphatic vessel obstruction, destruction and reflex spasm lead to lymph reflux obstruction, resulting in local edema; The balance of blood pressure and osmotic pressure between capillaries and interstitial fluid was destroyed, the return of interstitial fluid was blocked, and the fluid remained in interstitial fluid. Trauma, pain and inflammation can cause local neuroregulatory dysfunction and aggravate the generation of edema^[11].

Evaluation criteria for swelling after tooth extraction^[12]: The degree of swelling shall be combined with the subjective judgment and measurement of doctors. The line distance was used to measure the distance from the lateral mouth Angle to the earlobe, the distance from the outer canthus to the mandibular Angle, and the facial measurement distance was calculated, and then the percentage of facial swelling was calculated. The calculation formula is as follows: facial measurement distance = (distance from mouth Angle to earlobe + distance from outer canthus to mandibular Angle) / 2; Facial swelling percentage = (facial measurement distance after surgery - facial measurement distance before surgery) / Facial measurement distance before surgery. If the percentage of facial swelling is greater than 3%, it can be assessed as facial swelling.

2.3. Restricted mouth opening after tooth extraction

Mouth opening is divided into maximum mouth opening (painless mouth opening) and passive mouth opening. The restricted mouth opening after tooth extraction may be due to the reduction of active mouth opening caused by swelling or the reduction of passive mouth opening caused by pain^[13]. The reason is the increase of local vascular permeability, the exudation of inflammatory substances, the dysfunction of local nerve regulation, the reactive swelling of surrounding tissue, and the spasm of the open jaw muscle group caused by surgical trauma.

The evaluation criteria for restricted mouth opening after tooth extraction^[14]: the mouth opening of normal people refers to the distance between the incisor edges of the upper and lower incisor teeth, which is about equal to the width of the three fingers of the index finger, middle finger and ring finger when they are closed, and the average mouth opening is about 3.7cm. Clinically limited mouth opening means that the mouth opening degree is less than 2.5cm.

2.4. Dry grooves after tooth extraction

Dry groove can occur in any tooth extraction wound. Domestic scholars have reported that about 5% to 10% of patients with dry groove after mandibular third molar extraction are complicated by dry groove, which is a relatively serious complication. The cause is still unclear, and most scholars believe that it is related to surgical trauma and bacterial infection^[15]. The trauma impinges on the bone wall of alveolar fosse to obstruct the formation of blood clots, and the histamine produced affects wound healing and leads to fibrinolysis of blood clots, destruction of blood clots, loss of blood clots or no formation of blood clots, resulting in the emptiness of alveolar fosse, long-term exposure of the wound to the mouth, repeated infection, leading to dry slot disease. Treponemas dentis with fibrinolytic function in anaerobic bacteria are exposed to blood clots in alveolar cavities, and directly or indirectly produce activators or activators, activate the complex, produce fibrinolytic factors, destroy blood clots, and create conditions for secondary infection of other bacteria, thus leading to the occurrence of dry slot disease^[16].

The diagnostic criteria for dry groove^[17]: (1) Severe spontaneous pain still occurs 2~3 days after tooth extraction and radiates to the ear temporal or the top of the head, and the effect of taking

painkillers is not good;(2) Oral examination of tooth extraction wound is empty, no normal blood clot, alveolar bone wall is exposed;(3) The wound is grayish white, the odor is obvious, the pain is obvious, and the local lymph nodes may have swelling and tenderness.

3. Auto BT

3.1. Auto BT preparation

AutoBT production process: Under strict aseptic conditions, the extracted teeth were disinfected in alcohol, disinfected in hydrogen peroxide solution for 1 minute, then taken out and rinsed with sterile saline to remove all caries, plaque, foreign objects and attached soft tissues on the tooth surface, dried with a three-way gun and crushed with a crusher, and filtered repeatedly with a suitable filter for 4 to 5 times. Determine the particle size between 450~850 μ m, check the volume of the crushed tooth, and the maximum volume is not more than 3mL. Put the tooth particles into the tooth powder container with a funnel and put them into the automatic vacuum ultrasonic tooth demineralization accelerator for grinding, demineralization, degreasing, disinfection, etc. The processed bone meal particles can be placed into the corresponding alveolar fossa [18].

3.2. Auto BT osteogenic mechanism

Teeth, alveolar bone and jaw bone are derived from embryonic neural crest cells, although dentin and bone tissue structure is different, but the biochemical components of the two are similar, 70% inorganic, 20% organic and 10% water. AutoBT bone induced mainly with the dentin matrix of bone morphogenetic proteins (BMPs BoneMorphogeneticProteins.), scholars believe that BMPs as bone induction signal molecules, dentin matrix as its slow-release system, constantly release BMPs,By binding with growth factors in the matrix to stimulate its activity, undifferentiated mesenchymal cells around bone defects are stimulated to proliferate and transform into chondrocytes and osteoblasts, thus forming new bone tissue [19].In addition to BMPs, dentin also contains a variety of other growth factors, such as insulin growth factor (GF-11D), bone morphogenetic protein 2(BMP-2) and transforming growth factor (TGF- β), as well as non-collagen proteins in dentin, such as osteocalcin, osteonectin, phosphorylated proteins and salivary proteins.It has also been shown to be associated with new bone formation and promoting bone remodeling [20].Hydroxyapatite in inorganic substances has low crystal structure and good chemical stability.The results show that the guiding ability of bone with low crystal is stronger than that with high crystal.Kim et al. concluded that hydroxyapatite can be used as a scaffold to guide the growth of osteoblasts along its surface, and at the same time protect BMPs and other growth factors and proteins from being absorbed, thus providing effective support for new bone formation[21].Kim et al. [22] used AuToBT to induce bone formation, and postoperative imaging showed that the density was similar to that of normal alveolar bone, while histology showed no significant difference between the bone graft area and surrounding bone tissue 3 months later.Therefore, AutoBT has good bone induction, bone formation and bone conductivity, and is an effective new bone graft material.

3.3. Clinical application of Auto BT

3.3.1 Incremental bone implant surgery

WKim, Minamizato, Jin Xiyang, Pang, Pohl et al.[23-27] used AuToBT in implant guided bone regeneration, alveolar bone site preservation, maxillary sinus external elevation, alveolar ridge bone augmentation, etc. The results showed that AUTOBT had good short-term osteogenic effect and no significant clinical complications were observed.It shows that AutoBT has reliable osteogenic effect.

3.3.2 Maxillofacial bone defect

Kim, Liu Xiaofang [28,29] et al. implanted AutoBT into the jaw defect area, and X-ray images showed good bone healing in the bone defect area 3 months after surgery. Histologically, the material was gradually absorbed and replaced by the surrounding new bone tissue. X-ray images showed the following 6 months after surgery: AuToBT was fused with the surrounding normal bone tissue, and the low-density image of the cyst cavity basically disappeared, and the trabecular structure and new bone formation were visible.As a new generation of bone tissue replacement material, AuToBT is safe and effective in the repair of bone defects, which can improve the short-term osteogenic effect and speed up the repair of bone defects. However, for large jaw defects, it has high requirements for bone graft

materials, and AuToBT needs to be combined with other bone graft materials.

3.3.3 Periodontal tissue regeneration

AuToBT not only induces osteogenesis, but also has a certain effect on tooth and periodontal tissue regeneration. Jiang Yuegui et al.^[30] used AuToBT as a kind of apical inducer, and AuToBT has the ability of proliferation and osteogenic differentiation of human periodontal membrane cells.

3.3.4 Other orthodontic treatments

If the alveolar bone mass is insufficient, AuToBT can be used to perform incremental orthodontic bone surgery, and a stable bone structure can be formed half a year after surgery, and the movement range of orthodontic teeth can be expanded^[31]. In addition, it can also be used in surgeries such as cleft palate and alveolar cleft.

4. Conclusions

Mandibular impacted third molar is one of the common diseases in oral surgery. Due to the continuous change of living environment and eating habits, the masseteric muscle has gradually evolved, resulting in the continuous reduction of jaw volume, but the volume of teeth has not changed, resulting in the shortage of space for the third molar, which is impacted in the jaw [7,8]. The extraction of mandibular impacted third molar is more difficult than that of other teeth, with relatively high technical requirements, because the gum needs to be cut or the encase bone removed, the operation time is long, and the postoperative pain of patients is obvious, which brings a lot of inconvenience to life. How to promote the postoperative tissue healing, reduce the discomfort of patients, and accelerate the recovery speed? Reducing the impact on patients' quality of life is currently the focus of clinical research. In the past, it was often used to fill clots and gauze strips for patients. Although it can effectively stop bleeding, it has no significant improvement on patients' postoperative symptoms. Autogenous bone powder is a new type of bone graft material made from extracted teeth. It has good biocompatibility, bone conduction and bone induction ability. At the same time, the porosity, degradation rate and strength of the autologous bone meal are well coordinated. After implantation at the bone graft site, it can obtain immediate structural support, and its porous structure can directly guide the surrounding bone cells to grow along its surface to form new bone. The rate of new bone formation and degradation of autogenous bone meal is higher than that of other bone graft materials, and the rate of new bone formation and degradation match each other, so the osteogenic effect is good. At present, clinical studies on autologous bone meal have proved that good bone formation can be achieved even if autologous bone meal transplantation is not covered with absorbable film or titanium film. Autologous bone meal has a good application prospect in the field of bone graft replacement materials, as a bone implant material and the derived dental bank are of great commercial value. Based on the current research results, the future research direction of autologous bone meal should be the development of tissue engineering scaffolds, allogeneic or xenogenous autologous bone meal transplantation and the production of dental restoration materials.

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