

CLINICAL OBSERVATION OF THE EFFECT OF ANTERIOR TOOTH EXTRACTION PRESERVATION ON PATIENTS' ALVEOLAR RIDGE SOFT AND HARD TISSUES

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ABSTRACT

Objective: The effect of site preservation on the amount of alveolar ridge bone and soft tissues of patients at 6 months after anterior tooth extraction was evaluated simultaneously using cone-beam computed tomography and indirect computing model, and the clinical value of anterior tooth extraction site preservation for alleviating alveolar ridge absorption was assessed.

Methods: A total of 58 patients (64 teeth) with indications for anterior tooth extraction admitted to the Department of Stomatology in our hospital from January 2018 to January 2020 were included as the subjects of study to perform retrospective analysis. 30 patients were randomly selected for extraction site preservation as the experimental group. 28 patients were selected for conventional tooth extraction as the control group. For 58 patients before and after tooth extraction, plaster models were made, and cone-beam computed tomography was performed immediately after the operation and 6 months after the operation. The height of labial and palatal alveolar ridges was measured. The width of the alveolar ridge at different root lengths was measured at the points of 20%, 50%, 70% of the root length, as well as the highest point of the mesial gingival papilla, the distal gingival papilla and the upper jaw gingival margin or the height of the alveolar ridge soft tissue at the lowest point of the mandibular gingival margin. The differences in various measurement indicators at the same time point and different time points were compared between groups.

Results: The difference in age and gender between the experimental group and the control group ($P < 0.05$) was not significant; the differences in the height of labial and palatal alveolar ridges measured immediately after the operation, and the width of alveolar ridge at different root lengths between the two groups were not significant ($P < 0.05$), but at 6 months after the operation, there was a significant difference in the above measurement indicators between the two groups. It was mainly reflected that the height of labial and palatal alveolar ridges, the width of alveolar ridge at 20% and 70% of root length of the experimental group were significantly higher than those of the control group ($P > 0.05$); at the same time, 6 months after the operation, the height of the inner labial and palatal alveolar ridge, the width of alveolar ridge at 20% and 70% of root length of the experimental group were significantly less reduced than those of the control group ($P > 0.05$). It was found from the measurement of the plaster model that the differences between the experimental group and the control group in the mesial gingival papilla, the distal gingival papilla and the highest point of the upper gingival margin or the lowest point of the mandibular gingival margin before the operation ($P < 0.05$) were not significant. At 6 months after operation, the height of the alveolar ridge soft tissue at the highest point of the maxillary gingival margin or the lowest point of the mandibular gingival margin in the experimental group was significantly lower than that of the control group ($P > 0.05$). In addition, at 6 months after operation, the height of the alveolar ridge soft tissue at the highest point of the upper gingival margin or the lowest point of the lower gingival margin was significantly less changed than that of the control group ($P < 0.05$).

Conclusion: Anterior tooth extraction preservation can effectively maintain the height and width of patients' alveolar ridge, as well as the soft and hard tissues. It can be widespread promoted and applied clinically.

Keywords: Extraction site preservation, extraction, anterior teeth, alveolar bone, soft tissues.

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Introduction

Today, dental implant restoration has been widely applied in the restoration of missing teeth, but it requires sufficient alveolar bone mass around the implant. However, the tissues around the alveo-

lar socket have different degrees of absorption after tooth extraction⁽¹⁾. Some scholars report that within 6 months after tooth extraction, the width absorption of alveolar ridge is up to 4.0 mm, and height absorption is also close to 1.3 mm, with the most alveolar bone absorption at the labial site⁽²⁾. The decrease of alveolar bone has been proved to affect the implan-

tation effect of implants, and is not conducive to the improvement of appearance and function after implant restoration⁽³⁾. To fill bone substitute into the alveolar socket and cover with a biofilm can help delay the absorption of alveolar bone.

However, previous studies mainly focused on the differences between different materials and surgical methods in the increase of bone mass, and there are few reports on whether extraction site preservation can maintain the width of alveolar bone and height of soft tissues in the edentulous area^(4,5). In this study, 64 teeth of 58 patients who met the indications of anterior tooth extraction admitted to our hospital from January 2018 to January 2020 were analyzed retrospectively, to explore the effect of extraction site preservation on alveolar bone and soft tissues in patients who met the indications of anterior tooth extraction. Below, the process will be reported.

Clinical data

General data

The clinical data of 64 teeth of 58 patients who met the indications of anterior tooth extraction admitted to our hospital from January 2018 to January 2020 were analyzed retrospectively. All patients were divided into 2 groups, 28 cases undergoing regular tooth extraction were set as the control group and 30 cases undergoing extraction site preservation were set as the experiment group.

The control group included 18 males and 12 females, aged 36-68, with an average age of (46.49±6.70) years. According to the position of anterior teeth, there were 24 maxillary teeth and 8 mandibular teeth. The experimental group included 16 males and 12 females, aged 34-66, with an average age of (45.21±6.44) years. According to the position of anterior teeth, there were 20 maxillary teeth and 12 mandibular teeth. There was no significant difference between two groups in terms of general data ($P>0.05$). The study protocol complied with Declaration of Helsinki and the patients and their families gave informed consent.

Inclusion and exclusion criteria

Inclusion criteria:

- The patients received anterior teeth extraction voluntarily;
- Age ≥ 18 ; the oral cavity was in good hygienic condition;
- More than 2/3 of adjacent teeth had bone wrapping around the roots.

Exclusion criteria:

- Those who smoked more than 10 cigarettes per day;
- With severe bone defect;
- Severe periodontal disease;
- Took drugs that affected bone healing;
- Dental crowding and torsion;
- Needed anterior teeth extraction;
- With wisdom teeth, orthodontic, impacted or deformed teeth;
- Diabetes;
- Hypertension;
- Osteoporosis.

Methods

All patients undertook basic periodontal treatment 2 weeks before the surgery. Alginate material was used to make a dental cast and die stone was filled in the cast. Before surgery, the patients gargled compound chlorhexidine gargle in their mouth for 1min. The experimental group received extraction site preservation. Under local anesthesia, the periodontal ligaments were cut off using a minimally invasive dental blade. When the root got loose, the affected teeth were removed in such a way to minimize the damage to alveolar bone wall during tooth extraction. After the extraction, the alveolar socket was cleaned and scraped and DBBM was filled, so that it can be slightly higher than the top of alveolar bone. The surface was covered with an absorbable biofilm (Geistlich Bio-Gide®, Switzerland) that was tailored, so that it can completely cover the bone graft material and exceed the diameter by 2mm. The wound underwent a tension-relieving suture and coated with a surgical dressing. The control group received regular tooth extraction. After the affected tooth was removed, only the alveolar socket was scratched thoroughly, so that blood clot can fill the alveolar socket. Cone beam computed tomography (CBCT) was conducted immediately and 6 months after surgery, stitches were removed 7-10 days after surgery, and the healing of wound was observed. Alginate material was used to make a dental cast and die stone was filled in the cast again 6 months after surgery.

Observation Indicators

Measurement of the height/width of alveolar bone

CBCT was performed immediately after surgery. The long axis of adjacent tooth was selected as the reference point. After the tooth extraction, the

sagittal plane was reconstructed. The gnathic plane was selected as a maxillary refer-ence plane. The height was measured by the horizontal line (L1) of the highest point of the plane and a line perpendicular to L1 made through the vertices of alve-olar ridges on the labial and maxillary sides.

The labial and maxillary heights immediately after surgery were set to hB1 and hP1, and the labial and maxillary heights upon reexamination 6 months after surgery were set to hB2 and hP2. Their differences were denoted as ΔhB and ΔhP respectively. According to the shape of tooth extraction socket, The root length of the extracted tooth was measured. At 20%, 50% and 70% of the root length, lines perpendicular to the long axis of alveolar ridge were made respectively, and the widths of alveolar ridge on the labiolingual side were measured. The widths immediately after surgery were set to dA1, dB1and dC1 and the widths 6 months after surgery were set to dA2, dB2 and dC2 respectively. Their differences were denoted as ΔA2, ΔB2 and ΔC2.

Measurement of the height of soft tissues

The horizontal plane of the cusp of adjacent tooth was selected as the reference plane, and perpendicular lines were made at the highest and lowest points of mesial gingival papillae, distal gingival papillae and gingival margin and their heights were measured.

Immediately after surgery, the distances from the highest and lowest points of mesial gingival papillae, distal gingival papillae and gingival margin to the plane of orientation were set to hM1, hD1 and hF1 respectively. 6 months after surgery, hM2, hD2 and hF2 were measured, and their differences were set to ΔM2, ΔD2 and ΔF2 respectively.

Statistical method

SPSS 20.0 was selected to analyze the data. Among them, the measurement data were compared by t test and expressed as ($\bar{x} \pm s$), while the enumeration data were compared by χ^2 test and ex-pressed as %. The significant level was $P < 0.05$.

Results

Comparison of the height of alveolar bone measured by CBCT between 2 groups

The levels of hB2 and hP2 in the experiment group were significantly higher than those in the control group ($P < 0.05$). The levels of ΔhB and ΔhP in the experiment group were significantly lower than

those in the control group ($P < 0.05$). There was no significant difference between 2 groups in terms of the levels of hB1 and hP1 ($P > 0.05$). See Table 1.

Group	Number of cases	hB1	hP1	hB2	hP2	ΔhB	ΔhP
Control group	28	20.35±1.64	23.78±1.38	14.65±1.17	15.93±1.54	6.75±1.25	7.46±1.89
Experimental group	30	20.08±1.27	23.72±1.33	16.48±1.24*	18.88±1.31*	4.37±1.50*	4.99±1.76*

Table 1: Comparison of the height of alveolar bone measured by CBCT between 2 groups CBCT (mm). * $P < 0.05$, compared with the control group.

Comparison of the width of alveolar bone measured by CBCT between 2 groups

The levels of dA2 and dC2 in the experiment group were significantly higher than those in the control group ($P < 0.05$). The levels of ΔdA and ΔdC in the experiment group were significantly lower than those in the control group ($P < 0.05$). There was no significant difference between 2 groups in terms of the levels of dA1, dB1, dC1, dB2 and ΔdB ($P > 0.05$). See Table 2.

Group	Number of cases	dA1	dB1	dC1	dA2	dC2	dB2	ΔdA	ΔdC	ΔdB
Control group	28	5.21±0.47	6.49±0.58	5.69±0.56	3.72±0.34	4.05±0.38	5.42±0.34	1.49±0.67	1.56±0.74	1.02±0.64
Experimental group	30	5.25±0.42	6.40±0.66	5.65±0.50	4.49±0.33*	4.76±0.45*	5.47±0.36	0.75±0.34*	0.88±0.46*	0.96±0.57

Table 2: Comparison of the width of alveolar bone measured by CBCT between 2 groups (mm). * $P < 0.05$, compared with the control group.

Comparison of the height of soft tissues measured by cast between 2 groups

The levels of hF2 in the experiment group were significantly lower than those in the control group ($P < 0.05$). The levels of ΔhM, ΔhD and ΔhF in the experiment group were significantly higher than those in the control group ($P < 0.05$). There was no significant difference between 2 groups in terms of the levels of hM1, hD1, hF1, hM2 and hD2 ($P > 0.05$). See Table 3.

Group	Number of cases	hM1	hD1	hF1	hF2	hM2	hD2	ΔhM	ΔhD	ΔhF
Control group	28	6.67±0.28	5.94±0.20	8.03±0.38	10.68±0.25	7.54±0.37	7.03±0.39	-1.06±0.25	-1.07±0.28	-2.51±0.35
Experimental group	30	6.54±0.37	6.02±0.28	8.09±0.21	9.23±0.41*	7.50±0.45	7.07±0.33	-0.99±0.34*	-0.90±0.30*	-1.22±0.36*

Table 3: Comparison of the height of soft tissues measured by cast between 2 groups (mm). * $P < 0.05$, compared with the control group.

Discussion

The decrease in the bone mass of the implantation area can exert a significant impact on the initial stability of the implant. To guarantee sufficient bone mass has become an important prerequisite for improving the functions and restoration effect of the implant⁽⁶⁾. How to effectively defer or avoid alveolar bone absorption after tooth extraction and protect the morphology of tissues around the alveolar socket and enhance the implantation effect of implant has attracted more and more attention from the medical community. The notion of extraction site preservation means that immediately after tooth extraction, the biomaterials are grafted to support and fill the alveolar socket, effectively reduce alveolar bone absorption, avoid the occurrence of gingival epithelium or fibrous tissues in the extraction socket and accelerate the osteogenesis process of extraction socket. This is of great significance for the preservation of alveolar bone or the increase of bone mass⁽⁷⁾.

The basic steps of extraction site preservation include minimally invasive tooth extraction, the implantation of bone substitute and suture, etc. Among them, minimally invasive tooth extraction is a key step to the preservation of extraction site. During operation, first of all, the periodontal ligaments are cut off. And a minimally invasive tooth extraction is conducted after the root gets loose. Avoid damaging the alveolar bone by tapping with a dental elevator and a dental hammer. After the affected tooth is removed, the alveolar socket is cleaned and scratched thoroughly, so that fresh blood can fill it⁽⁸⁾. In terms of bone substitutes, deproteinised bovine bone matrix (DBBM) was selected in our study, which is characterized by high porosity, large surface area and similarity to natural bone components, etc. It can have a good osteoprogenic effect⁽⁹⁾. Studies by foreign scholars show that DBBM can effectively delay alveolar bone absorption and accelerate the formation of new bone. Meanwhile, when being used in conjunction with biofilm, it can further inhibit the vertical and horizontal absorption of alveolar bone and increase the width of alveolar bone⁽¹⁰⁾.

A study on the filling of calf bone meal in the mandibular extraction socket of animal model showed that after 3 months of healing after surgery, the vertical height of alveolar ridge decreased to 25%, while the vertical height of unfilled animals decreased to nearly 50%⁽¹¹⁾. Another study included patients who lost a single tooth in the maxillary anterior teeth area. Xenogeneic bone materials were

filled in the extraction socket and the extraction socket was closed with connective tissues. 4 months after surgery, CBCT imaging showed that the widths 2mm, 5mm and 8mm below the crest of alveolar ridge decreased by 20%, 12% and 7% respectively⁽¹²⁾. In our study, CBCT was used to evaluate the changes in the width and height of alveolar bone, and the results showed that the levels of hB2 and hP2 in the experimental group were significantly higher than those in the control group ($P < 0.05$). The levels of ΔhB and ΔhP in the experimental group were significantly lower than those in the control group ($P < 0.05$). The levels of dA2 and dC2 in the experimental group were significantly higher than those in the control group ($P < 0.05$).

The levels of ΔDa and ΔdC in the experimental group were significantly lower than those in the control group ($P < 0.05$), which suggested that extraction site preservation was prevailing in the maintenance of the height/width of alveolar ridge, but there was no significant difference between two groups in terms of the width of alveolar bone at 50% of the root length ($P > 0.05$). This was probably because the local soft tissues tension at 50% root length, and the decrease of the height of alveolar bone in the control group made the width measurement at 50% close to that of the root⁽¹³⁾.

Some reports suggest that extraction site preservation allows the alveolar ridge to effectively support the gingival papilla and gingival margin, prevent gingival papilla and gingival margin from shrinking as the alveolar bone absorption increases, enhance the aesthetics of gingiva and dentition and make sure that the denture implanted later has good stability⁽¹⁴⁾. Other studies corroborate that during extraction site preservation, there is no need to suture the wound tightly, but simply expose part of the overlying collagen membrane^(15, 16). The wound was closed and healed with the help of the proliferation of surrounding soft tissues. The follow-up after surgery showed that the gingival width increased by 2-3mm. In this study, 6 months after surgery, the height of soft tissues of alveolar socket of patients undergoing extraction site preservation was significantly higher than that of the control group, which further supported that extraction site preservation can effectively improve the height of the highest point of the gingival margin of alveolar bone.

There are also some limitations in this study it belongs to single-center retrospective reports, the sample size is relatively small, and the conclusions may be biased; the follow-up is short, and the long-

term prognostic evaluation still needs to be verified in subsequent research.

In summary, to treat patients who met the indications of anterior tooth extraction by extraction site preservation can effectively maintain the height/width of alveolar ridge and protect the soft tissues of gingiva.

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