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Research Article

Optimization of Direct Dental Implantation in the Inter-Root Partition of Molars of the Upper Jaw (Experimental Study)

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Abstract

The method of direct dental implantation, which consists in installing an implant in the well of a newly extracted tooth, was first published by R.J. Lazzara in 1989, the advantages of which are, first of all, a reduction in the rehabilitation time for patients with partial adentia and a decrease in the degree of atrophy of bone tissue, which allows for further prosthetics with maximum aesthetic and functional results.

Keywords: *Direct Dental Implantation; Molars; Upper Jaw*

Introduction

As a review of the literature shows, the solutions to the problem of direct dental implantation in the molar area fit mainly in two treatment options, namely, the use of long dental implants and their installation in periapical palatal root tissues or the use of large diameter implants and primary stability due to their contact with the vestibular and oral walls of the hole. The disadvantage of the first treatment option is the low success rate (82%, after 5 years of observation), which is caused by off-axis loading and the lever effect of the orthopedic design. In the second treatment option, the main disadvantage is the high risk of loss of the vestibular plate of the bone and, as a consequence of the recession of soft tissues and exposure of the threads of the implant thread. Gluckman presented an alternative technique, which consists in installing a small diameter dental implant in the inter-root septum of the molars, however, it does not clearly present the stages of preoperative planning, and most importantly there are no recommendations regarding the selection of the optimal diameter of the implant to be installed.

Objective of the Study

To determine the optimal diameter of the implant during direct dental implantation in the interroot septum of the maxillary molars in an animal experiment.

Materials and Methods

Determining the optimal implant diameter, based on the principles of creating adequate primary stability and correct, from the point of view of prosthetics, positioning was performed on 10 upper jaws of Landras pigs aged 8 - 12 months, taken after slaughtering animals at the farming company LLC “Marine-E”, Divnogorsk city.

At the first stage, CBCT was performed on all the experimental material using the VATECH Pax-i3D (PHT-6500) apparatus. Considering the fact that the interroot septum in the region of the molars of the upper jaw has the shape of a pyramid and its base is an irregular triangle, the basis of this study was the method for determining the diameter of the implant for installation in the interroot septum (RF Patent for invention No. 2599877 dated 04/21/2015 "Method determining the diameter of the implant during immediate dental implantation in the interroot septum when removing molars of the upper jaw").

The essence of the method is to determine the diameter of the only possible circle inscribed in the base of the interroot septum (irregular triangle). Using the values of the area and perimeter calculated in the program for viewing and analyzing three-dimensional images of Ez3D plus, the mathematical formulas were used: (D) = r * 2; (r) = S/p; p = P/2, where D is the diameter, r is the radius, S is the area, the P is the perimeter, the is the p-half-perimeter and the diameter of the only circle that can be entered into the triangle constructed at the base of the inter-root septum was determined.

We hypothesized that the calculated diameter will exactly match the maximum possible diameter of the dental implant planned to be installed in the interroot septum. In the program for viewing and analyzing computed tomograms Ez3D plus, the height of the interroot septum and the diameter of the circle inscribed in the base of the interroot septum in the region of the third and fourth premolars of the upper jaw of pigs were calculated using the method described above.

At the next stage, atraumatic extraction of these pigs' teeth, the most similar in structure to the first and second human molars, was performed. With a fracture of the interroot septum, the experiment was considered unsuccessful.

Next, in the area of the apex of the interroot septum with a round boron with a diameter of 5 mm, a platform was prepared in which, strictly adhering to the surgical protocol, implantation beds for dental implants from DENTIS (Korea) were formed with a platform/apex diameter of 3.7/3.0; 4.1/3.4; 4.3/3.6; 4.8/4.1 mm in turn, starting with a smaller size. The criteria for the failure of the experiment were: fracture of the interroot septum, torc < 30 N/cm^2. Thus, a total of 40 experiments were performed. After each placement of dental implants in the interroot septum of the third and fourth premolar pigs, the control cone beam computed tomography was performed. In the program for viewing and analyzing tomograms, the position of the installed implant was evaluated.

Results and Discussion

The study found that the studied sizes of the alveolar processes of the right and left upper jaws of pigs did not differ significantly from each other ($p > 0.05$). It was revealed that the height of the interroot septum of the third and fourth premolar pigs in the upper jaw was 10.7 [9.8; 12.0] mm. The diameter of the inscribed circle in the interroot septum of these teeth was 5.1 [4.5; 6.2] mm.

It was found that in 7.5% of cases, a fracture of the interroot septum occurred at the stage of extraction of three-root teeth. The height of the interroot septum and the diameter of the circle inscribed in its base were on average 9.2 mm and 4.1 mm, respectively. In the future, these cases were not taken into account in the study.

Thus, the study of choosing the optimal diameter of the dental implant during direct dental implantation in the interroot septum of multi-root teeth was carried out in 37 cases (100%). The height of the partition and the diameter of the circle inscribed in its base were 11.0 [9.8; 12.0] mm and 5.1 [4.5; 6.4] mm, respectively. At the stage of implant placement with a diameter of 3.7/3.0 mm, a fracture of the interroot septum occurred in 16.2% (6 cases, average height and diameter of 10.6 mm and 3.8 mm, respectively), of which 16.6% of cases (1 case, height - 13.0 mm, diameter - 3.8 mm) the torc of the installed implant was 30 N/cm^2. This was regarded by us as a successful operation.

The installation of dental implants with a diameter of 4.1/3.4 mm was performed in 31 cases. The values of the height of the partition and the diameters of the circle inscribed in its base were 11.1 [9.8; 12.0] mm 5.7 [4.7; 6.5] mm, respectively. Fracture of the interroot

septum was observed in 12.9% of cases (4 cases, average height and diameter - 11.1 mm and 4.3 mm, respectively). The installation of dental implants with a diameter of 4.3/3.6 mm was performed in 27 cases. The height of the interroot septum was 11.1 [9.9; 12.0] mm, the diameter of the circle inscribed in its base was 5.9 [4.8; 6.5] mm. At the stage of installation, a fracture of the interroot septum occurred in 25.9% (7 cases, average height and diameter 10.7 mm and 4.7 mm, respectively), of which 28.6% of cases (2 cases, average height and diameter - 7.75 mm and 4.7 mm, respectively) the torc of the implants installed was 30 N/cm^2. This was regarded by us as a successful operation.

The installation of dental implants with a diameter of 4.8/4.1 mm was performed in 20 cases. The height of the interroot septum was 10.9 [10.1; 12.1] mm, the diameter of the circle inscribed in its base was 6.2 [5.8; 6.8] mm. Fracture of the interroot septum was observed in 10% of cases (2 cases, average height and diameter 11.2 mm and 4.9 mm, respectively), of which in one case the implant torc reached 30 N/cm^2 (height 10.7 mm, diameter - 5.1 mm).

In total, the operation of direct dental implantation into the inter-root septum of three-root teeth in the experiment was successfully performed in 80% of cases. A search was made for the correlation between the diameters of the circles inscribed in the base of the inter-root partitions of the three-root pig teeth and the diameters of the platform/body of the dental implants installed in them (Figure 1). Thus, based on the results of an experimental study, during direct dental implantation in the interroot septum of the maxillary molars, we recommend using an implant with a platform/body diameter less than 0.4 mm than the circumference calculated in the preoperative period using the developed technique.

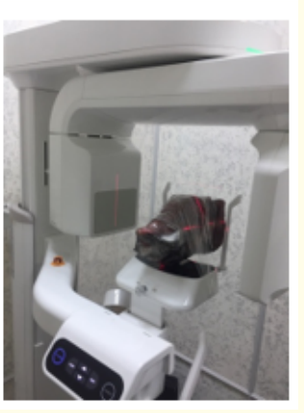
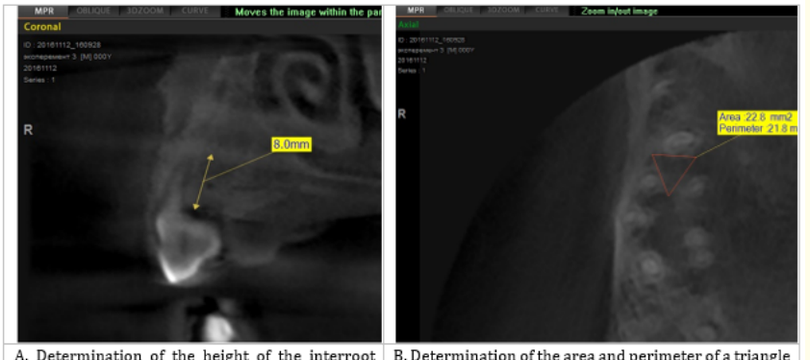


Figure 1: *Implementation of CBCT experimental material on a VATECH Pax-i3D (PHT-6500) apparatus.*

Next, an analysis of the computer tomogram of the upper jaw was performed in the Ez3D plus program. The height of the interroot septum and the diameter of the inscribed circle in the base of the interroot septum of the third premolar were calculated according to the developed method (Figure 2).

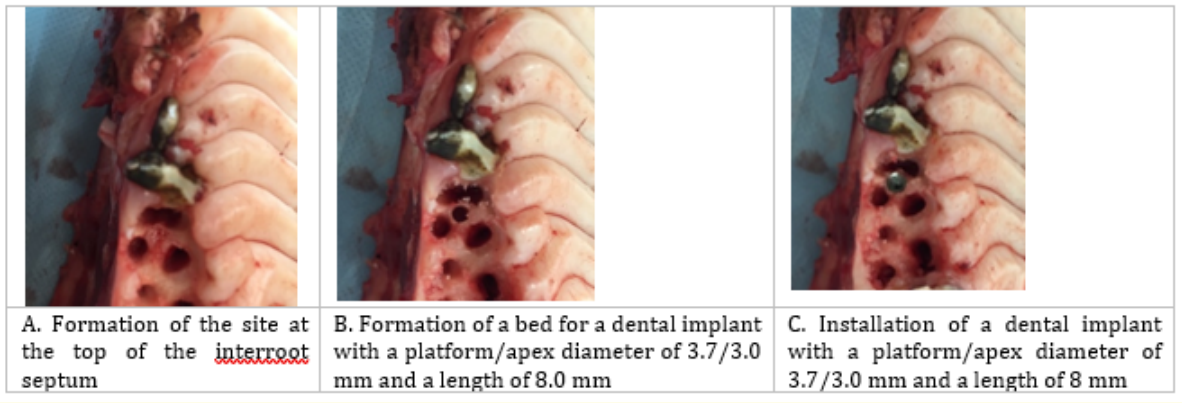


A. Determination of the height of the interroot septum of the third premolar

B. Determination of the area and perimeter of a triangle built at the base of the interroot septum

Figure 2: *Planning for immediate dental implantation in the inter-root septum in the experiment.*

Thus, the height of the interroot septum was 8 mm, and the diameter of the circle inscribed in the triangle constructed at the base of the interroot septum of the third premolar corresponded to 4.2 mm. At the next stage, atraumatic removal of the third premolar was performed. At the top of the interroot septum with a boron with a diameter of 5 mm, a site was prepared for the further formation of the implantation bed (Figure 3A and 3B).

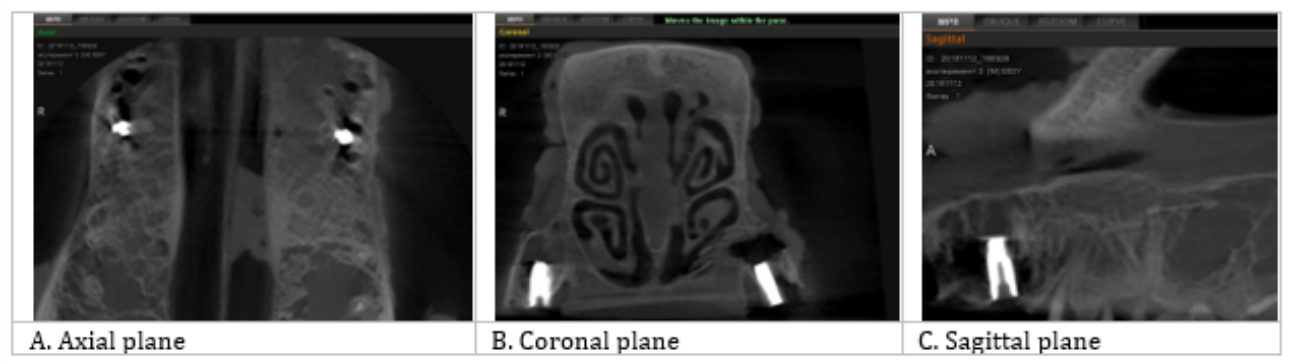


A. Formation of the site at the top of the interroot septum | B. Formation of a bed for a dental implant with a platform/apex diameter of 3.7/3.0 mm and a length of 8.0 mm | C. Installation of a dental implant with a platform/apex diameter of 3.7/3.0 mm and a length of 8 mm

Figure 3: *Protocol of direct dental implantation in the interroot septum in the experiment.*

After the implantation bed was formed, the first dental implant of DENTIS (Korea) was installed with a platform/apex diameter of 3.7/3.0 mm and a length of 8 mm (Figure 3B).

On the control CBCT, the position of the dental implant was evaluated as satisfactory (Figure 4).



A. Axial plane | B. Coronal plane | C. Sagittal plane

Figure 4: *Control CBCT after direct dental implantation in the inter-root septum in the experiment.*

After successful implant placement, it was removed and the implant bed expanded to the next implant diameter (4.1/3.4 mm) (Figure 5A). When a dental implant with the following diameter of 4.1/3.4 mm and a length of 8 mm was inserted, a fracture of the interroot septum and a torc of 20 N/cm^2 were observed (Figure 5B).

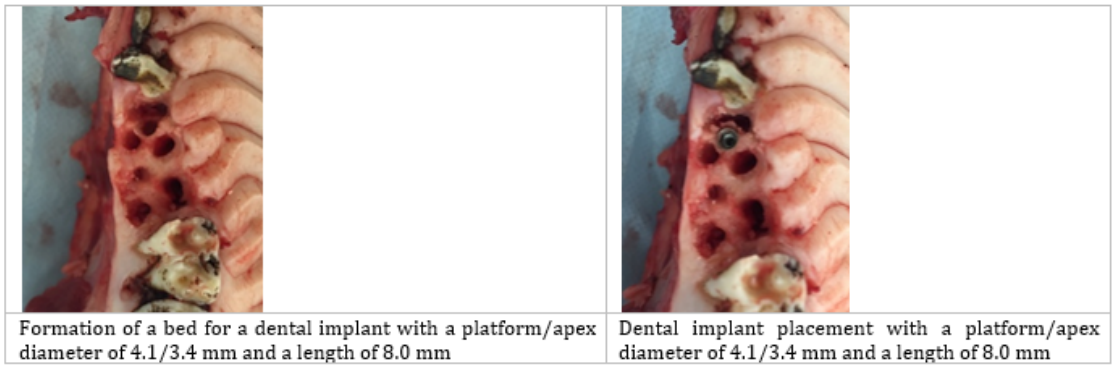


Figure 5: *Fracture of the interroot septum with direct dental implantation.*

Thus, experimentally determined criteria for choosing the diameter of the dental implant, based on the preoperative calculation of the diameter of the circle inscribed in the base of the interroot septum of the maxillary molars and during the surgical stage of direct dental implantation in the experiment.

Conclusion

1. When planning direct dental implantation in the interroot septum of the maxillary molars, it is necessary to take into account the diameter of the circle inscribed in its base, calculated according to the developed technique (RF Patent for the invention No. 2599877 of 04/21/2015);

2. When a dental implant is installed with a diameter exactly matching the calculated value, a fracture of the interroot septum and a torc of 20 N/cm^2 occur.

3. During direct dental implantation into the interroot septum of the maxillary molars, it is recommended to use an implant with a platform/body diameter less than 0.4 mm than the circumference calculated in the preoperative period according to the developed technique.

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