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A method of dental implantation with palatal exposure (vestibular bone shield) for single defects with moderate lateral atrophy of the maxillary alveolar process

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Abstract. Currently, the incidence of dental defects due to tooth loss due to complications of caries and periodontal disease is quite high. This necessitates restoration of these defects, including the placement of dental implants. The literature provides insufficient information on patient rehabilitation using dental implants with palatal exposure (vestibular bone shield) for single defects with moderate lateral atrophy of the alveolar process of the maxilla. This prompted this research. Therefore, this paper presents the clinical results of the practical application of this method using implants with a less rough and anodized neck. The paper presents the results of a 5-year application of the developed method in 118 clinical cases of middle-aged and elderly patients with single partial secondary adentia in the form of included defects with moderate lateral atrophy of the alveolar process of the maxilla. The obtained data were processed using MS Office Excel. A combination of essential features contributes to the solution of a methodological problem: increasing the effectiveness and minimally invasiveness of rehabilitation for single, included defects with moderate lateral atrophy of the maxillary alveolar process using implants with milled and anodized necks when placed in the maxillary ridge with lateral atrophy and palatal exposure (vestibular bone shield). This eliminates the need for bone augmentation and allows for immediate loading with orthopedic structures.

Thus, the use of dental implantation with palatal exposure (vestibular bone shield) and a milled and anodized neck contributes to the increased effectiveness of surgical interventions and orthopedic rehabilitation for moderate lateral atrophic changes in the maxillary alveolar process.

Keywords: dental implantation, secondary edentia, included alveolar process defect, moderate alveolar process atrophy, palatal implant exposure, vestibular bone shield, osseointegration, orthopedic structures.

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Introduction. Dental implantation is currently undergoing rapid development, offering the most optimal option for restoring dental defects from a physiological perspective, regardless of financial costs [1, 2]. The incidence of dental defects due to tooth loss due to complications of caries and periodontal disease is quite high, necessitating restoration, including the installation of dental implants. Various methods of dental implantation for moderate to severe atrophic changes in the alveolar processes exist, each with its own advantages and disadvantages [3, 4]. Therefore, research aimed at improving dental implantation for complex clinical cases is essential in clinical dentistry. Currently, the literature provides insufficient information regarding the placement of dental implants with palatal exposure (vestibular bone shield) for single defects with moderate lateral atrophy of the alveolar process of the maxilla during comprehensive patient rehabilitation [5, 6, 7]. This situation determines the difficulties and complexities in the rehabilitation of dental defects in the maxilla using artificial titanium supports without bone augmentation and immediate (one-stage) loading, which dictates the need for research aimed at solving these problems [8, 9, 10].

The above characterizes the presence of scientific, practical, and theoretical significance in solving clinical problems in single defects with moderate lateral atrophy of the alveolar process of the maxilla, which served as the basis for this research.

The aim of the study was to improve the efficiency of rehabilitation of patients with single defects with moderate lateral atrophy of the alveolar process of the maxilla through the clinical application of the developed method.

Material and methods. To achieve the set objectives, a clinical analysis and evaluation of the clinical application of the developed method of dental implantation with palatal exposure (vestibular bone shield) for single defects with moderate lateral atrophy of the alveolar process of the maxilla were conducted (patent application No. 2025130384 dated November 4, 2025). The article presents the results of a five-year observation of the developed method in 118 clinical cases in a group of middle-aged and elderly patients from 45 to 71 years old (study group). To compare the study results, a control group (n=36) was formed, aged 47-69 years, in which dental implants were installed using the dental implantation method (L.T. Volova, V.D. Arkhipov, A.V. Arkhipov, N.V. Volov, patent No. 2416376 dated April 20, 2011). Inclusion criteria for the study group were the presence of a single partial secondary edentia in the frontal and lateral sections of the maxilla in the form of included defects. The presence of oncological diseases, allergies to local anesthetics, refusal to participate in the study, and severe general somatic diseases formed the basis of the exclusion criteria. According to the proposed method, in the case of a single missing tooth, characterized by an included defect with moderate lateral atrophy of the maxillary alveolar process, a dental implant with a milled and anodized neck and palatal exposure (vestibular bone shield) was inserted after infiltration anesthesia with 4% Ultracaine® D-S Forte (1.7 ml). A linear incision was then made along the ridge with a #15C scalpel, and a mucoperiosteal flap was raised with a raspatory to provide access to the area of the missing tooth. A dental navigation surgical template was secured, and a bed for the implant was formed at 800 rpm using a navigation set of surgical burs on an angled handpiece on a physiodispenser with copious irrigation using chilled saline solution, according to the standard drilling protocol. A dental implant was inserted with a palatal exposure, leaving the coils uncovered by bone tissue. The implant height was then adjusted, and an Octa abutment and healing cap were installed. If necessary, circumferential cortical bone reduction (profiling) was performed around the abutment to ensure passive seating. The mucoperiosteal flap was adapted to the multi-unit exit site and sutured. A healing cap was then installed. Once the target torque of 35-45 N/cm was achieved, a provisional device was secured.

Permission to conduct the study was obtained from the local ethics committee of the M.K. Ammosov North-Eastern Federal University (Protocol No. 40 dated September 18, 2022). Each participant signed an informed consent form.

The obtained data were processed using MS Office Excel (2016).

Qualitative indicators are presented as absolute values and relative percentages. Significant differences were determined using Student's t-test, with the critical value set at p=0.05.

Results and discussion. A method of dental implantation with palatal exposure (vestibular bone shield) for single defects with moderate lateral atrophy of the maxillary alveolar process is used for patient rehabilitation with the installation of a dental implant with a milled and anodized neck. The essence of the developed method is to increase the effectiveness of dental implantation and the subsequent prosthetic stage, reduce treatment time, and minimize invasiveness during the installation of a dental implant with a milled and anodized neck in the maxillary alveolar process by exposing the palatal coils and creating a vestibular bone shield in the area of singly missing maxillary teeth, simultaneously restoring the lost contour by grafting a free gingival graft.

A schematic demonstration of the technique is presented in 3D visualizations. The implementation of the dental implantation method with palatal exposure (vestibular bone shield) using implants with milled and anodized necks in the area of included single-tooth defects in the maxillary arch begins with an assessment of the thickness and height of the alveolar process. Virtual planning was performed using a 3D cone-beam computed tomography (CBCT). The results were then used to select an implant based on diameter and height. Meanwhile, an orthopedist, implant surgeon, and dental technician modeled a surgical template and then printed it on a 3D printer. Infiltration anesthesia with Ultracaine® D-S Forte was administered, and the area of the maxilla with partial secondary edentia and moderate alveolar bone atrophy in the area of tooth 11 was exfoliated (Fig. 1).

A dental navigation surgical template was then attached (Fig. 2).

Then, using drills and copious irrigation with cooled saline, the implant bed was formed according to the manufacturer's recommended drilling protocol (Fig. 3).

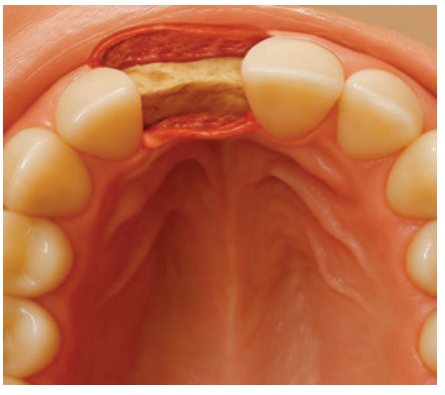

Fig. 1. A detached section of the maxilla with partial secondary edentia and moderate alveolar bone atrophy in the area of tooth 1.1.

Fig. 2. The dental navigation surgical template applied to the tooth.

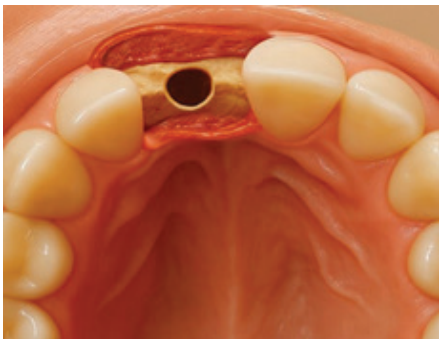

Fig. 3. The prepared site for the dental implant

The dental implant was inserted into the prepared site by exposing the coronal portion of the site (vestibular bone shield) with a milled and anodized neck in projection 1.1 (Fig. 4).

When a certain implant torque of more than 35 N/cm was reached during surgery, an Octa abutment superstructure and a provisional crown made of polymethyl methacrylate (PMMA) were installed, followed by interrupted sutures in the postoperative wound (Fig. 5).

After 3-6 months, the permanent prosthetic structure was fabricated and secured.

It should be emphasized that, using the proposed method, a cover can be

placed on the installed implant, if necessary, with suturing and opening of the implant after final osseointegration in 3-4 months, followed by the formation of a gingival cuff. Furthermore, in cases of low bone density and no indication for immediate loading (single-stage), where the force on the installed implant is greater than 25 N/cm but less than 35 N/cm, a gingival cuff former or an Octa abutment with a healing cap can be installed until integration is complete.

A comparative analysis of the effectiveness of the developed method shows that in the study group, the duration of surgical and prosthetic rehabilitation was accelerated by 2.19 times ($p \leq 0.05$). The success rate for the surgical stage of treatment was n=115 (97.45+0.03%), compared to n=34 (94.44+0.22%) in the control group ($p \leq 0.05$). However, the control group has some disadvantages related to the technical complexity of the procedure and the need to use bone substitutes and barrier membranes, which may lead to some inflammatory reactions after the intervention. Furthermore, the membrane used, made from the patient's autologous blood plasma, does not possess the required mechanical and biological properties and therefore cannot serve as a barrier to ascending infection. Thus, based on the obtained results of dental implantation with palatal exposure (vestibular bone shield) using implants with milled and anodized necks for single defects with moderate lateral atrophy of the maxillary alveolar process, this method is considered universal in the selection of dental implants with suitable designs from various manufacturers, with milled and anodized necks. Furthermore, it achieves minimally invasive interventions with increased effectiveness of postoperative tissue regeneration.

Clinical example. Patient P., born in 1967, presented to the Clinic of the North-Eastern Federal University named after M.K. Ammosov on May 15, 2024, complaining of the absence of tooth 1.4 in the upper jaw on the right side and the presence of an aesthetic defect (Fig. 6).

Objectively: partial secondary adentia in the form of an included defect. The mucous membrane on the vestibular and palatal aspects of the alveolar process is pale pink, sufficiently moist. There is moderate lateral atrophy of the alveolar process of the maxilla in the projection of the missing tooth 1.4. Results of 3D CBCT: the bone height of the dental arch to the bottom of the maxillary sinus in the area of the extracted tooth 1.4 is 15.0 mm. Moderate lateral atrophy of the alveolar bone in the crest area is noted,

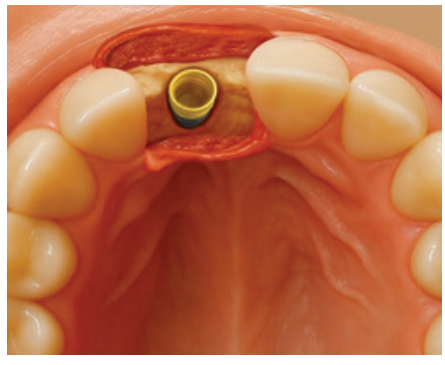

Fig. 4. Dental implant inserted into palatal bone tissue (vestibular bone shield) with a milled and anodized neck in projection 1.1.

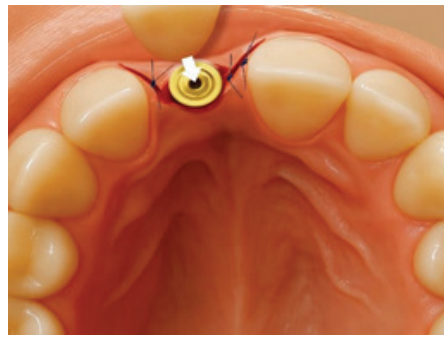

Fig. 5. Installed Octa abutment superstructure and provisional PMMA crown with suturing of the postoperative wound

where the indicator is 4.8-5.5 mm. Following consultation with an orthopedic dentist, an implant surgeon, and a comprehensive clinical and laboratory examination, a decision was made to install a JDentalCare JDIcon Plus dental implant with a less rough and anodized neck, with palatal exposure (vestibular bone shield) in position 1.4.

On May 18, 2024, a dental implant with a less rough and anodized neck was installed in position 1.4. Procedure: Under local anesthesia with 1.7 ml of Ultracaine® D-S Forte, a linear incision was made along the ridge of the upper right jaw in the projection of the extracted tooth #14. A #15C scalpel was used to make a linear incision along the ridge. A mucoperiosteal flap was raised with a raspatory to ensure sufficient visualization and general access to the surgical area. A dental navigation surgical template was fixed. Using the NSK Surgic Pro OPT physiodispenser, a 20:1 angled handpiece, and a navigation kit, a bed for the implant was formed to the desired depth with ample cooling using saline. After this, a dental implant with a less rough and anodized neck was installed in position 1.4 d3.7 L 11.5, torque 35 N/cm with palatal exposure (vestibular bone shield) (Fig. 7).

Fig. 6. Defect of the dental arch of the upper jaw with the absence of 1.4 tooth

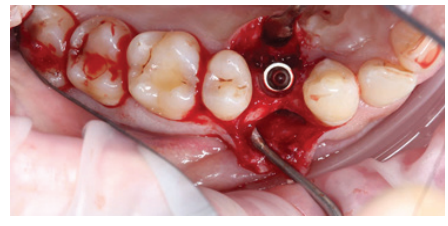

Fig. 7. A dental implant installed in the alveolar process in position 1.4 with palatal exposure (vestibular bone shield)

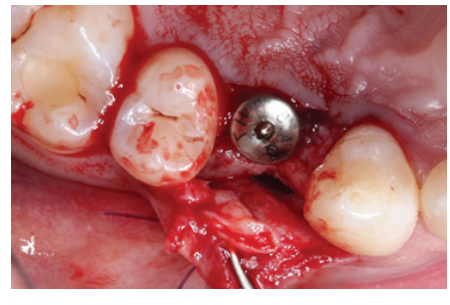

Fig. 8. A gingival cuff former installed on a dental implant and a free gingival graft from the palate implanted in the vestibular area

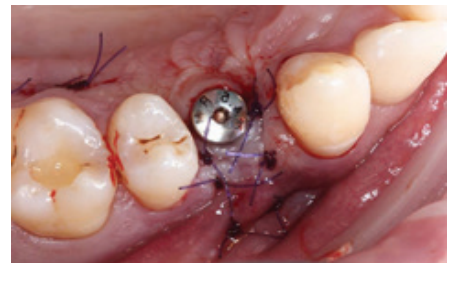

Fig. 9. Mucoperiosteal flap at the exit site of the gingival cuff former, the wound surface is sutured with interrupted sutures "Monokvik 5.0"

Fig. 10. Condition after removal of sutures and before fixation of the orthopedic structure

Next, using a physiodispenser, angled handpiece, and profiling bur, a circular reduction of the alveolar ridge around the

implant was performed at 350 rpm with copious cooling using saline. The height was then adjusted and the gingival cuff former was installed with a torque of 10 N/cm. A free gingival graft from the palate was placed in the vestibular area to correct the loss of bone contours (Fig. 8), and the mucoperiosteal flap at the gingival cuff former exit site was adapted and sutured with interrupted Monoquik 5.0 sutures (Fig. 9). Digital impressions were taken to fabricate a provisional orthopedic restoration.

On May 19, 2024, the patient presented for examination and placement of a provisional restoration. Objective status: satisfactory general condition, facial configuration is normal, regional lymph nodes are not enlarged, mouth opening is free and painless. There are no pathological changes in the oral mucosa. Palpation of the surgical site is painless, there is no discharge, no signs of infection, and the sutures are adequate. A temporary PMMA crown was placed with a torque of 15 N/cm.

On May 29, 2024, a follow-up examination and suture removal were performed. Objective data: satisfactory general condition, facial configuration is normal, regional lymph nodes are not enlarged, mouth opening is free and painless. No pathological changes are observed in the oral mucosa. Palpation of the surgical site was painless, there was no discharge, and no signs of infection were detected upon examination. The sutures were adequate and partially resorbed. The sutures were removed, and recommendations were given (Fig. 10). The permanent implant was fabricated and secured after 4 months. The tissue around the implants is stable, with no signs of inflammation or tissue loss.

Discussion. A wide range of clinical methods exist for the rehabilitation of isolated defects in the maxilla. For example, a method for installing dental implants is used for horizontal atrophy of the alveolar processes of the jaws. This involves filing down the ridge until a sufficient dental arch thickness is achieved, allowing for implant placement [11]. After the incision, a mucoperiosteal flap is raised, and the alveolar ridge crest is skeletonized. After resection of the ridge to a level where the bone thickness allows for implant placement, a Lindemann pilot cutter or fissure bur is used to subsequently prepare the implant bed. The disadvantages of this method include its invasiveness, deterioration of aesthetic parameters at the orthopedic stage due to a decrease in bone and gingival height, and elongation of the clinical crown, which limits its indications for use. In addition, there is a method of bone grafting for the reconstruction of alveolar processes with atrophic changes or trauma using the patient's own bone graft from the maxillary tuberosity area, with simultaneous installation of dental implants and provisional structures [12]. Under local anesthesia, atraumatic tooth extraction is performed, the socket is curettaged, and a dental implant of the required size is installed in an orthopedically favorable position. Next, a temporary plastic crown is tried in and customized. The donor site of the maxillary tuberosity is anesthetized, and an incision is made along the ridge, reflecting the mucoperiosteal flap. The autograft is then collected with a bone chisel, subsequently fixed in the area of the dental defect. The autograft should be positioned 2.0 mm below the gingival margin. In this case, the gap between the implanted autograft and the dental implant is filled with cancellous bone chips. After fixing the provisional structure, the wound surface is sutured. Disadvantages of this method include the risk of exposure of the marginal gingiva and, consequently, the underlying bone tissue, primarily in individuals with a thin mucosal biotype and without attached keratinized gingiva. Furthermore, a significant drawback is the creation of a second surgical site for harvesting autogenous tissue, which, as a result, causes additional trauma.

It should be noted that practical dentistry utilizes a two-stage implantation method, which utilizes autogenous bone and guided tissue regeneration to create an optimal alveolar ridge volume for placement of dental implants [13]. The procedure begins with skeletonization of the alveolar ridge and cutting out an autogenous bone block to fit the defect. Next, holes are created for screws to secure the autograft. Next, the graft is secured and the space is filled with crushed autogenous bone, and the wound is sutured. After six months, the surgical site is exposed. The screws are then removed and dental implants are installed. After 3-4 months, the implants are exposed, the formers are installed, and the prosthesis is fabricated within 10-14 days. The disadvantages of this method include prolonged treatment, up to 18 months or more, due to the fact that dental implantation is performed after the optimal bone volume of the alveolar process has been restored. This method also causes additional trauma, as the autograft is removed from the mandible, where a bone defect has formed, and the membrane and fixing screws must be removed. Thus, the obtained results of dental implantation with palatal exposure (vestibular bone shield) using implants with milled and anodized necks for single defects with moderate lateral atrophy of the maxillary alveolar process demonstrate that, compared to existing solutions, the new method offers advantages related to the versatility of using dental implants from various manufacturers of suitable designs with milled and anodized necks, which ensure optimal mucogingival integration on the exposed palatal side. Furthermore, the method is minimally invasive due to the elimination of the need for alveolar ridge reduction and bone augmentation using bone substitutes, eliminating the need for repeat surgery to place superstructures. Minimally invasive procedures are used for dental implant placement, leading to increased effectiveness of postoperative tissue regeneration processes. This significantly reduces the time required for complex (surgical and orthopedic) rehabilitation of patients, facilitating the production of optimal orthopedic structures. The combination of the above features contributes to increased effectiveness of surgical interventions and orthopedic rehabilitation for moderate lateral atrophic changes in the alveolar process of the upper jaw.

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