VILNIUS UNIVERSITY

Algirdas Puišys

EVALUATION OF CRESTAL BONE STABILITY AROUND DENTAL IMPLANTS PLACED IN LOWER JAW AFTER VERTICAL SOFT TISSUE THICKENNING

Summary of doctoral dissertation

Biomedical Sciences, Medicine (06B)

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This doctoral dissertation was written at Vilnius University and Vilnius implantology center in 2012–2016.

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The dissertation will be defended at the Medical Research Council of Vilnius University.

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VILNIAUS UNIVERSITETAS

Algirdas Puišys

KRAŠTINIO KAULO STABILUMO VERTINIMAS APLINK APATINIAME ŽANDIKAULYJE ĮSRIEGTUS DANTŲ IMPLANTUS VERTIKALIAI PASTORINUS MINKŠTUOSIUS AUDINIUS

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EVALUATION OF CRESTAL BONE STABILITY AROUND DENTAL IMPLANTS PLACED IN LOWER JAW AFTER VERTICAL SOFT TISSUE THICKENNING

INTRODUCTION

Relevance of the study

Dental implants are placed in to the alveolar bone. The function of them is to hold dental prosthesis. One of the main success criteria for long term function is stable bone around implant neck, which means – *crestal bone.*

Crestal bone stability remains one of the most debated issues in implant dentistry. It is considered to be important for cortical bone preservation, longevity of short implants and prevention of peri-implant tissues recession, which usually accompanies crestal bone loss (Bengazi et al. 1996; Ekfeldt et al. 2003). Initial vertical mucosal tissue thickness was shown to be one of the factors having impact on bone stability. Berglundh and Lindhe in an animal study demonstrated that if mucosal tissues are thinned to 2 mm or less, there is significantly more crestal bone resorption after healing, compared with implants placed in thick mucosal tissues (Berglundh & Lindhe 1996) Linkevicius et al. performed clinical controlled study and confirmed hypothesis suggested in an animal experiment. It was found that mucosal tissues of 2 mm or less in thickness might cause bone loss of 1.38 mm, while implants placed in thick tissues had significantly less bone loss of 0.25 mm (Linkevicius et al. 2009; Berglundh & Lindhe 1996). Furthermore, the succeeding pilot study, comparing regular implant/abutment connection implants with platform switching implants has confirmed that distraction of microgap horizontally does not preserve bone in thin tissues (Linkevicius et al. 2010).

Currently dental implants in the market have two major types of implant/abutment connection – regular implant/abutment connection, when implant diameter matches with abutment, and platform switching connection, when abutment of a narrower diameter, than that of an implant is utilized for implant restoration.

Platform switching has become a standard feature in the design of conventional implants. Its introduction has expanded the possibilities of crestal bone preservation, as

numerous studies have reported reduced bone resorption for platform-switched implants compared with platform-matched implants. Cappiello and colleagues (Cappiello et al. 2008) Prosper and colleagues (Prosper et al. 2009) and Canullo and colleagues (Canullo & Rasperini 2007) have shown the superiority of platform-switched implants over regular implants with regard to development of crestal bone stability. Recent systematic reviews unanimously confirm that implants with PS preserve crestal bone better than implants with matching abutments (Al-Nsour et al. 2012; Annibali et al. 2012; Atieh et al. 2010; Canullo & Rasperini 2007). From a technical point of view, PS results in a horizontal displacement of the implant-abutment microgap away from the bone crest. The microgap is one of the major factors responsible for bone remodeling in the apical direction (Hermann et al. 1997; Hermann et al. 2001). However, other factors, such as implant neck polishing (Hammerle et al. 1996; Wiskott & Belser 1999) and mucosal tissue thickness (Berglundh & Lindhe 1996), have been shown to take part in the etiology of crestal bone loss as well. Nevertheless, there are data from randomized controlled clinical trials that do not confirm the hypothesis that platform switching is enough to reduce bone loss (Enkling et al. 2011; Enkling et al. 2013; Dursun et al. 2013). Some of the studies on platform switching show a wide diversity of crestal bone loss figures, ranging from 0.3 mm to 1.3 mm (Vela-Nebot et al. 2006). Recently it has been suggested that bone resorption may be mainly related to biological factors rather than to biomechanical factors like implant diameter (Canullo et al. 2012). Furthermore, the study by Vandeweghe and De Bruyn showed that platform switching is only effective when mucosal thickness allows the establishment of a biological width (Vandeweghe & De Bruyn 2012). It is very interesting to note that most of the studies on platform switching did not evaluate vertical mucosal tissue thickness at implant placement. Hence, the effect of vertical soft tissue thickness on crestal bone level around implants with platform switching is still not clear.

Rationally, it can be suggested that thin tissues might be thickened during implant placement, thus reducing bone resorption. Soft tissue augmentation is very widely used procedure in many fields of implant dentistry. It was shown to be effective in developing the adequate width of attached tissues or increase of soft tissue volume due to esthetic reasons. Recently, it was shown that soft tissue graft might reduce bone remodeling at implants installed immediately after tooth extraction (Caneva et al. 2013). Autogenous

connective tissue grafts from palatine for a long time have been a standard grafting material with very successful outcome (Dordick et al. 1976; Studer et al. 2000; Orsini et al. 2004; Sanz et al. 2009). However, some studies show obvious disadvantages of this approach. Harvesting procedure results in prolonged healing time at the donor site and therefore to an increased patient's morbidity (Griffin et al. 2006). Ongoing pain and numbness for several weeks after the surgery is frequently indicated by patient (Del et al. 2002). In addition, in some patients, anatomical limitations preclude harvesting of appropriate quality and quantity grafts (Soileau & Brannon 2006). These issues led to the use of alternative grafting techniques with allogenic materials, which also have shown to be successful (Gapski et al. 2005; Dordick et al. 1976; Wilson, Jr. et al. 2005; Lorenzo et al. 2012). Therefore, one of the most widely used and researched resources from the family of allografts is acellular dermal matrix (ADM) derivative membrane. This material is donated from human skin without epidermis and cells, and serves as a matrix that supports revascularization, cell repopulation, and tissue remodeling. ADM may be used for soft tissue augmentation if a root coverage procedure, an enlargement of keratinized tissue, deepening of the vestibule, or augmentation of localized alveolar defects is indicated (Wei et al. 2000; Aichelmann-Reidy et al. 2001; Batista, Jr. et al. 2001; Harris 2003). However, the use of ADM membrane for vertical peri-implant tissue augmentation has not been researched as usually, the buccal aspect of soft tissue fell in the scope of interest of many authors. Therefore, it should be clarified if usage of ADM membrane for thin soft tissue thickening is effective in reducing crestal bone loss.

The aim of the study

To investigate how implants with matching implant/abutment connection and implants with platform switching maintain crestal bone stability in lower jaw in different soft tissue thickness and after soft tissue thickening with allogenic membrane up to 1-year after prosthetic treatment.

Objectives of research

1. To evaluate the influence of thin and thick soft tissue on peri-implant bone level around implants with matching implant/abutment connection 2 months after second stage surgery, after prosthetic treatment and after 1-year follow-up.
2. To evaluate the influence of thin and thick soft tissue on peri-implant bone levels around implants with platform switching 2 months after placement, after prosthetic treatment and after 1-year follow-up.
3. To evaluate the influence of thin soft tissue thickening with allogenic membrane on crestal bone stability around implants with regular matching implant/abutment connection.
4. To evaluate the influence of thin soft tissue thickening with allogenic membrane on crestal bone resorption around implants with platform switching.
5. To evaluate the gain of vertical soft tissue thickness after augmentation with allogenic membrane.

Defended statements

1. Soft tissue thickness has influence on crestal bone level around implants with matching implant/abutment connection.
2. Soft tissue thickness has influence on crestal bone level around implants with platform switching.
3. Thin soft tissue thickening with allogenic membrane has impact on crestal bone loss around implants with matching implant/abutment connection.
4. Thin soft tissue thickening with allogenic membrane has impact on crestal bone loss around implants with platform switching.
5. Allogenic membrane can be used for vertical soft tissue augmentation.

Innovativeness and significance of the study

1. It was found, that implants with matching implant/abutment connection does not reduce crestal bone loss, if implants are placed in vertically thin soft tissues.

2. It was found, that platform switching does not reduce crestal bone loss, if implants are placed in vertically thin soft tissues.

3. The thickening of thin soft tissues with allogenic membrane reduces crestal bone loss around implants with matching implant/abutment connection.

4. The thickening of thin soft tissues with allogenic membrane reduces crestal bone loss around implants with platform switching.

5. Allogenic membrane can be placed directly on denuded bone and can be successfully used for vertical augmentation of peri-implant soft tissues.

6. The initial vertical soft tissue thickness should be measured, if studies on crestal bone levels around implants are conducted.

Material and Methods

Patients selection

Subjects for the study were selected among patients in Vilnius Implantology Center Clinic, Vilnius, Lithuania. The protocol for this study was approved by the Vilnius regional ethical committee for biomedical trials (No.158200-07-512-149).

102 patients participated in thirst study. A total 105 implants with platform switching were placed. Second study involved 113 patients with 120 implants with matching implant/abutment connection. Depending on the vertical soft tissue thickness, every patient was divided it to the 3 groups:

A) Thin tissue ≤ 2 mm;

B) Thin and thickened with allogenic membrane (in the thirst trial was used "Tutodent Dermis" GmbH Tutodent (Germany), for second trial – "AlloDerm" ("Biohorizons", JAV));

C) Thick tissue ≥ 2.5 mm.

Implants with platform switching (Straumann, Switzerland) were used in the third trial and with matching implant/abutment connection (BioHorizons, USA) in the second. Implant type has been chosen by the patient following the treatment plan.

Inclusion criteria were: (1) no less than 18 years of age; (2) generally healthy patients, no medical contraindication for implant surgery; (3) missing teeth in lower jaw posterior area; (4) minimum of 6 mm bone width; (5) healthy soft tissue (BOP<20%,

PI<20% CPITN<2); (6) minimum 2 mm keratinized gingiva buccaly and lingually; (7) no bone augmentation procedures before and during implant placement; (8) signed informed consent form for participation and permission to use obtained data for research purposes. Patients were excluded if they did not meet inclusion criteria and they additionally had (1) poor oral hygiene PI > 20%; (2) history of uncontrolled periodontitis; (3) smoking; (4) diabetes; (5) alcoholism; (6) take antiepileptic and antihypertension drugs.

Crestal bone stability after mucosal tissue thickening around implants with platform switching

Surgical treatment

Surgery was performed by one surgeon A. P. Patients received a prophylactic dose of 2 g amoxicillin (Ospamox; Biochemie, Austria) 1 hour prior to the surgery. After the administration of 4% articaine 40 ml solution (Ubistesin, 3M ESPE, Germany) for local anesthesia, a mid-crestal incision on the center of edentulous ridge was performed.

After crestal incision, buccal flap was raised, while lingual part was left not elevated to ensure direct visibility. Vertical tissue thickness was measured with 1.0 mm marked periodontal probe (Hu-Friedy, Chicago, IL, USA) at the bone crest in the center of future implant placement (Picture 1).

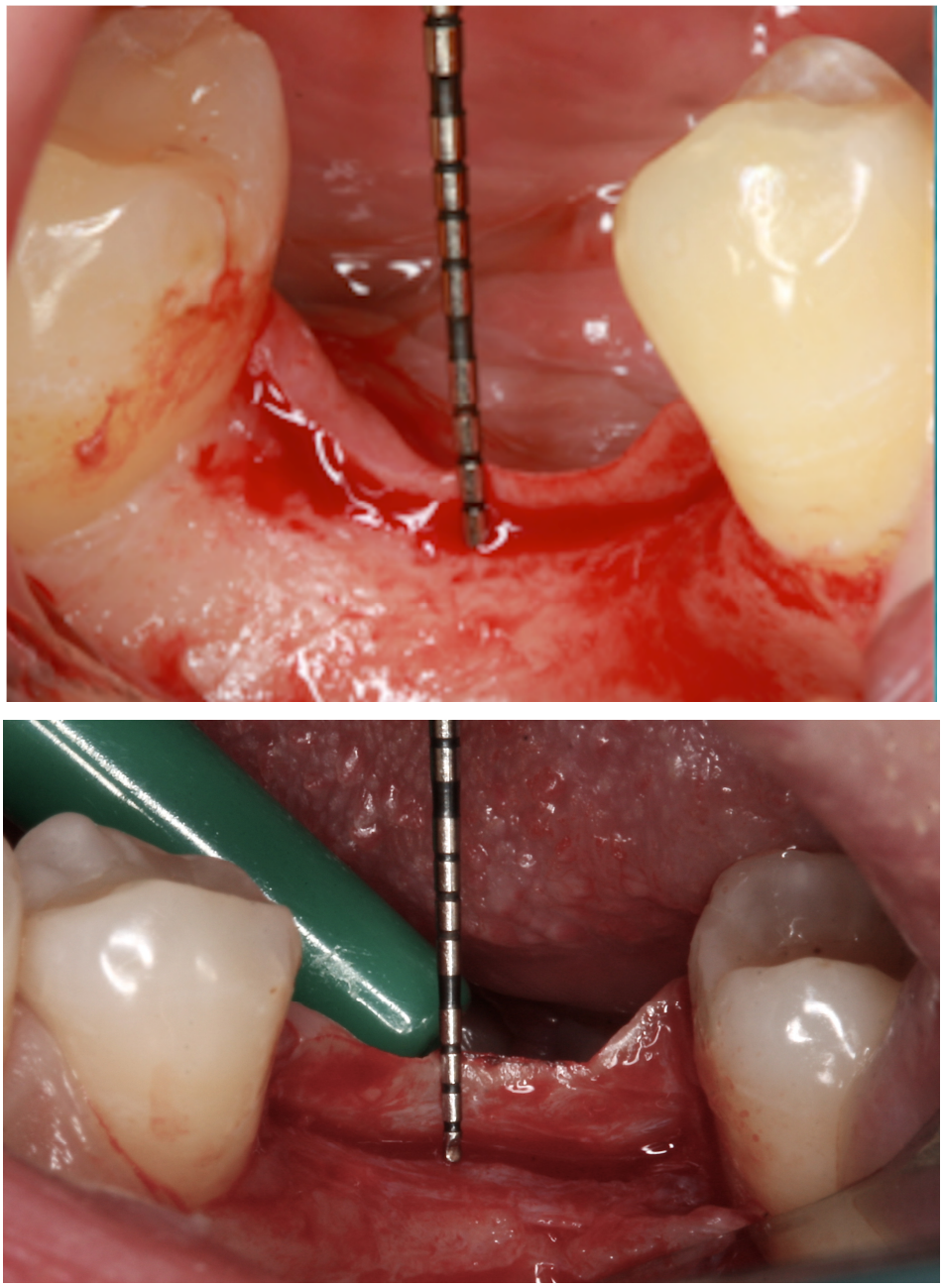
After measurement, the lingual flap was raised to completely expose implant placement site. If vertical tissue thickness was 2 or less mm, tissues were considered as thin. If tissue thickness was more than 2 mm, tissues were defined as thick.

Therefore, 3 groups were formed (Picture 2): T1 test group – implants placed in thin tissues, T2 test group – implants placed in thin tissues and thickened with allogenic membrane simultaneously with implant placement and C, control group – implants placed in naturally thick tissues.

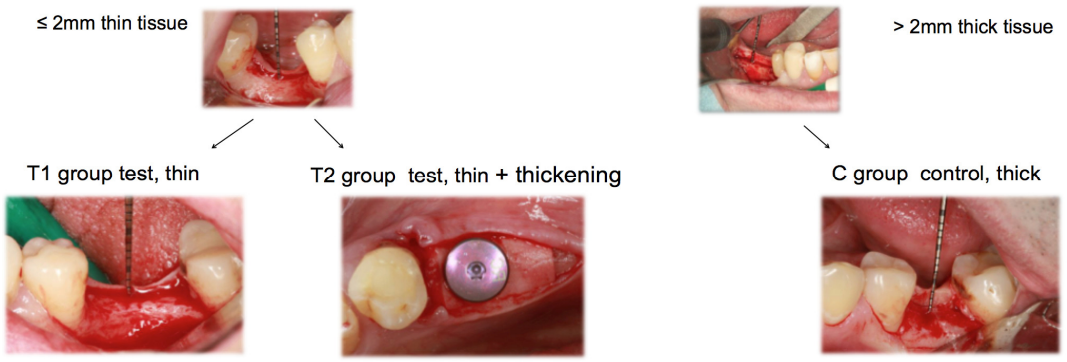
Bone level implants (Institute Straumann AG, Switzerland) of 4.1 mm in diameter were placed equally with bone crest in one-stage approach according to manufacturer's recommendations.

Allogenic membrane (Tutodent Purous Dermis, Zimmer, USA) with dimensions of 10 x 20 mm and 2 mm in thickness was used for vertical thickening of tissues in group

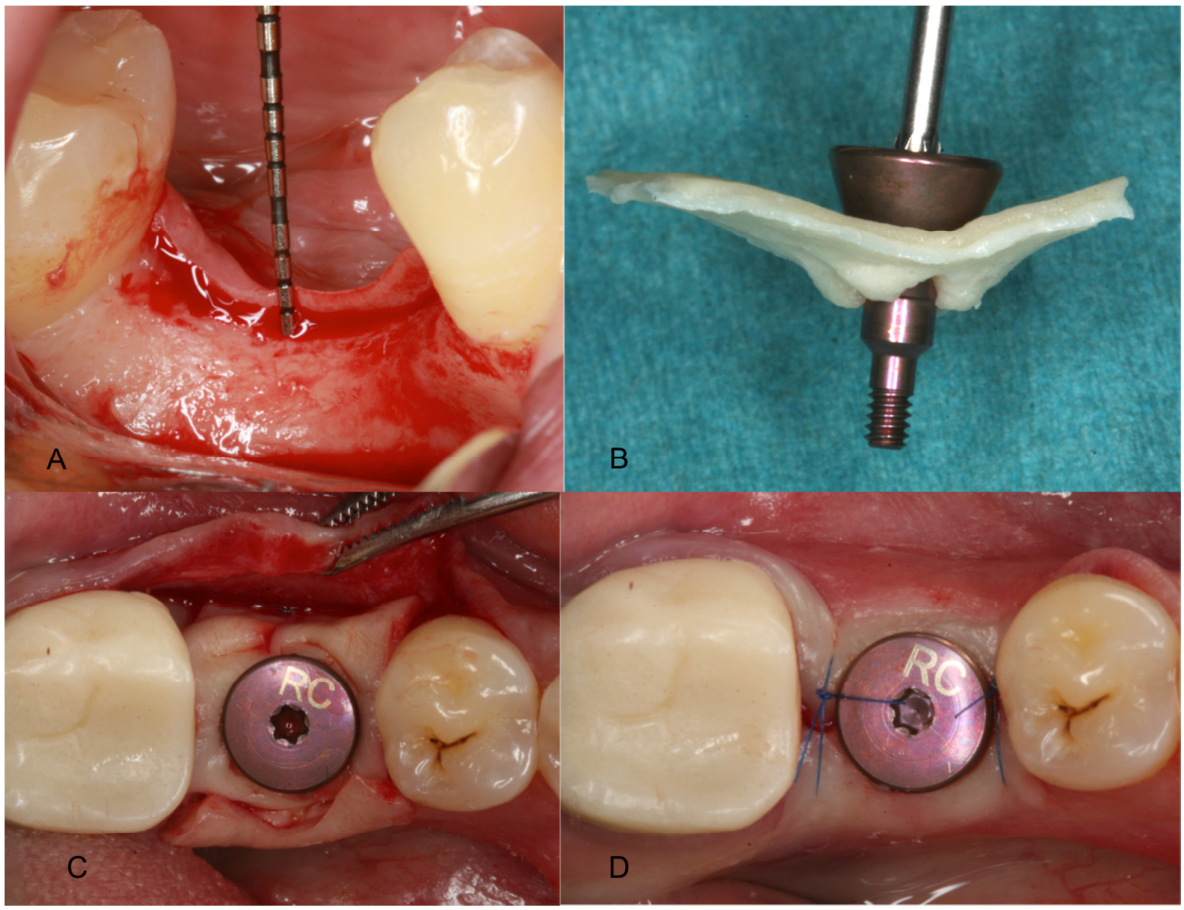
T2. For easier manipulation membrane was treated with sterile saline solution for 10 minutes. Small perforations were made through membrane surface, that healing abutments could be connected to implants (Picture 3 B). After full thickness flap elevation, membrane was secured over implants directly on bone surface (Picture 3 C) and tissues sutured with 6/0 sutures (Polysorb; USS-DG, Norwalk, CT) (Picture 3 D).



Picture 1. Vertical measurement of naturally thick mucosal tissues



Picture 2. Formation of 3 groups according to soft tissue thickness



Picture 3. (A) Thin mucosal tissues before implant placement; (B) Perforated membrane with healing abutment; (C) Allogenic membrane positioned on bone ridge and healing abutment connected to implant; (D) Tissues sutured over membrane and implant at the end of one-stage surgery

Patients were instructed to rinse the operated site with 0.12% chlorhexidine-digluconate (Perio-aid, Dentaid, Spain) solution twice a day for a week and prescribed 0.5 g of amoxicillin (Ospamox; Biochemie, Austria) 3 times daily for 7 days. For pain control, patients were suggested 400 mg of ibuprofen to be taken as needed. Patients were advised to minimize trauma to the site and advised to clean healing abutments with very soft toothbrush. The sutures were removed 7-10 days after surgery.

Restorative procedures

Before starting prosthetic treatment, implant success criteria were applied. The implants were considered successful and suitable for restoration, if they had:

1) Absence of radiolucency around the implant;

2) No clinically detectable mobility;

3) No suppuration, pain, or on-going pathologic processes.

Impressions were taken using an open-tray technique. A polyvinylsiloxane (Flexitime; Heraeus Kulzer, USA) putty and correction material was used for a one-step impression with the individual tray covered with adhesive. Temporary crown was made for 2 months,

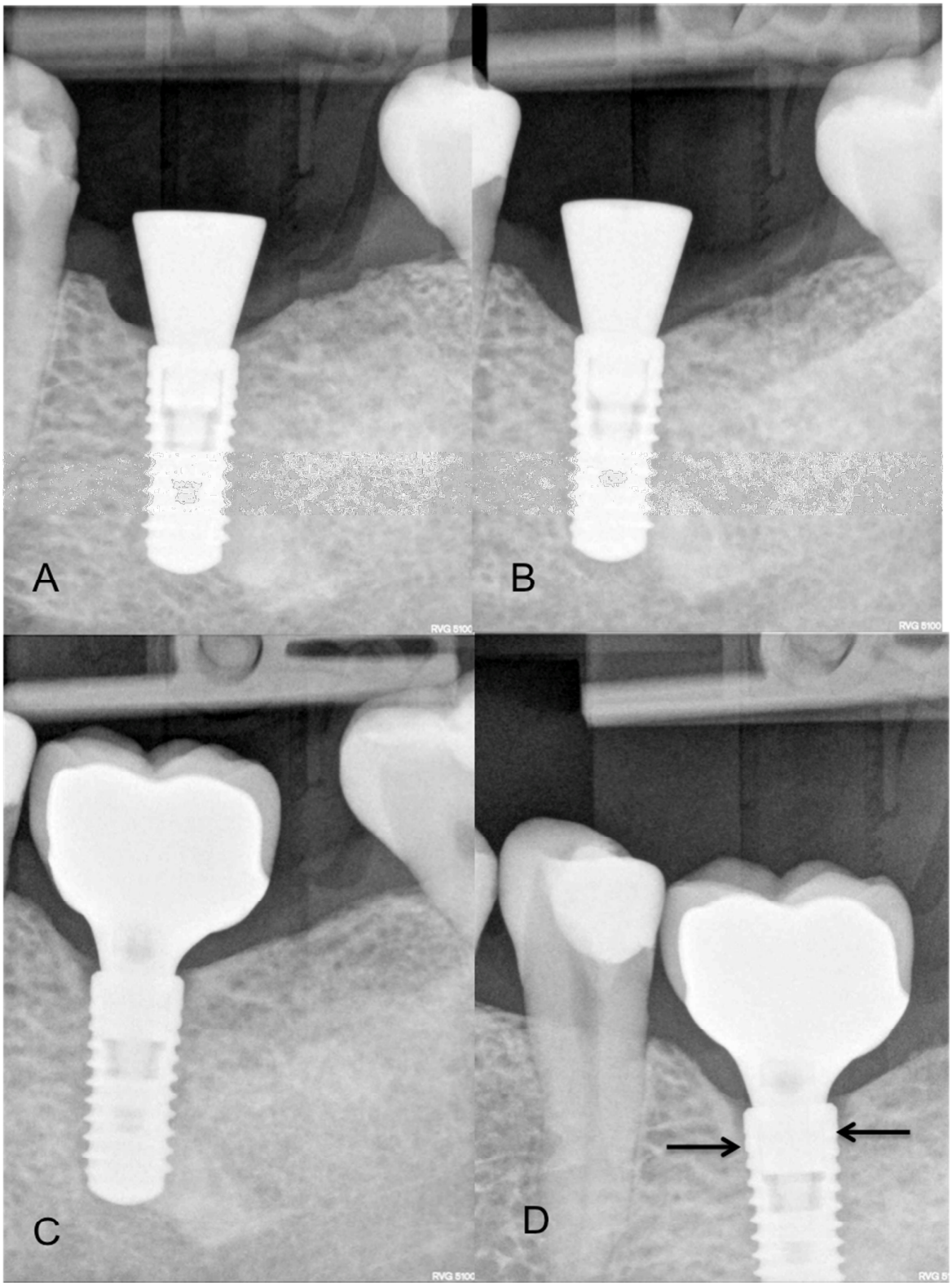
After soft tissue conditioning porcelain-fused-to-metal fixed screw retained restorations were made by the same technician and cemented with resin cement (iCem, Hereaus Kulzer, Germany) on standard abutments in the laboratory (Picture 3). Then restorations were screwed to implants and screw access permanently closed with light-cured composite (Gradia Anterior, GC, Tokyo, Japan). Crowns were tightened to the implants, using a torque wrench set to 35N/cm2. After prosthetic treatment patients were instructed on cleaning implant-supported restorations. Patients were recalled 6 and 12 months after prosthetic treatment for oral hygiene and evaluation. At each visit the restorations were evaluated for mobility and peri-implant soft tissue condition. Prosthetic treatment was done by one prosthodontist T. L.

Radiographic assessment and measurements

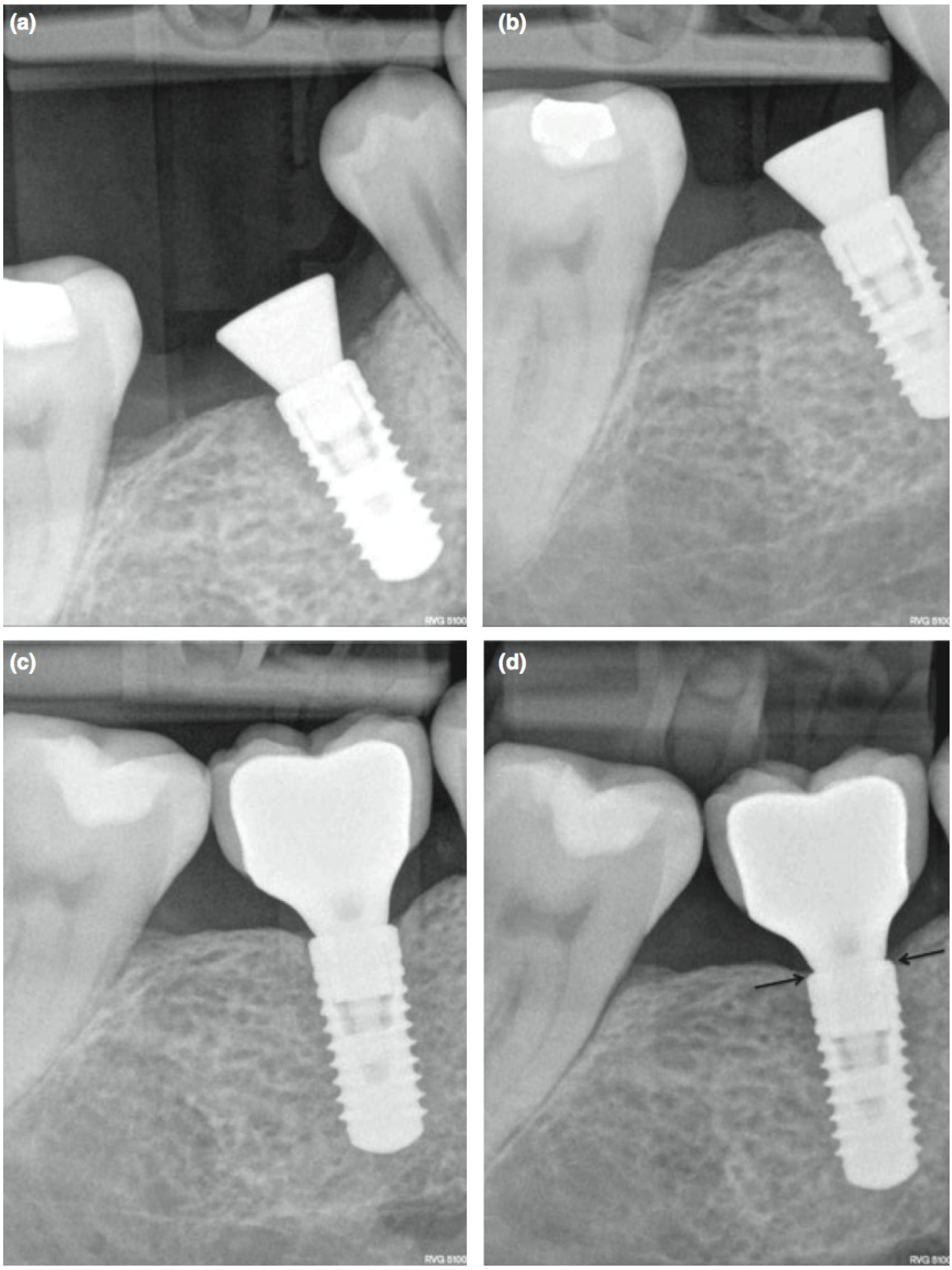
Intraoral radiographs were performed 4 times in each patient during the study: (1) after implant placement and (2) after 2 months of healing (3) after prosthetic delivery and (4) after 1-year follow-up post reconstruction.

This was performed for T 1 group implants (Picture 4 A, B, C and D), T 2 group (Picture 5 A, B, C and D) and C group (Picture 6 A, B, C and D). The x-ray machine standard set-up was as follows: voltage - 70kV, intensity of power - 4mA and exposure time was specified manually depending on implant location, ranging from 0.110–0.189s.

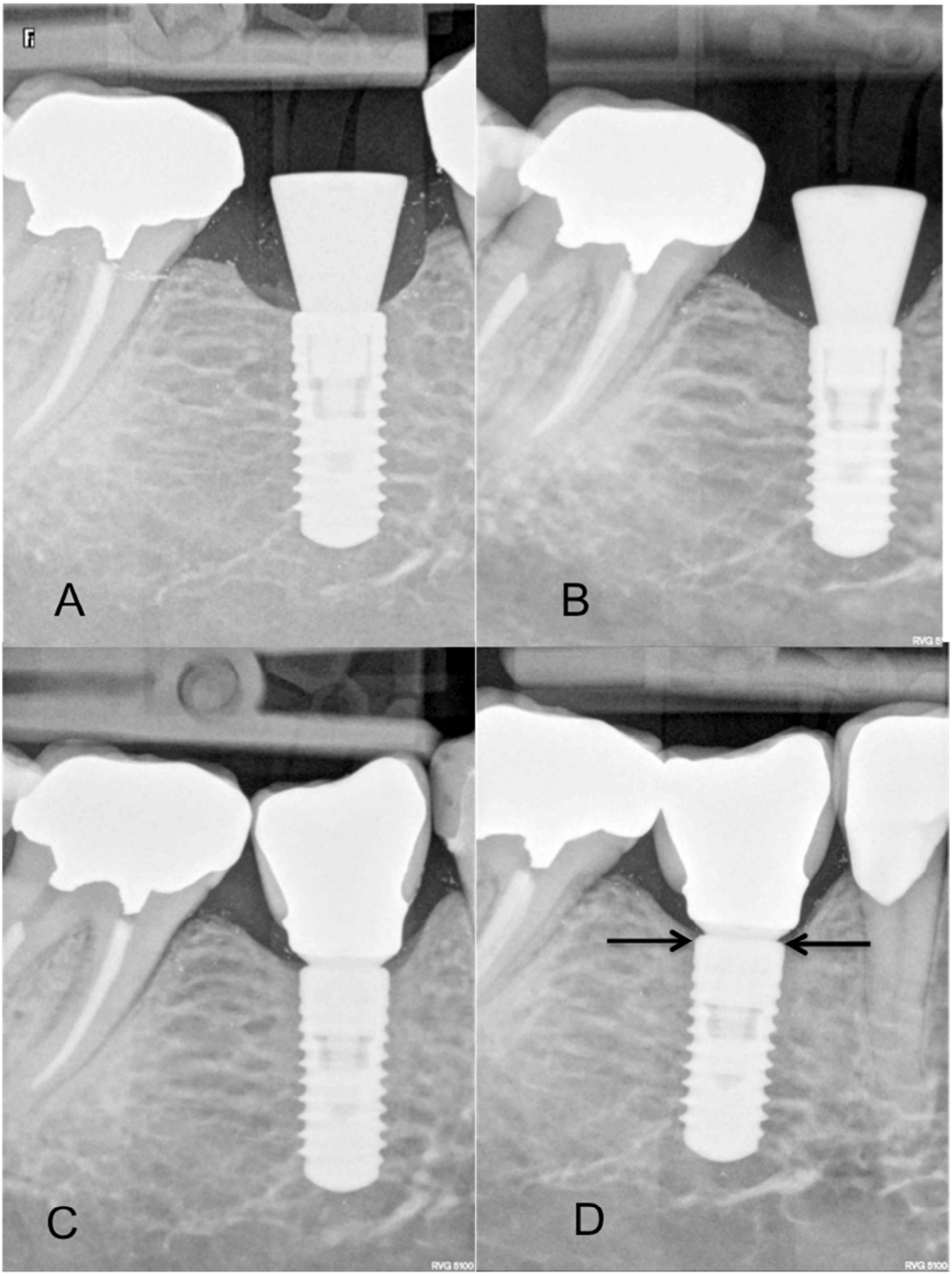
Paralleling technique with a Rinn-like film holder was used for radiographic examination (Picture 7, 8). The images were obtained in the way that implant/abutment interface and the threads would be clearly visible to assure that Radiological evaluation and measurements were performed using RVG Windows Trophy 7.0 software measurement program with a magnification (x 10) by one examiner. Before calculation of the crestal bone changes, the calibration of RVG images was performed, using calibration program in Trophy RVG software, using implant diameter as a reference point (Picture 9). Bone loss and comparison between groups and within groups was reported separately, on distal and mesial sites (Picture 10). The intra-examiner agreement was determined by second and third measurements, which were performed with 1 month intervals. The mean difference between measurements was less than 0.1 mm and the mean of three measurements was used.



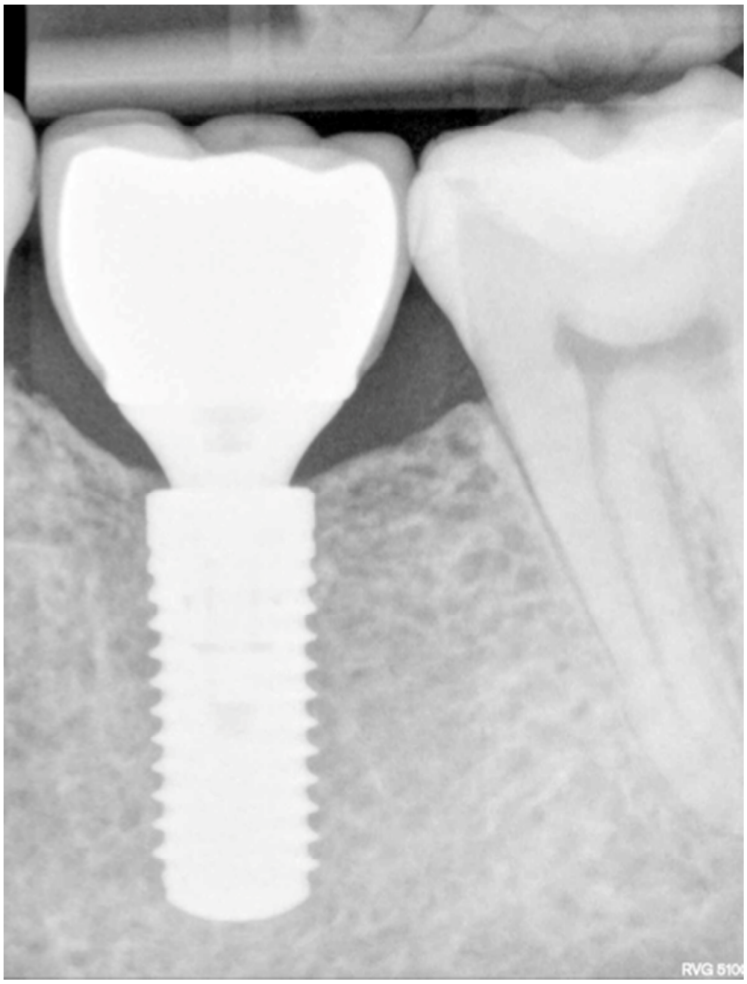
Picture 4. Crestal bone levels in thin tissues after implant placement (A), 2 months after placement (B), after prosthetic rehabilitation (C) and after 1-year follow-up (D)



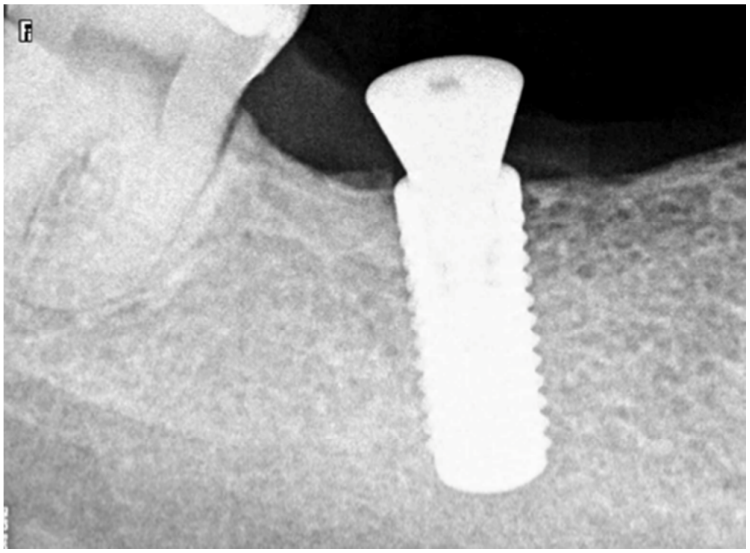
Picture 5. Crestal bone levels in thickened tissues with allogenic membrane after implant placement (A), 2 months after placement (B), after prosthetic rehabilitation (C) and after 1 year follow-up (D)



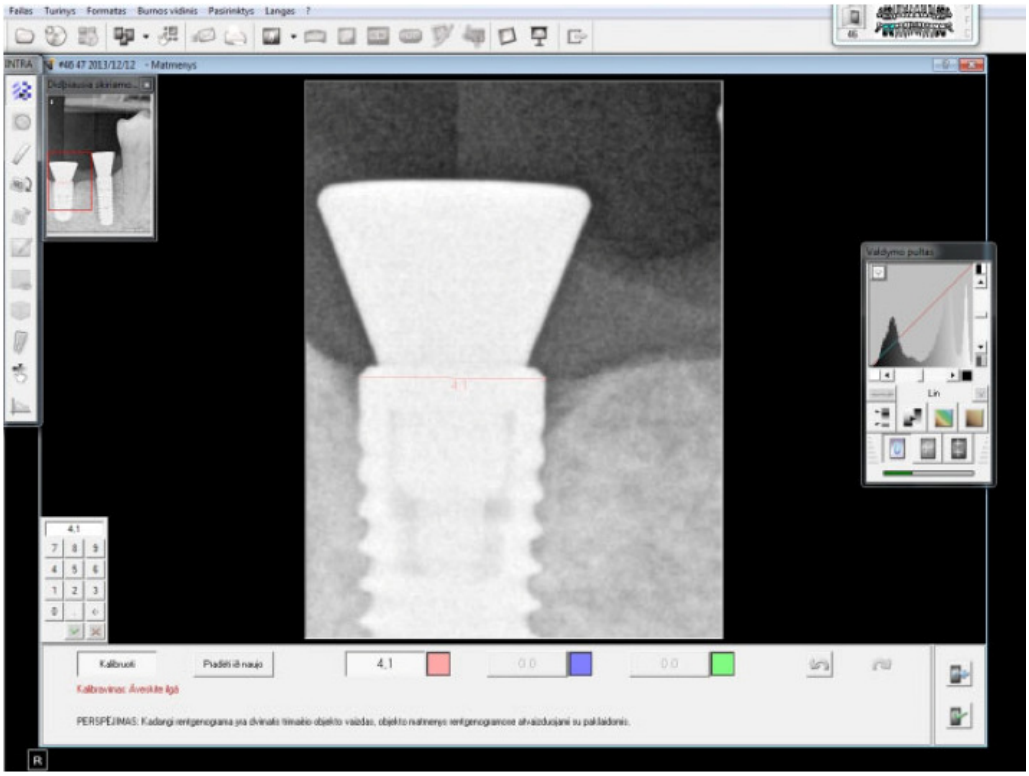
Picture 6. Crestal bone level after implant placement (A), 2 months after placement (B), after prosthetic rehabilitation (C) and after 1 year follow-up (D) in naturally thick tissue group



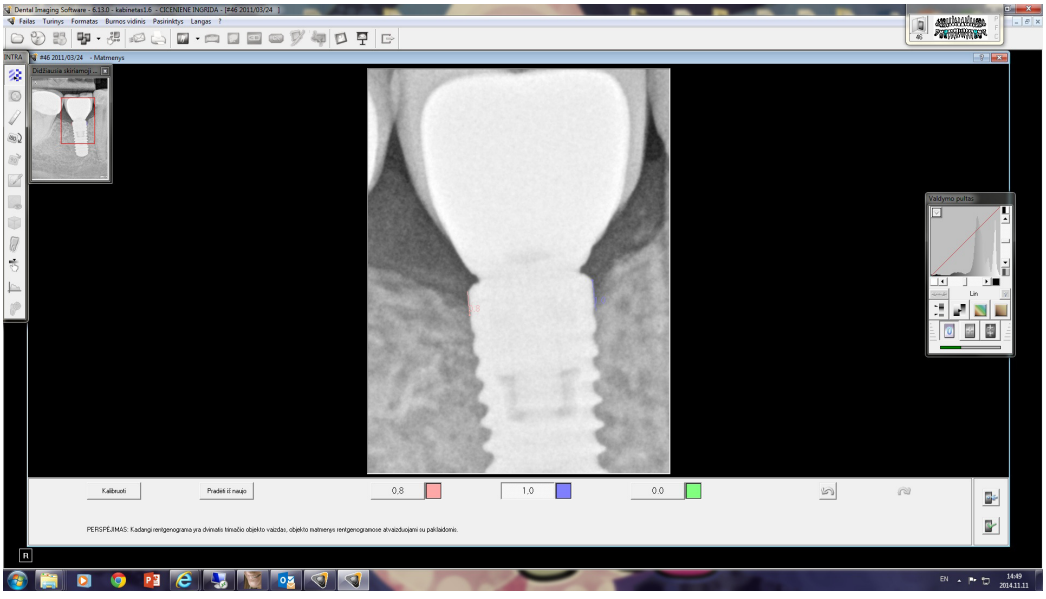
Picture 7. Parallel x-ray



Picture 8. Non parallel x-ray



Picture 9. The calibration of RVG images



Picture 10. Measurement of crestal bone loss

Statistical analysis

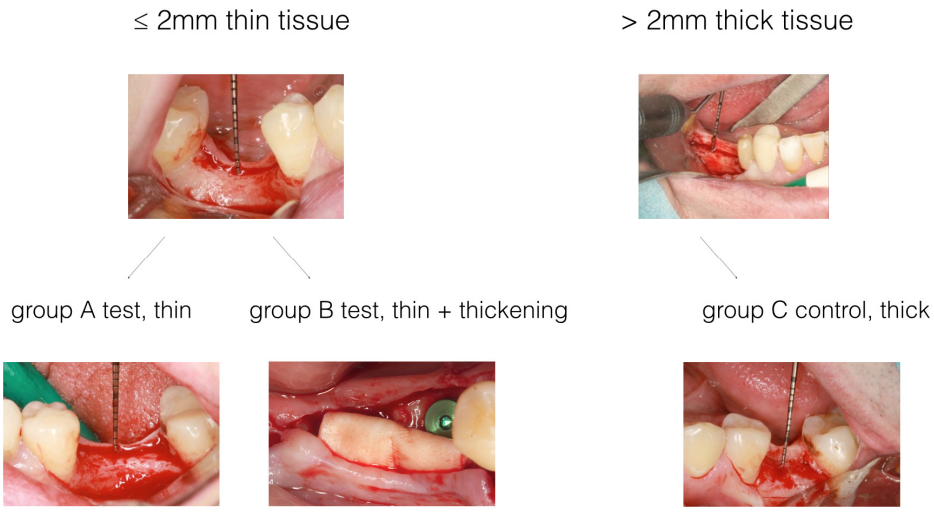
It is estimated, that in every group there should be no less than 32 patients, representing 95% of general population cases. Data were analysed using SPSS 17.0 for Windows (SPSS; Chicago, IL, USA) statistical software. The single patient was treated as a statistical unit. Mean bone loss was calculated for each group with standard error. Descriptive statistics, including means, SEs, medians, and ranges of measurements, were calculated. The Mann-Whitney U-test was used to find differences between groups. The mean differences were considered statistically significant at $P \leq 0.05$ with a confidence interval of 95%.

Crestal bone stability after mucosal tissue thickening around implants with regular horizontally matching implant-abutment interface

Surgical treatment

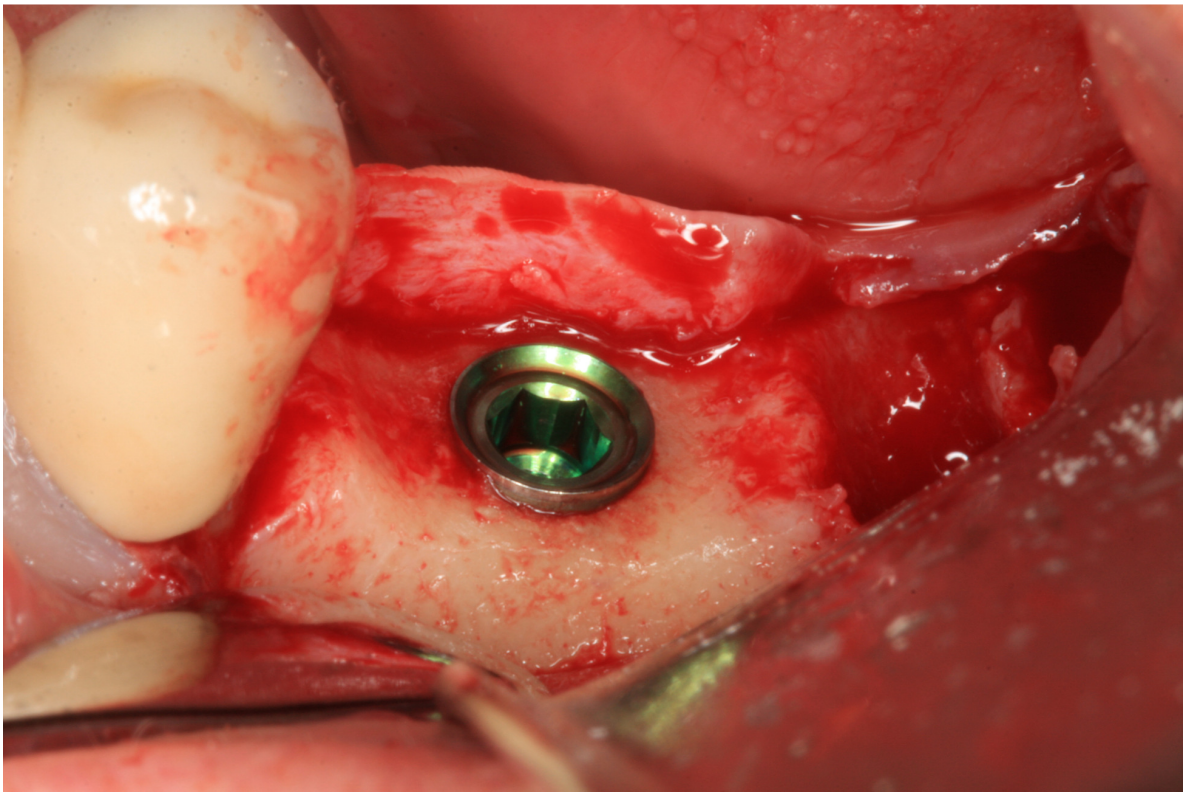
Premedication, planning, anesthesia, incision, flap elevation, measurement of tissue thickness, post-operative treatment and prosthetic procedures were the same as in the previous study.

Therefore, 3 groups were formed: A group – implants placed in thin soft tissues, B group – implants placed in thin soft tissues and thickened with allogenic membrane at the time of implant placement and C group – implants placed in thick soft tissues (Picture 11).



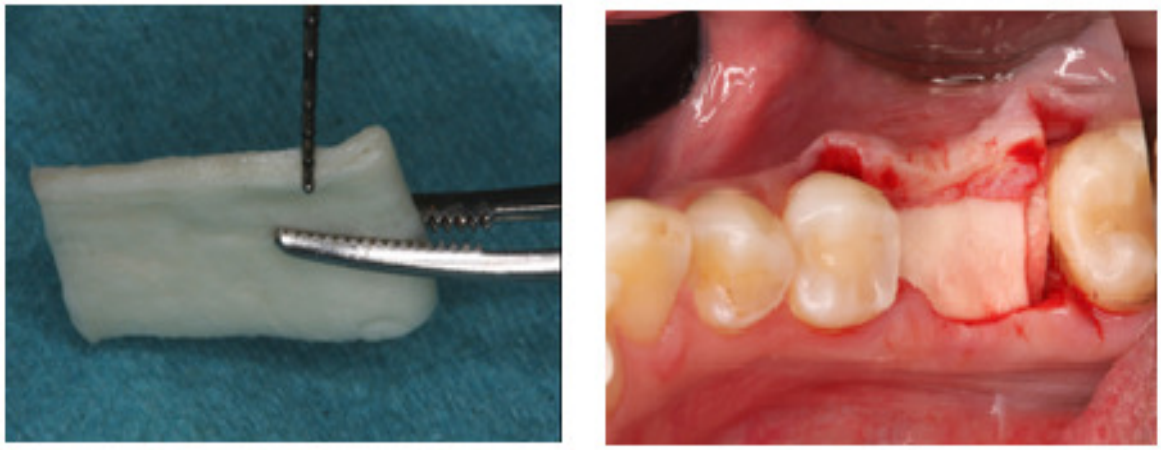
Picture 11. Formation of 3 groups according to soft tissue thickness

Internal hex implants with horizontally matching implant/abutment connection and laser-modified surface (Biohorizons Tappered Laser Lok, Birhingam, AL, USA) were positioned approximately 1 mm above bone crest by the same surgeon (AP) (Picture 12).



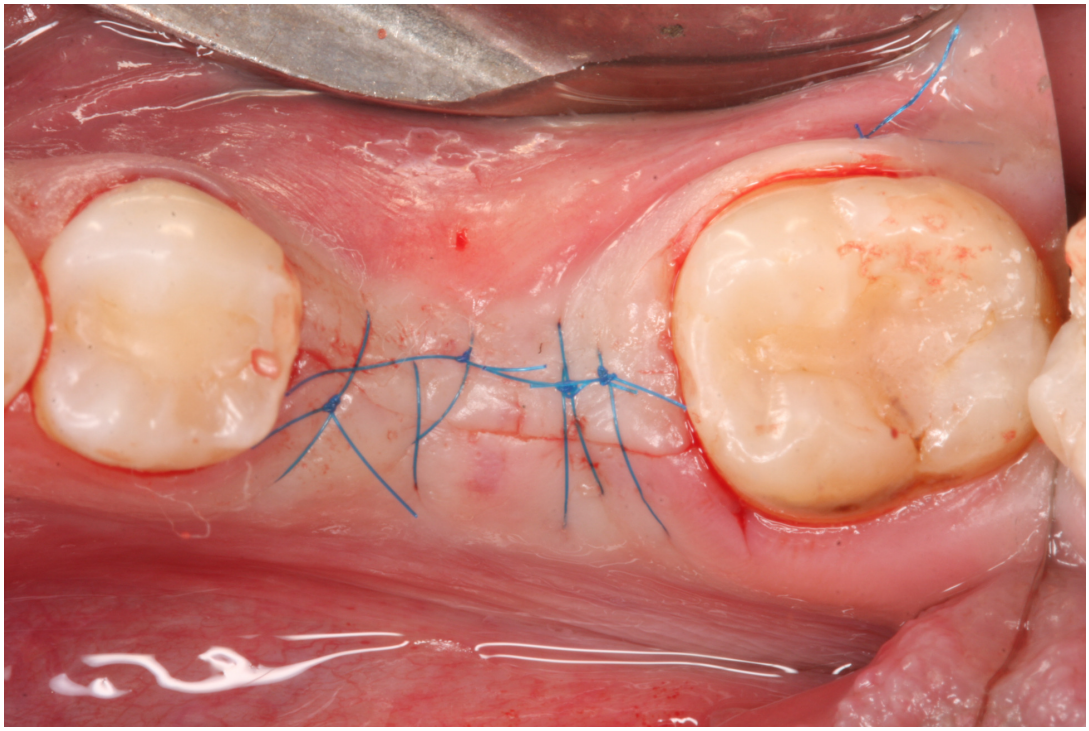
Picture 12. Supracrestal positioning of implant approximately 0.5 to 1 mm above bone crest

In group B allogenic membrane (AlloDerm, Biohorizons, AL) was used for soft tissue thickening. Standard dimension's (20x40 mm) membrane with thickness varying from 0.89-1.65 was treated with sterile saline solution for 20 minutes. Then membrane was folded 1 time to reach the thickness of 2-3 mm, individually adapted to implantation site and positioned over implant, covered with cover screw (Picture 13).



Picture 13. All implant placement site covered with allogenic membrane (“Alloderm”)

Membrane was extended mesio-distally to neighboring teeth, buccaly -10 mm and lingually for 5 mm beyond the implant margin to completely close implantation site. Periosteal releasing incisions were made, flaps were approximated and sutured without tension with 6/0 sutures (Assucryl, Assut Medical Sarl, Switzerland, Lousanne). Primary wound closure was always achieved (Picture 14).

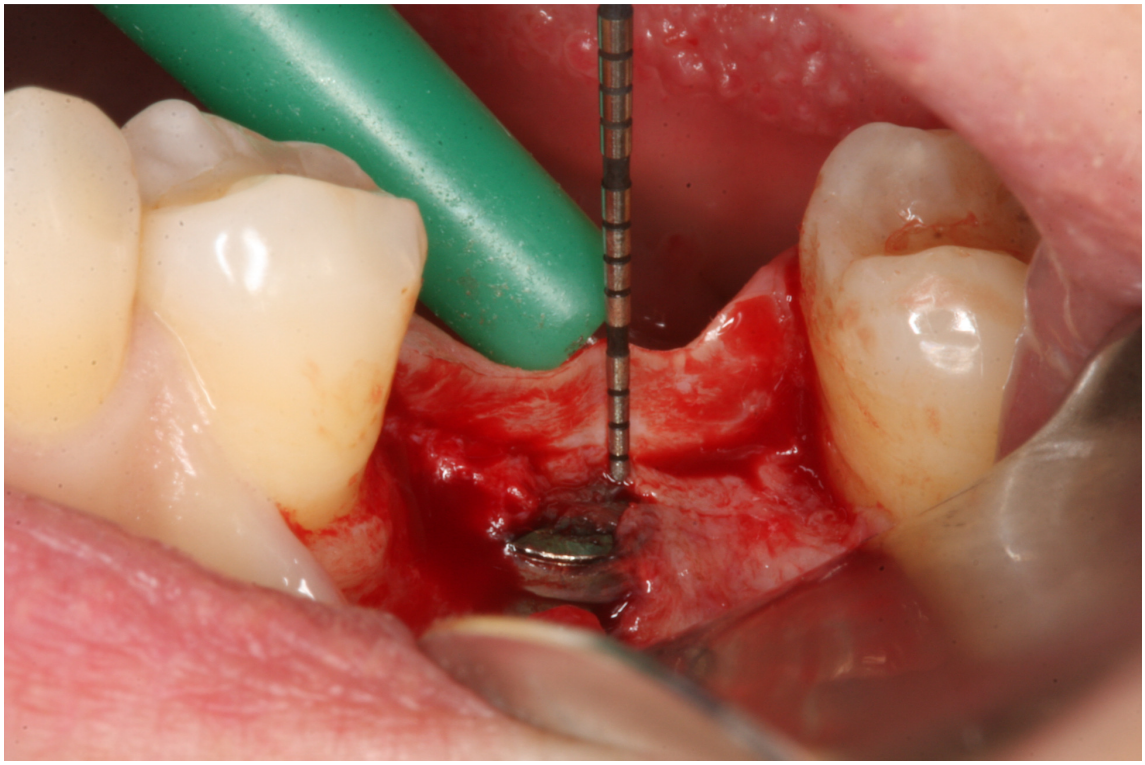


Picture 14. Sutured without tension full-thickness flaps

A and C group implants were placed in one stage approach with healing abutment and sutured with the same 4/0 sutures (Assucryl, Assut Medical Sarl, Switzerland, Lousanne).

INCREASE OF TISSUE THICKNESS MEASURMENT

After 2 months of healing second stage surgery was performed to connect healing abutments. After infiltration of local anesthetic, incision was made in the center of the bone crest to preserve attached mucosa. Full thickness buccal flap was raised and soft tissue thickness over implant was measured with periodontal probe in a previously described manner (Picture 15).

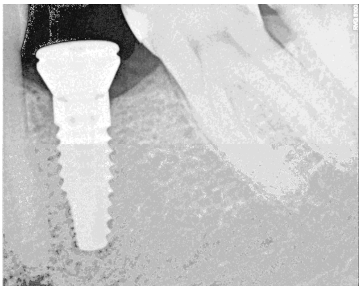
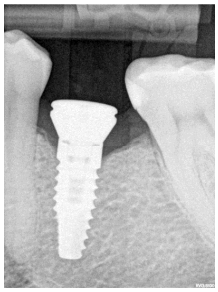
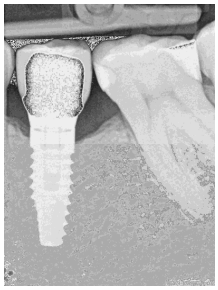
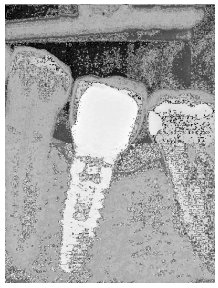


Picture 15. Measurement of increased soft tissue thickness after augmentation with allograft in B group implants

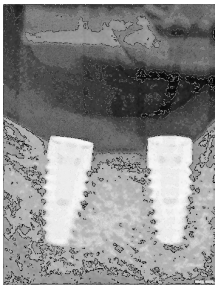
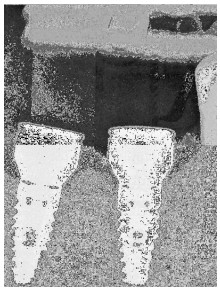
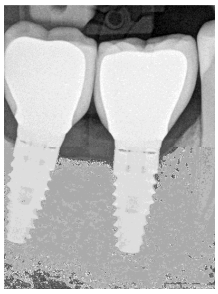
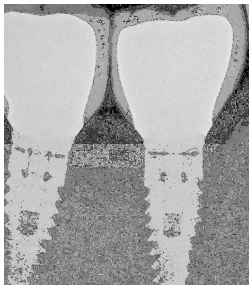
Then lingual flap was raised, healing abutment was connected to implant and tissues were sutured without tension with single interrupted 4/0 sutures (Assucryl, Assut Medical Sarl, Switzerland, Lousanne). No soft tissue excision was made.

Radiographic examination

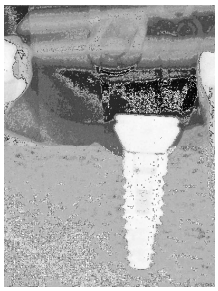
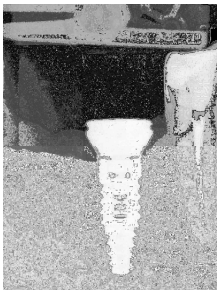
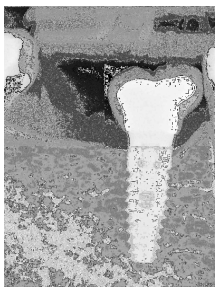
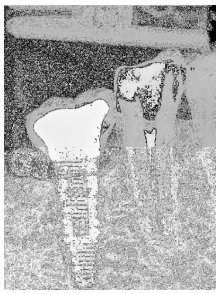
Radiographical examination was performed as it was described in page 15 (Picture 16 A, B, C and D), B group (Picture 17 A, B, C and D), and C group (Picture 18 A, B, C and D). Further on X-ray pictures are presented.

A  B  C  D 

Picture 16. Crestal bone levels after implant placement (A), 2 months after placement (B), after prosthetic rehabilitation (C), and after 1-year follow-up (D) in thin soft tissue group

A  B  C  D 

Picture 17. Crestal bone levels after implant placement (A), 2 months after placement (B), after prosthetic rehabilitation (C), and after 1-year follow-up (D) in thickened soft tissue group

A  B  C  D 

Picture 18. Crestal bone levels after implant placement (A), 2 months after placement (B), after prosthetic rehabilitation (C), and after 1-year follow-up (D) in naturally thick tissue group

Statistical analysis

It is estimated, that in every group there should be no less than 32 patients, representing 95% of general population cases. Data were analysed using SPSS 17.0 for Windows (SPSS; Chicago, IL, USA) statistical software. The single patient was treated as a statistical unit. Mean bone loss was calculated for each group with standard error. Descriptive statistics, including means, SEs, medians, and ranges of measurements, were calculated. The Mann-Whitney U-test was used to find differences between groups. The mean differences were considered statistically significant at $P \leq 0.05$ with a confidence interval of 95%.

RESULTS

Influence of mucosal tissue thickness on crestal bone changes around implants with platform switching

Initially, 102 patients fulfilled inclusion criteria and received 105 implants. Later 3 patients with 3 implants were excluded from the study on the basis of refusal to attend follow-up checkups. Five patients received multiple implants, however only 1 implant per patient was included into the study to keep patient-based study design. The selection which one of two implants will be included into analysis was randomised by envelope drawing. Therefore, the final sample included 97 patients, 33 patients and implants in T1 group, 32 in T2 and control groups consisting of 28 males and 69 females. Subjects' average age was 47.3±1.2 ranging from 21 to 65 years at the beginning of the experiment. All implants were placed in posterior mandible. Depending on the quadrant of the jaw, the implants were distributed in the following way: III quad. – 44 (46.9%) cases, and IV – 53 cases (53.1%). All 97 implants integrated successfully. 97 single crowns were constructed afterwards.

Overall, the implant survival rate after 1 year of function in test and control groups was 100%. Survival was defined stable functioning implant in the mouth at a time of evaluation. No prosthetic complications were recorded at follow-up visits. All allogenic membranes healed uneventfully, no exposures and/or suppuration were registered. Crestal bone loss and statistical significance were measured after 2 months, after prosthetic rehabilitation and after 1-year follow-up.

Bone loss calculation around test and control implants

Crestal bone loss was calculated around mesial and distal sites of implants in test and control groups after 2 month, after delivering of prostheses and 1 year after loading. Measurements and cases are depictured in the Table 1, 2 and 3.

Table 1. Bone loss around test 1 (T1) implants on mesial and distal sites after 2 month, after prosthetic and after 1 year follow-up

	After 2 month		**After prosthetics**		**After 1 year**	
Cases	M	D	M	D	M	D
1	-2.1	-0.7	-2.4	-1.3	-2.1	-1.2
2	-0.7	-0.1	-1	-0.8	-1.2	-0.8
3	-0.6	-0.8	-0.9	-0.4	-1.2	-1.3
4	-0.4	-0.5	-0.6	-0.9	-1	-1.3
5	-1.4	-1.1	-1.9	-1.4	-1	-1.4
6	-0.8	-0.7	-0.6	-0.7	-1	-1.1
7	-1	-1.8	-0.8	-0.7	-1	-1.2
8	-1.7	-1.7	-0.5	-0.8	-1.1	-1.3
9	-0.6	-0.8	-0.8	-0.7	-1.2	-0.9
10	-0.6	-1	-1.8	-0.9	-1.6	-1.2
11	-0.8	-0.6	-0.8	-0.9	-1.1	-1.2
12	-0.3	-0.9	-0.3	-0.9	-1.2	-1.2
13	0	0	-0.1	-0.6	-1	-1.1
14	-1.5	-1	-0.9	-1	-2.1	-1.6
15	0	-0.3	-0.5	-0.4	-1.2	-1.1
16	0	-0.8	-1.5	-1	-1.2	-1.2
17	-1.7	-1.1	-1	-0.8	-1.2	-0.9
18	-0.5	-0.1	-0.6	-0.6	-1	-1.3
19	-0.1	-0.2	-0.6	-0.6	-1.8	-1.9
20	-0.8	-0.8	-0.9	-0.8	-1.2	-1
21	-1.9	-1.9	-3.7	-3.1	-1.4	-1.4
22	-1	0	-1	0	-2	-1
23	-0.2	-0.7	0.3	-1.1	-0.2	-0.1
24	0	-0.1	0	-1.1	-0.1	-0.1
25	-0.2	-0.6	-0.9	-0.6	-0.7	-0.6
26	-0.7	-0.1	-1	-0.8	-1.2	-0.8
27	-0.8	-0.7	-0.6	-0.7	-1	-1.1
28	-0.2	-0.6	-0.9	-0.6	-0.7	-0.6
29	-1.9	-1.9	-3.5	-3.1	-1.4	-1.4
30	-0.1	-0.2	-0.6	-0.6	-1.8	-1.9
31	-0.8	-0.7	-1	-1	-1.5	-1.5
32	-0.6	-0.5	-0.8	-0.8	-1.5	-1.8
33	-0.8	-1	-1	-1	-1.2	-1

Table 2. Bone loss around test 2 (T2) implants on mesial and distal sites after 2 month, after prosthetic and after 1 year follow-up

	After 2 month		**After prosthetics**		**After 1 year**	
Cases	M	D	M	D	M	D
1	0	0	-0.5	0	-0.5	0
2	1	-0.8	-1	-0.4	-1.1	-0.5
3	0	0	0	0	0	0
4	-0.8	0	-0.3	0	-0.8	0
5	-0.4	-1.3	-0.4	-0.8	-0.4	-1.3
6	-0.3	0	-0.3	0	-0.3	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	-0.8	-0.7	-0.8	-0.7	-0.8	-0.7
10	-0.2	-0.3	-0.2	-0.7	-0.2	-0.3
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	-0.6	0	0	0	-0.6	0
18	0	0	0	-0.4	0	0
19	0	0	0	0	0	0
20	0	0	0	-0.3	0	0
21	0	0	-0.6	-0.5	0	0
22	0	0	0	0	0	0
23	0	0	-0.8	-0.4	0	0
24	0	0	-0.5	-0.6	0	0
25	-0.6	-0.8	-0.6	-0.8	-0.6	-0.8
26	0	0	0	0	0	0
27	-0.3	-0.5	0	0.1	-0.3	-0.5
28	-1	-1.1	-1	-1.1	-1	-1.1
29	-0.1	0	-0.1	0	-0.1	0
30	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
31	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
32	-0.1	-0.2	-0.1	-0.2	-0.2	-0.3

Table 3. Bone loss around control (C) implants on mesial and distal sites after 2 month, after prosthetic and after 1 year follow-up

	After 2 month		**After prosthetics**		**After 1 year**	
Cases	M	D	M	D	M	D
1	0	-0.7	0	-0.3	0	-0.3
2	-0.4	-0.4	-0.3	0	-0.3	0
3	-0.1	0	-0.1	-0.2	-0.1	-0.2
4	0	0	0	0	0	0
5	-0.8	0	-0.8	0	-0.8	0
6	0	0	0	0	0	0
7	-1.1	-0.3	-1.1	-0.3	-1.1	-0.3
8	0	0	0	0	0	0
9	-0.5	0	-0.5	-1	-0.5	-1
10	0	0	-0.5	0	-0.5	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	-0.1	0	-0.8	0	-0.8	0
14	-0.1	-0.1	-0.7	-1	-0.7	-1
15	-0.3	-0.5	0	-0.1	0	-0.1
16	0	0	-0.2	-0.1	-0.2	-0.1
17	0	-0.2	0	-0.2	0	-0.2
18	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	-0.7	-0.2	-0.7	-0.2
22	-0.6	0	-0.6	0	-0.6	0
23	-0.8	0	0	-0.1	0	-0.1
24	0	0	0	0	0	0
25	0	-0.6	0	-0.2	0	-0.2
26	0	-1	0	-1	0	-1
27	0	0	0	0	0	0
28	-0.2	0	-0.2	0	-0.2	0
29	0	-1	0	-1	0	-1
30	0	0	0	0	0	0
31	-0.1	-0.2	-0.1	-0.2	-0.2	-0.3
32	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3

Table 4. Averages of all groups

Group	After 2 months		After prosthetics		After 1 year	
	M	D	M	D	M	D
T 1	-0.75 ± 0.11	-0.73 ± 0.10	-1.00 ± 0.15	-0.93 ± 0.11	-1.22 ± 0.08	-1.14 ± 0.07
T 2	-0.16 ± 0.06	-0.20 ± 0.06	-0.25 ± 0.06	-0.24 ± 0.06	-0.24 ± 0.06	-0.19 ± 0.06
C	-0.17 ± 0.05	-0.17 ± 0.05	-0.22 ± 0.06	-0.24 ± 0.06	-0.22 ± 0.06	-0.20 ± 0.06

Comparison of control and test groups

Table 5. Crestal bone loss around implants 2 months after placement and statistical difference between groups (Mann–Whitney U-test, significant when $P \leq 0.05$)

Group	Mesially / distally	Mean ± SE	Median	Max.	Min.
T 1 (N=33)	Mesially	-0.75 ± 0.11	-0.70	-0.00	-2.10
	Distally	-0.73 ± 0.10	-0.70	0.00	-1.90
T 2 (N=32)	Mesially	-0.16 ± 0.06	0.00	1.00	-1.00
	Distally	-0.20 ± 0.06	0.00	0.00	-1.30
C (N=32)	Mesially	-0.17 ± 0.05	0.00	0.00	-1.10
	Distally	-0.17 ± 0.05	0.00	0.00	-1.0

Group	Mesially	Distally
T 1 and T 2	<u>P=0.001</u>	<u>P=0.001</u>
T 2 and C	P=0.861	P=0.827
T 1 and C	<u>P=0.001</u>	<u>P=0.001</u>
Underlined values show statistical significance		

Table 6. Crestal bone loss around implants after prosthetic restoration and statistical difference between groups (Mann-Whitney U test, significant when P≤0.05)

Group	Mesially / distally	Mean ± SE	Median	Max.	Min.
T1 (N=33)	Mesially	-1.00 ± 0.15	-0.85	0.30	-3.70
	Distally	-0.93 ± 0.11	-0.80	0.00	-3.10
T2 (N=32)	Mesially	-0.25 ± 0.06	-0.05	0.00	-1.00
	Distally	-0.24 ± 0.06	0.00	0.10	-1.10
C (N=32)	Mesially	-0.22 ± 0.06	0.00	0.00	-1.10
	Distally	-0.19 ± 0.06	-0.05	0.00	-1.00

Group	Mesially	Distally
T 1 and T 2	<u>P=0.001</u>	<u>P=0.001</u>
T 2 and C	P=0.734	P=0.987
T 1 and C	<u>P=0.001</u>	<u>P=0.001</u>
Underlined values show statistical significance		

Table 7. Crestal bone loss around implants after 1-year follow-up and statistical difference between groups (Mann-Whitney U test, significant when P≤0.05)

Group	Mesially / distally	Mean ± SE	Median	Max.	Min.
T 1 (N=33)	Mesially	-1.22 ± 0.08	-1.20	-0.10	-2.10
	Distally	-1.14 ± 0.07	-1.20	-0.10	-1.90
T 2 (N=32)	Mesially	-0.24 ± 0.06	0.00	0.00	-1.10
	Distally	-0.19 ± 0.06	0.00	0.00	-1.30
C (N=32)	Mesially	-0.22 ± 0.06	0.00	0.00	-1.10
	Distally	-0.20 ± 0.06	-0.05	0.00	-1.00

Group	Mesially	Distally
T1 and T2	<u>P=0.001</u>	<u>P=0.001</u>
T2 and C	P=0.909	P=0.312
T1 and C	<u>P=0.001</u>	<u>P=0.001</u>
Underlined values show statistical significance		

Comparison between time in groups – after 2 month vs after 1 year

Table 8. Group T 1

T 1	Difference mesially	Difference distally
After 2 months(N=33)	-0.75 ± 0.11	-0.73 ± 0.10
After 1 year (N=33)	-1.22 ± 0.08	-1.14 ± 0.07
P value	0.001	0.001

Table 9. Group T 2

T 2	Difference mesially	Difference distally
After 2 months(N=32)	-0.16 ± 0.06	-0.20 ± 0.06
After 1 year (N=32)	-0.24 ± 0.06	-0.20 ± 0.06
P value	0.467	0.955

Table 10. Group C

C	Difference mesially	Difference distally
After 2 months(N=32)	-0.17 ± 0.05	-0.17 ± 0.05
After 1 year (N=32)	-0.22 ± 0.06	-0.20 ± 0.06
P value	0.638	0.432

Table 11. Groups T 1 and C without gingiva thickness

T 1 + C	Difference mesially	Difference distally
After 2 months	-0.47 ± 0.07	-0.45 ± 0.06
After prosthetics	-0.62 ± 0.09	-0.57 ± 0.08
After 1 year	-0.73 ± 0.08	-0.68 ± 0.07

Table 12. Gingiva thickness

Group	Gingiva thickness
T1 (N=33)	1.55 ± 0.07
T2 (N=32)	1.50 ± 0.09
C (N=32)	2.88 ± 0.07

Crestal bone stability around implants with horizontally matching connection after soft tissue thickening

Initially, 113 patients agreed to participate in the study and received 120 implants. Seven implants were removed from the study because radiographic images of implants were not sufficiently parallel to correctly calculate crest bone changes. Two implants were lost before loading, and two patients with two implants were excluded from the study on the basis of refusal to attend follow-up check-ups. In addition, six patients received two implants; however, only one from two was included into the study to keep the patient as a statistical unit. Therefore, the final sample included 103 patients, consisting of 31 men and 72 women. Subjects' average age was 45.3 1 1.2 ranging from 21 to 55 years at the beginning of the experiment. One hundred two internal hex implants with traditional horizontally matching connection and laser-modified surface were placed by the same surgeon: 34 in group A, 35 in group B, and 34 implants in group C. Good primary stability (>35 N) was achieved in all implants. Overall, the implant survival rate after 1 year of function in all groups was 98.3%. No prosthetic complications were recorded at follow-up visits.

Soft tissue thickness in T1 and T2 groups was 1.51 ± 0.09 mm. In the group T2 the thickness increased to the 3.75 ± 0.09 mm after thickening. C group patients have had the thickness 2.98 ± 0.08 mm.

All 35 allografts survived and healed uneventfully, except one membrane, which had spontaneous exposure. The exposed part of the allograft was trimmed with surgical scissors; site irrigated with 0.12% chlorhexidine-digluconate solution, and antibiotics intake was prolonged for an additional week. These measures led to normal wound healing afterwards.

Crestal bone loss after 2 months, after prosthetic rehabilitation, and after 1-year follow-up can be seen in further presented tables.

Crestal bone loss in all groups after 2 months of healing

Table 13. Crestal bone loss in all groups after 2 months of healing (Mann-Whitney test, significant when P≤0.05)

Group	Difference mesially	Difference distally
T1 Thin (N=34)	-0.86 ± 0.08 mm	-0.97 ± 0.09 mm
T2 Thin augmented (N=35)	-0.17 ± 0.04 mm	-0.20 ± 0.05 mm
C Thick (N=34)	-0.22 ± 0.05 mm	-0.25 ± 0.05 mm

Group	Mesially	Distally
T1 and T2	<u>P=0.001</u>	<u>P=0.001</u>
T2 and C	P=0.417	P=0.329
T1 and C	<u>P=0.001</u>	<u>P=0.001</u>
Underlined values show statistical significance		

Crestal bone loss in all groups after prosthetic treatment

Table 14. Crestal bone loss in all groups after prosthetic treatment (Mann-Whitney test, significant when P≤0.05)

Group	Difference mesially	Difference distally
T1 Thin (N=34)	-1.39 ± 0.08 mm	-1.55 ± 0.08 mm
T2 Thin augmented (N=35)	-0.25 ± 0.04 mm	-0.28 ± 0.05 mm
C Thick (N=34)	-0.34 ± 0.05 mm	-0.36 ± 0.05 mm

Group	Mesially	Distally
T1 and T2	<u>P=0.001</u>	<u>P=0.001</u>
T2 and C	P=0.117	P=0.193
T1 and C	<u>P=0.001</u>	<u>P=0.001</u>
Underlined values show statistical significance		

Crestal bone loss in all groups after 1-year follow-up

Table 15. Crestal bone loss in all groups after 1-year follow-up (Mann-Whitney test, significant when P≤0.05)

Group	Difference mesially	Difference distally
T1 Thin (N=34)	-1.65 ± 0.08 mm	-1.81 ± 0.06 mm
T2 Thin augmented (N=35)	-0.31 ± 0.05 mm	-0.34 ± 0.05 mm
C Thick (N=34)	-0.44 ± 0.06 mm	-0.47 ± 0.07 mm

Group	Mesially	Distally
T1 and T2	P=0.001	P=0.001
T2 and C	P=0.166	P=0.255
T1 and C	P=0.001	P=0.001
Underlined values show statistical significance		

Table 16. Statistical difference in all groups between period of 2 months after placement and 1-year follow-up

T1	Difference mesially	Difference distally
After 2 months (N=34)	-0.86 ± 0.08 mm	-0.97 ± 0.09 mm
After 1 year (N=34)	-1.65 ± 0.08 mm	-1.81 ± 0.06 mm
P value	0.000	0.000
T2		
After 2 months (N=35)	-0.17 ± 0.04 mm	-0.20 ± 0.05 mm
After 1 year (N=35)	-0.31 ± 0.05 mm	-0.34 ± 0.05 mm
P value	0.018	0.030
C		
After 2 months (N=34)	-0.22 ± 0.05 mm	-0.25 ± 0.05 mm
After 1 year (N=34)	-0.44 ± 0.06 mm	-0.47 ± 0.06 mm
P value	0.005	0.012

Table 17. Soft tissue thickness before and after vertical augmentation with ADM membrane

Soft tissue biotype	Mean ± SE	Median	Min.	Max.
Thin biotype	1.54 ± 0.08	1.75	0.5	2.0
Augmented soft tissues	3.75 ± 0.09	4.0	3.0	5.,0
Volume increase	2.21 ± 0.14	2.0	1.0	4.5

CONCLUSIONS

1. Even microgap is taken away vertically by placing implants 1 mm above the bone, bone loss occurs around implants with matching abutments, if thin tissues are present.

2. Implants with platform switching do not reduce crestal bone loss, if vertically thin tissues are present.

3. Vertical thickening of soft tissues with allogenic membrane significantly reduced the amount of bone loss around implants with matching abutments.

4. Vertical thickening of soft tissues with allogenic membrane significantly reduced the amount of bone loss around implants with platform switching.

5. Allogenic membrane might be suitable tool to thicken mucosal tissues vertically and can be placed directly on the bone surface during one-stage surgery, as well as during two-stage surgery.

PRACTICAL RECOMENDATIONS

1. It is recommended to take into consideration soft tissue thickness as mandatory when calculation of early crestal bone loss or PS is as goal of research.

2. To place implants with matching abutment 0.5-1 mm above the bone.

3. To do soft tissue thickening, if vertical dimension of it is 2mm or less.

4. To use for soft tissue thickening, an allogenic membrane, thus replacing CTG from palate and reduce morbidity for the patient.

5. It is possible to place an allogenic membrane directly on bone during one-stage surgery, as well as during two-stage surgery and simplify surgical procedure.

KRAŠTINIO KAULO STABILUMO VERTINIMAS APLINK APATINIAME ŽANDIKAULYJE ĮSRIEGTUS DANTŲ IMPLANTUS VERTIKALIAI PASTORINUS MINKŠTUOSIUS AUDINIUS

Reziumė

Tyrimo aktualumas. Dantų implantai yra sriegiami į žandikaulio kaulą ir veikia kaip dantų protezų fiksuojamoji atrama. Esminis sėkmingą dantų implantų funkcionavimą lemiantis veiksnys – stabilus žandikaulio kaulas apie implanto kaklelį, vadinamas kraštiniu kaulu (angl. *crestal bone*).

Kraštinio kaulo stabilumas – daugiausia diskusijų šiuolaikinėje implantologijoje keliantis klausimas. Šis kaulas yra svarbus norint užtikrinti trumpų implantų patvarumą ir minkštųjų audinių apie implantus recesijos (atsitraukimo), kuri dažnai prasideda patirpus kraštiniam kaului, profilaktiką (Bengazi ir kt. 1996; Ekfeldt ir kt. 2003).

Nepaisant gamintojų ir gydytojų praktikų pastangų, kraštinio kaulo tirpimo apie implanto kaklelį išvengti nepavyksta. Dažniausiai kaulas vidutiniškai 0,5–2 mm patirpsta pirmaisiais metais, vėliau stabilizuojasi (Vela-Nebot ir kt. 2006), bet į klausimą, kodėl taip vyksta, iki šiol nėra atsakyta.

Buvo teigiama, kad kraštinio kaulo tirpimui įtakos turi implanto konstrukcija. Naudojant implantus su siauresnio skersmens implanto atramos jungtimis (PS), kraštinis kaulas netirpsta, taigi jie yra geresni nei paprasti – su vienodo skersmens implanto atramomis – implantai (Canullo ir Rasperini 2007; Cappiello ir kt. 2008; Prosper ir kt. 2009; Atieh ir kt. 2010; Al-Nsour ir kt. 2012; Annibali ir kt. 2012). Manyta, kad siauresnio skersmens implanto atramos jungtis yra geresnė, nes mikrotarpas tarp implanto ir jo atramos yra toliau nuo kraštinio kaulo. O būtent mikrotarpas ir yra siejamas su kraštinio kaulo remodeliacija implanto viršūnės kryptimi (Hermann ir kt. 1997; 2001). Vis dėlto nėra pakankamai duomenų, pagrindžiančių, kad, naudojant implantą su siauresnio skersmens implanto atramos jungtimi, kraštinis kaulas tirpsta mažiau (Enkling ir kt. 2011; Dursun ir kt. 2013).

Galima nurodyti ir dar daug kitų veiksnių, turinčių įtakos kraštinio kaulo tirpimui, pavyzdžiui: poliruotas implanto kaklelio paviršius (Hammerle ir kt. 1996; Wiskott ir Belser 1999), minkštųjų audinių storis (Berglundh ir Lindhe 1996) ir kt. Kai kurie tyrėjai

teigia, kad kraštinio kaulo tirpimą vertėtų sieti su biologiniais, o ne biomechaniniais veiksniais (Canullo ir kt. 2012). Vandeweghe ir De Bruyn atlikto tyrimo rezultatai parodė, kad siauresnio skersmens implanto atramos jungties naudojimas yra efektyvus tik tokiu atveju, jei dėl pakankamo dantenų storio susidaro biologinis plotis (Vandeweghe ir De Bruyn 2012). Reikia pažymėti, kad daugeliu atveju, tiriant siauresnio skersmens implanto atramos jungtis, nebuvo įvertintas vertikalus minkštųjų audinių storis, taigi, jo įtaka kraštinio kaulo aukščiui apie implantus su siauresnio skersmens implanto atramos jungtimis nėra aiški.

Bandymai su gyvūnais parodė, kad, sriegiant implantus į minkštuosius audinius, kurie yra 2 mm ar plonesni, kraštinis kaulas gydamas daug labiau tirpsta nei tais atvejais, kai implantai sriegiami į storus (> 2 mm) minkštuosius audinius (Berglundh ir Lindhe 1996). Iškelta hipotezė buvo patvirtinta tyrimu, kurio rezultatai rodo, kad jei minkštieji audiniai apie implantus yra plonesni nei 2 mm, kraštinis kaulas patirpsta vidutiniškai 1,38 mm, o esant storiems minkštiesiems audiniams (dantenoms) kraštinis kaulas tirpsta mažiau – vidutiniškai 0,25 mm (Linkevicius ir kt. 2009b).

Linkevičiaus su bendraautoriais atlikto tyrimo duomenys rodo, kad, palyginus vienodo ir siauresnio skersmens implanto atramos jungtis, kai mikrotarpas tarp implanto ir jo atramos yra toliau nuo kraštinio kaulo, kaulas vis tiek tirpsta, jei minkštieji audiniai yra ploni (Linkevicius ir kt. 2010). Svarbu pabrėžti, kad tai buvo tik bandomasis tyrimas.

Tad kyla klausimas, ar implantacijos metu pastorintos dantenos turi įtakos kraštinio kaulo stabilumui. Paprastai atliekant implantaciją plonus minkštuosius audinius siūloma pastorinti, kad būtų užtikrintas prisitvirtinusių dantenų storis dėl estetinių priežasčių. Neseniai buvo parodyta, kad iškart po danties pašalinimo iš gomurio perkeltas minkštųjų audinių transplantas sumažina kraštinio kaulo remodeliaciją po implantacijos (Caneva ir kt. 2013). Tačiau tikslaus atsakymo į klausimą, ar vertikaliai pastorinus plonus minkštuosius audinius kraštinis kaulas yra stabilesnis, kol kas nėra.

Minkštiesiems audiniams pastorinti ilgą laiką buvo naudojamas autogeninis jungiamojo audinio transplantas (Dordick ir kt. 1976; Studer ir kt. 2000; Orsini ir kt. 2004; Sanz ir kt. 2009), tačiau šio metodo taikymas turi daug trūkumų. Transplantato paėmimas iš gomurio pailgina donoro paėmimo vietos gijimą ir sukelia diskomfortą pacientui (Griffin ir kt. 2006). Skausmas po šios procedūros gali būti jaučiamas kelias savaites po operacijos (Del Pizzo ir kt. 2002). Be to, kai kuriais atvejais sudėtinga paimti

tinkamą jungiamojo audinio transplantą dėl anatominių gomurio savybių (Soileau ir Brannon 2006).

Visi pirmiau minėti trūkumai paskatino domėtis alternatyvia augmentacija (Dordick ir kt. 1976; Gapski ir kt. 2005; Wilson ir kt. 2005; Lorenzo ir kt. 2012). Dabar dažniausiai naudojamas ir aprašytas transplantas yra alogeninė membrana, arba beląstelė odos matrica (ADM). Ši medžiaga pagaminta iš paaukotos žmogaus odos, ji gali būti naudojama minkštiesiems audiniams augmentuoti, recesijoms dengti, keratinizuotoms dantenoms pastorinti, prieangiui gilinti ir vietiškai alveolės defektams augmentuoti (Wei ir kt. 2000; Aichelmann-Reidy ir kt. 2001; Batista ir kt. 2001; Harris 2003). Tačiau vertikalus minkštųjų audinių pastorinimas alogenine membrana dar nebuvo aprašytas, taigi, svarbu išsiaiškinti šios membranos panaudojimo galimybes storinant plonus minkštuosius audinius ir siekiant sumažinti kraštinio kaulo tirpimą.

Tyrimo tikslas – ištirti kraštinio kaulo stabilumą apie įsriegtus į apatinį žandikaulį implantus su vienodo ir siauresnio skersmens implanto atramos jungtimis, esant skirtingo storio minkštiesiems audiniams, ir pastorinus plonus audinius alogenine membrana, praėjus metams po protezavimo.

Tyrimo uždaviniai

1. Įvertinti ir palyginti kraštinį kaulą apie vienodo skersmens implanto atramos jungties implantus, esant skirtingo storio minkštiesiems audiniams, praėjus dviem mėnesiams po implantavimo, po protezavimo ir praėjus metams po protezavimo.
2. Įvertinti ir palyginti kraštinį kaulą apie siauresnio skersmens implanto atramos jungties implantus, esant skirtingo storio minkštiesiems audiniams, praėjus dviem mėnesiams po implantavimo, po protezavimo ir praėjus metams po protezavimo.
3. Įvertinti ir palyginti minkštųjų audinių pastorinimo alogenine membrana įtaką kraštinio kaulo tirpimui apie implantus su vienodo skersmens implanto atramos jungtimis.
4. Įvertinti ir palyginti minkštųjų audinių pastorinimo alogenine membrana įtaką kraštinio kaulo tirpimui apie implantus su siauresnio skersmens implanto atramos jungtimis.
5. Įvertinti minkštųjų audinių padidėjimą juos pastorinus alogenine membrana.

Ginamieji teiginiai

1. Minkštųjų audinių storis turi įtakos kraštinio kaulo stabilumui apie implantus su vienodo skersmens implanto atramos jungtimis.

2. Minkštųjų audinių storis turi įtakos kraštinio kaulo stabilumui apie implantus su siauresnio skersmens implanto atramos jungtimis.

3. Minkštųjų audinių pastorinimas alogenine membrana turi įtakos kraštinio kaulo stabilumui apie implantus su vienodo skersmens implanto atramos jungtimis.

4. Minkštųjų audinių pastorinimas alogenine membrana turi įtakos kraštinio kaulo stabilumui apie implantus su siauresnio skersmens implanto atramos jungtimis.

5. Alogeninė membrana gali būti naudojama minkštiesiems audiniams pastorinti vertikaliai.

Tyrimo reikšmė

1. Nustatyta, kad vienodo skersmens implanto atramos jungties naudojimas nesumažina kraštinio kaulo tirpimo, jei implantai sriegiami į vertikaliai plonus minkštuosius audinius.

2. Nustatyta, kad siauresnio skersmens implanto atramos jungties naudojimas nesumažina kraštinio kaulo tirpimo, jei implantai sriegiami į vertikaliai plonus minkštuosius audinius.

3. Minkštųjų audinių pastorinimas alogenine membrana sumažina kraštinio kaulo tirpimą apie implantus su vienodo skersmens implanto atramos jungtimis.

4. Minkštųjų audinių pastorinimas alogenine membrana sumažina kraštinio kaulo tirpimą apie implantus su siauresnio skersmens implanto atramos jungtimis.

5. Alogeninė membrana gali būti dedama tiesiai ant kraštinio kaulo ir sėkmingai naudojama minkštiesiems audiniams pastorinti vertikaliai.

6. Tiriant kraštinį kaulą apie implantus, rekomenduojama matuoti vertikalų minkštųjų audinių storį.

Tyrimo rezultatai ir išvados

1. Vienodo skersmens implanto atramos jungties naudojimas nesumažina kraštinio kaulo tirpimo, jei implantai į vertikaliai plonus minkštuosius audinius sriegiami 1 mm virš kraštinio kaulo, siekiant nesudaryti mikrotarpo.

2. Siauresnio skersmens implanto atramos jungties naudojimas nesumažina kraštinio kaulo tirpimo, jei implantai sriegiami į vertikaliai plonus minkštuosius audinius.

3. Minkštųjų audinių pastorinimas alogenine membrana sumažina kraštinio kaulo tirpimą apie implantus su vienodo skersmens implanto atramos jungtimis.

4. Minkštųjų audinių pastorinimas alogenine membrana sumažina kraštinio kaulo tirpimą apie implantus su siauresnio skersmens implanto atramos jungtimis.

5. Alogeninė membrana gali būti dedama tiesiai ant kraštinio kaulo ir gali būti sėkmingai naudojama minkštiesiems audiniams pastorinti vertikaliai atliekant tiek vieno, tiek dviejų etapų implantaciją.

Praktinės rekomendacijos

1. Tiriant ankstyvąjį kraštinio kaulo patirpimą arba siauresnio skersmens implanto atramos jungties poveikį ankstyvajam kraštinio kaulo patirpimui, rekomenduojama matuoti minkštųjų audinių storį.

2. Implantus su vienodo skersmens implanto atramos jungtimis rekomenduotina sriegti 0,5–1 mm virš kraštinio kaulo.

3. Pastorinti minkštuosius audinius, jeigu jie yra 2 mm ar plonesni.

4. Siekiant sumažinti diskomfortą pacientui, siūlytina vietoj jungiamojo audinio transplanto iš gomurio naudoti alogeninę membraną.

5. Alogeninę membraną galima dėti tiesiai ant kraštinio kaulo atliekant tiek vieno, tiek dviejų etapų implantaciją – taip supaprastinama chirurginė procedūra.

LIST OF PUBLICATIONS ON THE SUBJECT OF DISSERTATION

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2. **A. Puišys**, S. Žukauskas, R. Kubilius, E.Vindašiūtė, N. Verina, T. Linkevičius *Vertical soft tissue augmentation with porcine-derived collagen matrix membrane. A prospective study with 20 consecutive patiens*. Annual Meeting of the European Association for Osseointegration, Stockholm, Sweden, September 24-26, 2015.

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Early implant placement in aesthetic area with simultaneous guided bone regeneration and soft tissue augmentationusing collagen tissue matrix membrane. Annual Meeting of the European Association for Osseointegration, Stockholm, Sweden, September 24-26, 2015.

4. **A. Puišys** *Is conective tissue still the golden standard for soft tissue augmentation?* Congress of Implantology, Dusseldorf, Germany, Nowember 28-29, 2014.

5. **A. Puišys** *Creation of stable crestal bone around dental implants.* Conference, Hamburg, Germany, Nowember 22, 2014.

6. **A. Puišys**, T. Linkevičius, E. Vindašiūtė, N. Maslova *Soft tissue influence on crestal bone stability*. 31-st international conference, Bormio, Italy, March 4, 2014.

7. **A. Puišys**, T. Linkevičius, E. Vindašiūtė, N. Maslova *Factors affecting the stability of the marginal bone around the implants*. International Congress of Implantology, Kharkov, Ukraine, Nowember 20-22, 2013.

8. **A. Puišys**, T. Linkevičius, E. Vindašiūtė, N. Maslova *Crestal bone stability around implants with horizontally matching connection after mucosal tissue thickening. A controlled clinical trial*. Annual Meeting of the European Association for Osseointegration, Dublin, Airland, October 17-19, 2013.

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10. **A. Puišys**, T. Linkevičius, E. Vindašiūtė, N. Maslova M. Schlee *Influence of mucosal tissue thickening on the crestal bone stability around bone level implants. A pilot clinical study.* Europerio 7 scientific conference, Vienna, Austria, June 7-9, 2012.

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Algirdas Puišys graduated from odontology studies at Vilnius University in 2002. 2002-2003 practiced in “Šatrijos odontologijos klinika” and 2003-2006 studied periodontics at Lithuanian University of Health Sciences. From 2006 works in private practice as periodontologist. Algirdas Puišys participated in international conferences; he is the author and co-author of 16 scientific publications and a 1st place winner of clinical trials competition at European Association for Osseointegration congress, (EAO, Copenhagen 2012). In 2014 he successfully finished EAO Certification program. The doctoral student is a member of international organizations (European Association for Osseointegration (EAO), Baltic Academy of Osseointegration, (BOA Board member), Lithuanian Association of Periodontology (LPD), German Association of Implantology (DGI), International Implantology Team (ITI), Lithuanian Dental Chamber (LOR), European Association of Cosmetic Dentistry ESCD, European Centers for Dental Implantology (ECDI).