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Comparative radiographic and resonance frequency analyses of the peri-implant tissue after dental implants placement using flap and flapless techniques: An experimental study on domestic pigs

Komparativna radiografska analiza i analiza rezonantne frekvencije periimplantatnog tkiva nakon ugradnje dentalnih implantata primenom hirurške tehnike *flap* i *flapless*: eksperimentalna studija na domaćim svinjama

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Abstract

Background/Aim. Flapless implant surgery has become very important issue during recent years, mostly thanks to computerization of dentistry and software planning of dental implants placements. The aim of this study was to compare flap and flapless surgical techniques for implant placement through radiographic and radiofrequency analyses. **Methods**. The experiment was made in five domestic pigs. Nine weeks following domestic pigs teeth extraction, implants were placed, on the right side using surgical technique flap, and flapless on the left side. Digital dental X-rays were applied to determine primary dental implant stability quality (ISQ). At certain intervals, not later than three months, the experimental animals were sacrificed, and just before it, control X-rays were applied to measure dental implants stability. **Results.** Radiographic analysis showed that peri-implant bone resorption in the first 4 weeks following placement implants with flap and flapless surgical techniques was negligible. After the 3 months, mean value of peri-implant bone resorption of the implants placed using flap tehnique was 1.86 mm, and of those placed using flapless tehnique was 1.13 mm. In relation to the primary dental implant stability in the first and second week there was an expected decrease in ISQ values, but it was less expressed in the dental implants placed using the flapless technique. In the third week the ISQ values were increased in the dental implants placed by using both techniques, but the increase in flapless implant placement was higher (7.4 ISQ) than in flap implant placement (1.5 ISQ). The upward trend continued in a 4-week period, and after 3 months the dental implant stability values in the implants placed using flap technique were higher than the primary stability for 7.1 ISQ, and in the implants placed using flapless technique were higher comparing to the primary stability for 10.1 ISQ units. **Conclusion**. Based on the results of radiographic and resonance frequency analyses it can be concluded that the flapless technique in surgical implants placemat, leads to better results.

Key words:
dental implantation, endosseous; surgical flaps; dental implants; pigs; osseointegration.

Apstrakt

Uvod/Cilj. Implantatna hirurgija *flapless* postaje aktuelna poslednjih nekoliko godina zahvaljujući kompjuterizaciji stomatologije i softverskog planiranja ugradnje implantata. Cilj rada bio je da se radiografskom analizom i analizom rezonantne frekvencije uporede hirurške tehnike *flap* i *flapless* ugradnje implantata. **Metode.** Eksperiment je obavljen na pet domaćih svinja. Devet nedelja nakon ekstrakcije zuba, svinjama su ugrađeni implantati, sa desne strane hirurškom tehnikom *flap*, a sa leve hirurškom tehnikom *flapless*. Urađeni su digitalni radiološki snimci i izmerena primarna stabilnost implantata (ISQ). U određenim vremenskim intervalima do tri meseca, eksperimentalne životinje su žrtvovane, a neposredno pre rađeni su kontrolni rendgenski snimci i merena stabilnost implantata. **Rezultati.** Radiografskom analizom uočeno je da je periimplantatna koštana resorpcija u prve četiri nedelje bila zanemarljiva kod obe hirurške tehnike. Nakon tri meseca srednja vrednost periimplantatne koštane resorpcije kod *flap* implantata bila je 1,86 mm, a kod *flapless* implantata 1,13 mm. U odnosu na primarnu stabilnost implantata, u prvoj i

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drugoj nedelji došlo je do očekivanog pada vrednosti ISQ, ali je taj pad kod *flapless* implantata bio manji. U trećoj nedelji rasle su vrednosti ISQ kod *flap* i *flapless* implantata, ali je porast kod *flapless* implantata bio veći (7,4 ISQ) u odnosu na *flap* implantate (1,5 ISQ). Tendencija rasta se nastavila i u četvrtoj nedelji i nadalje, a nakon tri meseca vrednosti stabilnosti implantata kod *flap* implantata bile su veće u odnosu na primarnu stabilnost za 7,1 ISQ, a kod *flapless* implantata za 10,1 ISQ. **Zaključak.** Na osnovu rezultata radiografske analize i analize rezonantne frekvencije možemo zaključiti da hirurška tehnika ugradnje implantata *flapless* daje bolje rezultate od hirurške tehnike *flap*.

Ključne reči:
stomatološka enosalna implantacija; režnjevi, hirurški; implantati, stomatološki; svinje; oseointegracija.

Introduction

Progress made in the production technology of surface and design of dental implants makes a significant contribution to improving osseointegration characteristics of advanced implants, and the development of radiographic technology has greatly improved preciseness in the process of planning dental implant site.

Many authors suggest that minimally invasive implant surgery additionally improves function, esthetics and comfort [1] promoting early rehabilitation of patients in both functional as well as esthetic implant-prosthetics aspects [2].

Each implant surgery starts with gingival incision, that leads to different results depending on the way of incision [3]. Exposing bone surface for implant placement could be performed in two ways: classical flap method using raising mucoperiostal flap and flapless method, *ie* without raising a mucoperiostal flap.

The flap surgical method means placing an implant in which, after gingival incision is made, a mucoperiostal flap, is raised on the vestibular surface, making the bone on the alveolar ridge exposed. After implant site preparation and implant placement, the flap is sutured [1, 3, 4].

The flapless surgical procedure causes less crestal soft tissue damage. Application of this method – its name is self-explanatory (flap + less), no mucoperiostal flap while placing dental implant, and, therefore, the consequent trauma of peri-implant tissues is smaller. It can be performed in two ways.

The first way is to remove a part of the gingival tissue (size is matching with the implant diameter) above the alveolar bone, exceeded with the punch (round like) knife, then to preparation the bone for implant site starting from the centre of the exposed bone and subsequent dental implant placement (unsubmerged technique). Another way is to perform mini crestal incision and local uplift of mucoperiosteum, only up to the diameter of mini implant that we plan to place (3–5 mm). After implant site preparation and implant placement, mini incisal line is sutured with single suture (submerged technique) [1]. It is worth mentioning that the technique of flapless implant placement 3D panoramic radiograph of the jaw, as well as surgical stent are required.

Radiographic industry development (3D panoramic radiograph and cone beam appliances), as well as computerization of dentistry itself, enabled daily application of flapless dental implant placement technique, therefore researches on comparative analysis of the degree of success of flap and flapless placing implants techniques have been very present in the past few years. In research and comparative analysis of the results on flap and flapless dental implant surgery the parameters used are as follows resonance frequency analysis, radiographic (2D and 3D) analysis, clinical measurement of post operative edema of peri-implant mucosa, probing and determination of sulcus depth around the dental implant, determination of gingival index and gingival bleeding index (GBI) [5, 6], as well as survey testing of patients in terms of anxiety, subjective postoperative discomfort (pain, swelling, recovery) [7].

Resonance frequency analysis is a non-invasive diagnostic method that allows clinical measurement of dental implants stability and monitoring of tissue biological response and osseointergration as a function of time. Resonance frequency analysis (RFA) uses a sophisticated technology with computer-based measurement of resonance frequency (RF), which is determined by two parameters: the degree of bone density on implant-bone interface area and the level of marginal alveolar bone around the transducer [8].

Radiographic procedure in the assessment of peri-implant bone resorption is less invasive and far more practical than direct visualization, although radiography can only analyse proximal bone surfaces.

To reliably estimate peri-implant bone change radiographic images can be repeated at different observational intervals, while rulers, vernier calipers, digital measurers, optical comparators for measuring such changes are used. Computer technique for measuring peri-implant bone is considered to be the most reliable one comparing to another methods and therefore for peri-implant bone resorption analysis intraoral radiography and panoramic radiography supplemented with digital radiography are used nowadays [9, 10].

The aim of this study was to compare of flap and flapless surgical techniques of implant placement through radiographic and radiofrequency analyses.

Methods

In order to achieve the set goals experimental research on 5 domestic pigs, aged 2 and a half to 3 months, weight 20–25 kg were performed. The study included radiography and RFA. The experiment was conducted in 4 phases.

The first phase

During the short-term effect of intravenous anesthesia (ketamine 1 mL/10 kg *iv*) with prior premedication (acepromazine 0.1 mL/kg and 0.5 tramadol *im*) and local application of local anesthetic (lidocaine 2% with adrenaline 2 mL), the second and third premolars in the lower jaw on both sides were extracted. Prior to the surgical procedure animals were deprived of food (24 h) and water (12 h). Teeth were extracted to place implants in the position of premolars following wounds healing. The premolars in the lower jaw belong to the group of chewing teeth with very divergent and gracile roots, that is the reason for separation to precede extraction in order to make a minimum trauma to the surrounding bone and soft tissue.

Extraction wounds were sutured with individual surgical sutures and absorbable surgical sutures (Polysorb 3,0 Braun) and for 9 weeks left to heal secondary. According to the literature [11], a 9-week period is sufficient for bone healing, since the rate of bone healing in domestic pigs is somehow higher comparing to human.

Antibiotics [procaine penicilline with neomycine, (Neopenicillin® 4.000.000 "FM farm", Subotica); dose was 6–12.000 *im*] were administered in the experimental animals after teeth extraction for 5 days. After finishing anesthesia, 12 h later, food and water were given to the study animals. In a post-surgical period they were fed with mushy food during 7 days, kept in a purpose-made, experimental box with daily veterinary supervision. Conditions in the experimental box were in accordance with the current protocol for this kind of work: air temperature 18–24°C (± 2°C), humidity 60–70%, air velocity 0.2 m/s, illuminance 100 lux, with 1.40 kg of diet for finishing pigs (minimum 16% protein) and with automatic watering (flow rate 0.75 L/min, t° of water 18°C).

The second phase

Nine weeks later, anesthesia was given to the experimental animals *iv* with prior premedication and the protocol of implant placement in edentulous segments of the lower jaw with application of local anesthetic in the same manner like in teeth extraction. Each animal got three implants (Bredent, Blue Sky 3.5 × 10 mm) placed on each side as follows: on the right side three implants were placed with flap (submerged) technique (Figure 1); on the left side three implants were placed with flapless, mini-incisional technique (Figure 2).

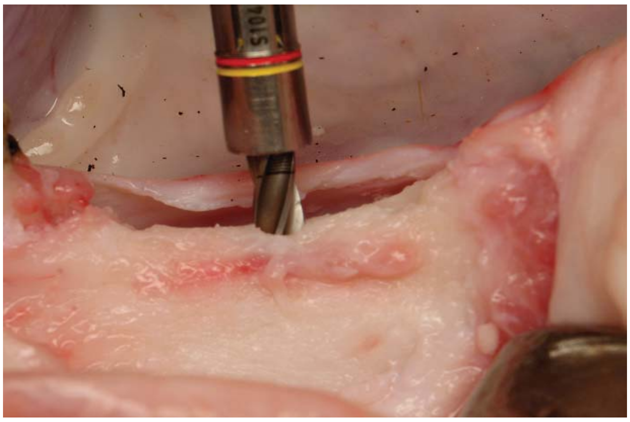

Fig. 1 – The flap tehnique – surgical preparation of the implant site.

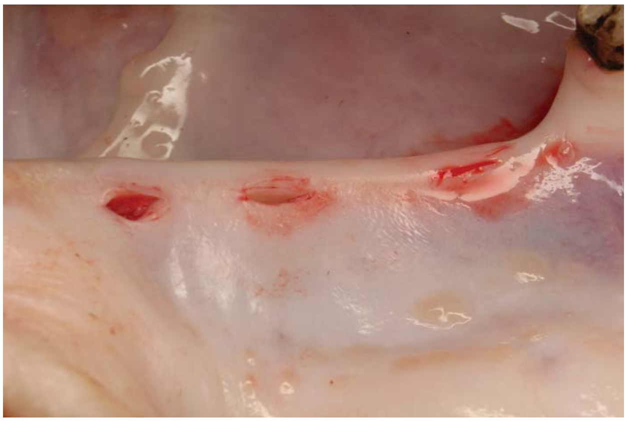

Fig. 2 –The flapless technique (mini incisions).

The incisions were sutured with single resorbable surgical sutures thread (Polysorb 4/0 Braun) and postoperative antibiotics therapy was administered as it was the case in the previous phase with daily veterinary supervision.

Upon completion of implants placement the primary stability of each implant was measured (ISQ – implant stability quality) with resonance frequency analysis using an ostell mentor instrument (Figure 3). Osstell is representative of RFA-technique and was tested first in 1997 [8].

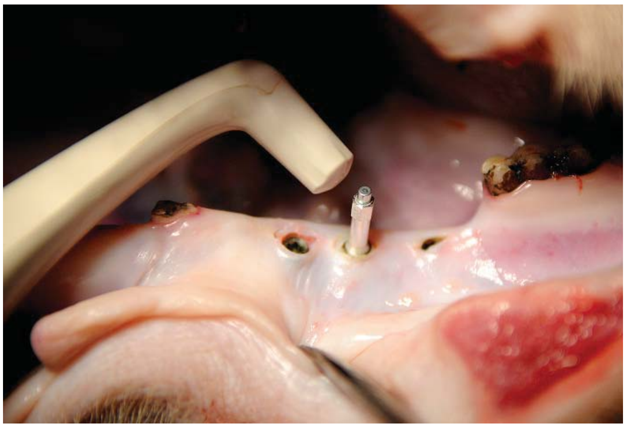

Fig. 3 – Primary stability measuring – flapless implants.

The apparatus consists of an Osstell transducer and Osstell analyzer connected to a PC or independent. The transducer is L-shaped or bolts-like (smartpeg) and firmly screwed in order to be positioned on the implant and its superstructure (4–5 N/cm²) and consists of 2 small voltage-controlled transducers. High-energy pulse-type oscillations of a continuous sinusoidal pulse excite implant, in order to register the mechanical vibration between the implant interconnection zone and the bone. As soon as the apparatus is activated the first electric transducer applies excitation signal of increasing frequency from 5 to 15 kHz to implant. Other voltage-controlled element registers ultrasonic vibrations response, *ie* resonant frequency of the implant-bone interface area and transmits a created signal to the amplifier, which amplifies it and to the analyzer which reads, evaluates and compares it with the frequency of the original signal.

The measured amplitude of resonance frequency is displayed numerically and graphically on the Osstell analyzer, and the maximum amplitude represents the stability of the implant, quantified through the ISQ units. The ISQ value reflects the rigidity of the system transducer-implant-bone and transducer calibration parameters. Measured on a scale from 0 ISQ (3500 Hz) to 100 ISQ units (8500 Hz), a higher ISQ value indicates a greater stability of the implant. After a while ISQ values rise because of osseointegration where implant–bone the connection becomes stronger.

At the same time dento-alveolar digital radiographs were made of parts of the mandible with placed implants using a Gendex device and Dentsply digitilization, with an X-ray distancer (made by the same producer) for standardization of the obtained X-ray images.

The third phase

According to the protocol the animals were sacrificed at various intervals of time (1 week, 14 days, 21 days, 28 days and 3 months upon implants placement) but immediately before it ISQ was measured and retroalveolar radiographic images performed of the parts of the mandible with implants.

Radiographic analysis included bone resorption measuring.

The dimensions of bone tissue loss were measured at certain time intervals and compared with the original height of each bone implants.

Measurements were carried out on the mesial and distal surface of each implant, and then the mean bone tissue loss determined in relation to the periods of sacrificing experimental animals (Figure 4). The error which might occur due to imaging techniques is corrected by determining the index as following:

Measured hight of implant (L') / Actual hight of implant (L = 10 mm) = Measured resorption of bone tissue (R) / periimplant bone resorption (PIBR)

$$PIBR = R \times L / L'$$

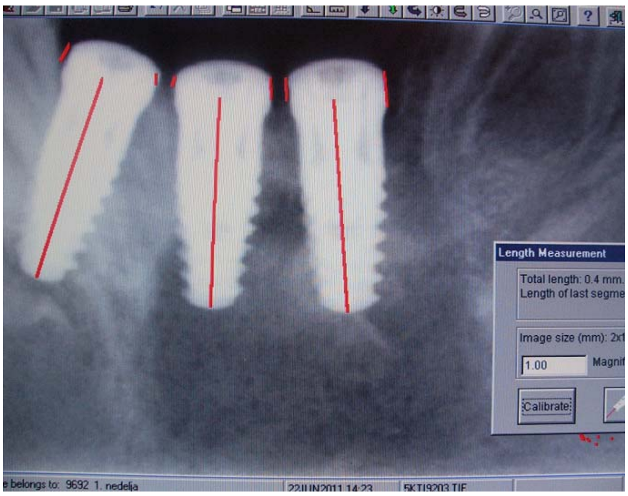

Fig. 4 – Radiographic analysis – peri-implants bone resorption measuring.

The fourth phase

At this stage statistic analysis and processing of the obtained results were performed, using repeated measures ANOVA with time (dependent variable measured after 7, 14, 21, 28 and 90 days) as within-subject factor, and method (flap *vs* flapless) as between-group order to factor.

Results

Embedded implant stability measurements were performed in all 30 implants on 4 sides of the implant (mesial, distal, buccal and lingual) immediately after their placement (primary stability) and immediately after experimental animals sacrifice and then the mean values of implants stability were calculated. The values of the primary stability of implants were taken initially, and then variations in the stability of the implant in relation to the primary stability at certain time intervals were measured, after the sacrifice of experimental animals. Statistically significant difference in stability was found between the methods ($F_{(1,4)} = 9.42$, $p = 0.037$). Neither the main effect of time [the difference in stability between the time points (Wilks lambda = .006, $F_{(4,1)} = 40.74$, $p = 0.117$)], nor the interaction (the difference in the shapes of recovery trajectories) were found to be significant (Wilks lambda = .029, $F_{(4,1)} = 8.43$, $p = 0.252$).

The obtained results are shown in Tables 1 and 2 and figure 5.

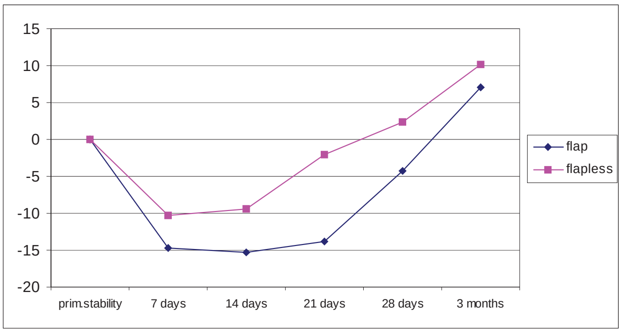

Fig. 5 – The ratio of deviation of implants stability values in relation to the primary stability of flap and flapless surgical techniques.

Radiographic analysis of digital X-ray images was used for measuring peri-implant bone resorption (PIBR) on mesial and distal surfaces of the implant at regular intervals. An error that might occur due to a recording technique was corrected through the appropriate index, thus calculating the mean value of peri-implant bone resorption for certain periods from the time of implants placement. The obtained values are shown in Tables 3 and 4. Bone resorption was analyzed, too. Again, a statistically significant difference between methods was found ($F_{(1,4)} = 32.45$, $p = 0.005$). The main effect of time (the difference in bone resorption between the time points) was significant (Wilks lambda = 0.006, $F_{(3,2)} = 173.06$, $p = 0.006$). The interaction (the difference in the shapes of the bone resorption trajectories) was marginally significant (Wilks lambda = .052, $F_{(3,2)} = 12.21$, $p = 0.077$).

The obtained results are shown in the Figure 6.

Table 1

Deviations of flap implant stability compared to primary stability at certain time intervals shown in Implant Stability Quality (ISQ) units

Experimental animal	Primary stability	After 7 days	After 14 days	After 21 days	After 28 days	After 3 months
No. 1	Implant I 73,73,72,73 Implant II 69,72,69,73 Implant III 63,63,63,65 Mean 69,0	Implant I 52,53,57,52 Implant II 60,56,52,52 Implant III 55,55,55,54 Mean 54,4				
No. 2	Implant I 57,58,58,53 Implant II 63,63,63,63 Implant III 56,56,59,60 Mean 59,1		Implant I 44,44,43,44 Implant II 46,45,46,48 Implant III 42,42,42,41 Mean 43,2			
No. 3	Implant I 78,78,82,71 Implant II 80,78,82,82 Implant III 79,84,84,84 Mean 80,1			Implant I 62,63,62,61 Implant II 62,63,63,63 Implant III 74,74,74,76 Mean 66,4		
No. 4	Implant I 62,62,59,60 Implant II 77,74,77,78 Implant III 63,63,65,63 Mean 66,9				Implant I 58,58,58,58 Implant II 69,69,70,70 Implant III 60,60,60,61 Mean 62,6	
No. 5	Implant I 69,69,71,68 Implant II 59,59,61,59 Implant III 55,55,49,56 M.value 60,0					Implant I 74,74,77,76 Implant II 66,64,64,64 Implant III 62,62,61,61 Mean 67,1
Deviations		- 14,6	- 15,2	- 13,7	- 4,3	+ 7,1

Table 2

Deviations of flapless implant stability compared to primary stability at certain time intervals shown in Implant Stability Quality (ISQ) units

Experimental animal	Primary stability	After 7 days	After 14 days	After 21 days	After 28 days	After 3 months
No. 1	Implant I 69,68,68,66 Implant II 62,64,68,62 Implant III 70,70,66,70 Mean 66,9	Implant I 53,60,57,57 Implant II 58,52,57,57 Implant III 56,58,57,58 Mean 56,6				
No. 2	Implant I 57,57,52,54 Implant II 72,70,69,72 Implant III 73,69,73,70 Mean 65,7		Implant I 49,49,49,51 Implant II 62,60,60,60 Implant III 59,59,59,59 Mean 56,3			
No. 3	Implant I 62,64,62,64 Implant II 72,69,69,72 Implant III 65,61,57,58 Mean 65,1			Implant I 60,60,59,60 Implant II 70,70,70,72 Implant III 57,57,60,62 Mean 63,1		
No. 4	Implant I 76,76,80,77 Implant II 62,62,60,63 Implant III 57,51,57,60 Mean 65,1				Implant I 80,82,82,82 Implant II 63,61,61,65 Implant III 60,57,57,59 Mean 67,4	
No. 5	Implant I 69,69,71,68 Implant II 59,59,61,59 Implant III 55,55,49,56 Mean 60,0					Implant I 79,79,77,76 Implant II 70,,69,69,69 Implant III 64,66,66,66 Mean 70,1
Deviations		- 10,3	- 9,4	- 2,0	+ 2,3	+ 10,1

Table 3

The values of peri-implant bone resorption (PIBR) after application of surgical flap techniques of implants placement

Experimental animal	After 7 days	After 14 days	After 21 days	After 28 days	After 3 months
No. 1	Implant I ms. Ø ds. Ø Implant II ms. Ø ds. Ø Implant III ms. Ø ds. Ø				
No. 2		Implant I ms. Ø ds. Ø Implant II ms. Ø ds. Ø Implant III ms. Ø ds. Ø			
No. 3			Implant I ms. 0,1 ds. Ø Implant II ms. 0,1 ds.0,2 Implant III mz.0,1 ds.0,1		
No. 4				Implant I ms.0,2 ds 0,4. Implant II ms 0,3. ds 0,2. Implant III ms.0,3 ds .0,4	
No. 5					Implant I ms.1,9 ds.1,8 Implant II ms.1,8 ds 2,0. Implant III ms 2,1 ds.1,6
P I B R (mean)	Ø	Ø	0,10 mm	0,30 mm	1, 86 mm

(ms = mesial, ds = distal)

Table 4

The values of peri-implant bone resorption (PIBR) after application of surgical flapless techniques of implants placement

Experimental animal	After 7 days	After 14 days	After 21 days	After 28 days	After 3 months
No. 1	Implant I ms. Ø ds. Ø Implant II ms. Ø ds. Ø Implant III ms. Ø ds. Ø				
No. 2		Implantat I ms. Ø ds. Ø Implantat II ms. Ø ds. Ø Implantat III ms. Ø ds. Ø			
No. 3			Implant I ms.0,1 ds 0,1. Implant II ms. 0,1 ds. Ø Implant III ms.0,1 ds 0,1		
No. 4				Implant I ms.0,3 ds.0,2 Implant II ms 0,1 ds.0,3 Implant III ms.0,3 ds 0,3.	
No. 5					Implant I ms 1,7 ds. 0,9 Implant II ms.0,9 ds 1,0. Implant III ms.1,0 ds.1,3
P I B R (mean)	Ø	Ø	0,08 mm	0,25 mm	1, 13 mm

(ms = mesial, ds = distal)

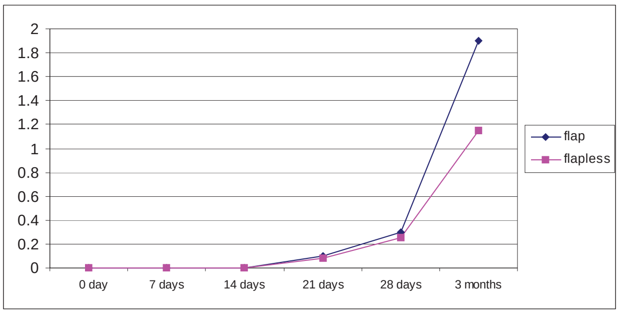

Fig. 6 – The ratio of deviation of peri-implant bone resorption of the flap and flapless surgical techniques.

Discussion

The first scientific research on flapless implant placement techniques dates back a few years ago [1, 12–14]. Evidently, minimally aggressive surgical technique results in less trauma and faster recovery of peri-implant tissue. Technological advances in radiology, use of computed tomography (CT) and cone beam apparatus and the creation of three-dimensional X-ray images of jaw bones, as well as software planning of implants placement enabled clinical application of surgical flapless implants placement techniques in everyday practice.

In a clinical research on comparative analysis of flap and flapless implant surgery, the obtained results in large numbers indicate faster repair of peri-implant tissue and subjectively easier postoperative recovery in patients with flapless technique applied [11].

In experimental flap and flapless implant surgery studies, the local inflammatory response of soft peri-implant tissue, the density of blood vessels in peri-implant tissue, resorption of peri-implant bone tissue and analysis of bone-to-implant-contact (BIC) and the degree of bone density around the implant were compared [5, 6, 15]. Basically advantages of flapless surgical technique are considerably less trauma of soft peri-implant tissue and minimal disruption of peri-implant tissue vascularization that occurs due to mucoperiostal flap raise. This is especially evident in the lower jaw with the most compact bone structure.

In fact, blood circulation within the mandible is centrifugal compared to the normal flow. Inferior alveolar artery is the main arterial supplier of the mandible. The artery passes through the body of mandible and brings blood from the interior of bone, through the cortical bone to the terminal branches of the blood vessels localized in the periosteum. As a result, the circulation of blood within the mandible has a centrifugal flow. When a tooth is extracted, the periodontal plexus is lost, *ie* tooth extraction leads to reduction of blood flow within the inferior alveolar artery [16]. After tooth extraction the alveolar bone heals through reparation or regeneration. Regeneration of tooth socket goes through secondary healing, and tissue in the area of the socket heals with scar tissue which consists of few blood vessels. Based on researches conducted by other authors it can be concluded that there is a reverse direction of blood flow at edentulous mandible from outside to inside the bone, *ie* nutrition is provided by blood vessels of the periosteum and soft tissues, while flap raising additionally reduces and compromises vascularization of the bone [1, 17], and therefore affects the other parameters for assessment of implant placement success. Literature data clearly indicate that bone regeneration almost entirely depends on vascularization, through the periosteum and a small part of bone edges [18]. Periosteum damage leads to rapid bone resorption, that numerous experimental studies report [19]. Choi et al. [1] in their extensive experimental research of flapless implant surgery obtained results, have tested the stability of implants placed in the canine mandible with resonance frequency analysis. During the first week, a decline in the expected value of implant stability in relation to the primary stability was recorded, and the values flapless technique were slightly higher. In the second week the values of implants stability placed with flapless technique remained the same, while the values of implants stability placed with flap method significantly decreased (by about 4 ISQ units). During the third and fourth week there was an expected increase in the value of implants stability, the values of flapless method showed more intensive and significant growth, and the difference in the mean value of implant stability at the end of the fourth week was about 6 ISQ units higher in the implants placed by flapless method. The results of our study on domestic pigs correspond to the results of Choi et al. [1]. The difference is that our values declined more after the first week, while the values of flapless technique were significantly higher (by 4.3 ISQ units). A tendency to decrease in the values of flap method continued in the second week, but with much lower intensity (about 0.6 ISQ), while the values for flapless surgery, increased by 0.9 ISQ units. In the third and fourth week the value of implant stability, placed with flap and flapless method, showed growth, and at the end of the fourth week the difference in the mean value was higher in the implants placed with flapless method by 6.6 ISQ units. Our study took 3 months, and in relation to the primary stability, the values after 3 months increased by 7.1 ISQ units in flap method, and increased by 10.1 ISQ units in flapless method.

Radiographic assessment of PIBR has been used for many years. Analysis of X-ray images has been used in many implant studies to compare different types, sizes, designs, implant surfaces, results of single- and two-phase implant insertion method, and recently flap and flapless techniques of implants placement [20–22].

An important parameter in assessing PIBR is the moment of initial X-ray image shooting. Many studies consider the period after placing implants as initial period [23, 24], while others consider the load period as the reference one [24]. In our study the initial X-ray image was taken immediately after the placement of implants because we opted for the submerged method and loading of implants was not foreseen in this experimental study.

Jeong et al. [20, 21] in their experimental and clinical studies compared peri-implant bone resorption around the implants placed with flap and flapless method, with radiographic analysis for 3-month a period.

Their results showed approximately 1 mm larger peri-implant bone resorption in implants placed with flap method as compared to those placed with flapless method.

Rousseau [22] in his 3-month period clinical studies with radiographic analysis of PIBR obtained no significant difference in the values of bone resorption in implants placed with both flap and flapless techniques.

The results of our research suggest that peri-implant bone resorption in the first 4 weeks was negligible in both flap and flapless method of implants placement, while the measured values 3 months after implants placement showed a difference in the level of the bone around the implant. The mean value of peri-implant bone resorption after 3 months was 1.86 mm in flap technique (ranging from 1.6 to 2.1 mm), and in flapless technique it was 1.13 mm (ranging from 0.9 to 1.7 mm).

The mean value of peri-implant bone resorption was for 0.73 mm less in cases of flapless technique for implants placement compared to the flap technique, which coincides with clinical and experimental researches mainly on dogs conducted by most researchers on this issue [20, 21 25–27].

Conclusion

According to radiographic and resonance frequency analyses of the peri-implant tissue after implant placement the flapless surgical technique has significant advantages over the flap technique.

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