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Original scientific paper

Densitometric Analysis of Dental Implant Placement between Flapless Technique and the Two-Stage Technique – A Pilot Study

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A B S T R A C T

Flapless technique is a surgical approach of implant placement without raising a mucoperiosteal flap. Such approach has many advantages: shorter surgical treatment, minimal bleeding, postoperative discomfort for the patient is reduced; possibility of immediate loading of the inserted implant, faster procedure of implant placement and by that less time is needed for the complete implant-prosthetic restoration. Purpose of this pilot study was radiographic assessment of flapless technique and determination of its clinical values in comparison with two-stage dental implant technique through computerized densitometric analysis. The sample consisted of 10 patients with missing teeth in the premolar region in the upper jaw. An implant was placed in that position. In the first group of 5 patients the implants were inserted with the flapless technique, and in the other group of 5 patients implant insertion was done with a two-stage technique. All inserted implants were loaded with metal-ceramic crowns 3 months after placement. The patients were followed for 18 months through clinical follow-ups and radiovisiographical (RVG) images made after 3, 12 and 18 months. After comparing the average densities, the results showed similar decrease of density in both groups, conventional two-stage technique showed 3.24 and flapless technique 1.23. It can be concluded that flapless technique in everyday clinical usage has the same result as the two-stage dental implant technique.

Key words: *minimally invasive surgical procedures, dental implants, density*

Introduction

Flapless technique is one of the latest minimally invasive surgical methods of implant placement without raising a mucoperiosteal flap. Procedure has many advantages for the patient as well as for the surgeon such as shorter surgical treatment, minimal bleeding, less postoperative discomfort for the patient, possibility of immediate loading of the inserted implant, faster procedure of implant placement and less time needed for the complete implant-prosthetic restoration[1–3]. Two-stage technique in dental implantology, due to raising full-thickness periosteal flap results in the possibility of marginal bone loss and soft tissue recession, while flapless technique has a potential to minimize crestal bone loss and soft tissue inflammation[4–6]. Avoiding the creation of a mucoperiosteal flap results in less postoperative patient discomfort and possible scar tissue formation. Leaving the periosteum intact on the buccal and lingual aspects of the ridge maintains a better blood supply to the site, reducing the likelihood of resorption[1,6]. Since flapless implant placement is generally a »blind« surgical technique, care must be taken when placing the implants due to possibility of cortical bone perforation, both lingual and buccal, especially on the lingual in the mandible molar area and the anterior maxilla[2]. Clinical conditions for using flapless approach consider a minimum of 5.0 mm keratinized tissue because the flapless procedure requires the actual removal of some of the tissue, and at least 4.5 mm of bone width must be available without undercuts of more than

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15°, and certain bone quality (type I or II). Traditional flap reflection is recommended if an undercut of more then 15° is detected because of greater visibility when placing the implant[1,7]. Flapless technique is usually considered in conjunction with single-stage implant placement and immediate loading of inserted implant. In a single-stage technique, implant coronal portion protrudes through the soft tissue so the second surgical exposure is not necessary as in two-stage surgical treatment[1,7–9].

Excellent results can be achieved by using minimally invasive flapless technique due to optimal implant design and surface of the implant which allows immediate implant loading with satisfied osseointegration. The implant shape is conical, it follows tooth-root form, and the surface is made of highly crystal phosphate, enriched by titanium oxide (e.g.TiUnite, Nobel Biocare), which behaves in an osseoconductive way. The result is better osseointegration and better contact between the new bone and the implant surface during the healing process[2,5,10,12].

Purpose of this study was the radiographic assessment of flapless technique and determination of its clinical values in comparison with two-stage dental implant technique through computerized densitometric analysis.

Materials and Methods

The sample of presented pilot study consists of 10 patients with missing teeth in the premolar region in the upper jaw. All the proper indications for the implant insertions were satisfied (enough bone width, intact neighboring teeth, existence of keratinized tissue of 2mm to 5mm and satisfied relation between upper and lower jaw). As a sample we used patients of both gender, 6 patients were female and 4 patients were male gender, aged between 25–40 years. All the surgical procedures were done at the Department of Oral Surgery, School of Dental Medicine, University of Zagreb. The surgical technique, enforced for each patient, was chosen according to criteria which have been already explained in Introduction. On each patient one implant Replace Select Groovy (Nobel Biocare) was inserted, with dimensions of 4.3/13 mm in 5 patients (3 implants were inserted with flapless surgical technique, and 2 implants with two-stage surgical technique), 3.5/13 mm in 3 patients (two-stage technique) and in 2 patients 5.0/13 mm (flapless technique). During the flapless technique, the tissue punch was used to make a circular incision through the attached gingiva and periosteum at the proposed implant site. The buccal-lingual dimensions of the bone were measured on 3 places with the bone caliper: at the coronary part, at the middle, and at the apical part of the future implant site. With that approach all the undercuts of more than 15°, were able to recover. In cases were the undercuts were more than 15°, the surgical approach with flap reflection were used.

Patients were carefully observed over a period of 18 months. Through 3 follow-ups (first 3 months after the implant placement without prosthetic suprastructure, 12 months after the implant placement with prosthetic suprastructure and 18 months after the implant placement) radiovisiographical (RVG) images were taken with the Orix 70 apparatus (Ardet, Buccinasco, Italy, 2002). Those RVG images were automatically digitalized and stored in the computer with the processed software DIGORA 2.5 for Windows (Copyright, Soredex, 2005) and adjusted to this research, in measuring bone density around inserted dental implant, not only in certain contours, but also in the precise positions. 12 points with diameter of 1mm on correctly allocated positions on cervical, middle and apical part of newly formated bone, around inserted implant, were measured. The measured densities were obtained automatically due to performed software package, after entering the RVG image. Positions of the 12 points were in advance specified and inserted in the software database, so the measurements on all the implants were every time in the same points. Three of those points served as a correction factors, and they were positioned on different parts of the implant. First correction point was placed in the apical part of the implant, were density of the gray shadows was highest; second correction point was placed in the middle part of the implant were was already the perforation of the implant for the screw (density of gray shadows have medium intensity), and third correction point was placed on the cervical part of the implant, in the position were the crown screw is attached to the implant (density of gray shadows have minimal intensity) (Figure 1). Correction points served for revision of density change in measured points which occurred in discontinuity on the x-rays (distortion on x-rays at each

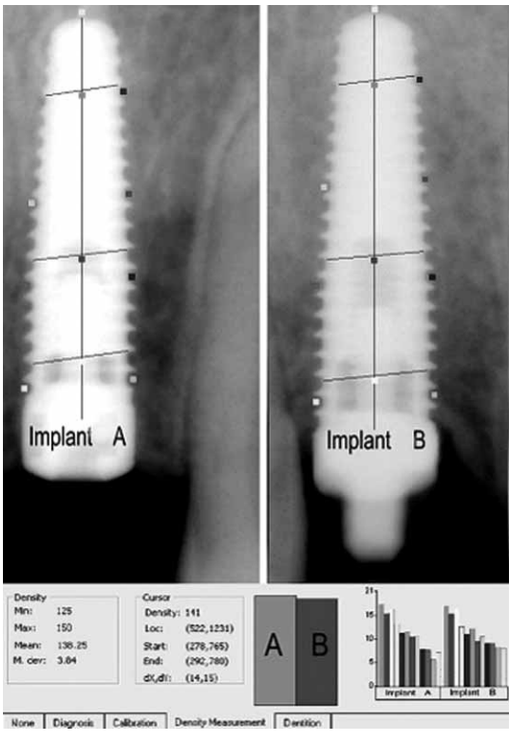

Fig. 1. Position of the correction points.

TABLE 1
BONE DENSITIES THROUGH 3 MEASUREMENTS FOR 5 PATIENTS IN THE TWO-STAGE TECHNIQUE GROUP

	Patient 1			Patient 2			Patient 3			Patient 4			Patient 5		
Point	3. month	12. month	18. month	3. month	12. month	18. month	3. month	12. month	18. month	3. month	12. month	18. month	3. month	12. month	18. month
1	254.96	255.14	254.19	254.52	255.41	254.99	254.42	254.85	254.12	253.99	254.12	254.01	253.84	254.04	253.94
2	248.23	244.21	245.74	247.91	244.82	245.83	248.35	247.68	246.07	244.25	244.58	244.56	242.38	243.15	242.67
3	247.43	251.25	250.69	249.95	251.36	251.44	250.81	251.04	251.83	248.08	247.84	247.92	247.09	246.44	246.89
4	204.16	200.31	198.22	204.16	203.54	202.38	194.69	192.42	192.1	200.74	199.86	197.94	198.53	197.69	196.99
5	190.12	187.21	183.72	191.29	189.36	188.45	193.53	191.34	189.79	185.65	186.41	184.27	184.33	183.04	182.85
6	192.82	216.23	205.14	190.21	191.24	190.41	193.74	190.95	190.41	193.54	192.85	192.41	186.37	184.65	184.22
7	177.2	179.43	179.12	172.28	174.67	173.56	177.6	177.52	177.08	174.91	175	173.57	180.7	178.31	177.68
8	180.74	176.78	172.1	181.84	180.05	179.68	184.9	182.37	181.69	184.67	180.49	179.62	182.57	179.91	179.56
9	171.4	155.62	151.12	170.69	167.66	166.95	168.67	167.44	166.55	168.55	167.21	165.74	174.39	171.24	170.77
10	166.53	162.23	169.72	169.88	163.59	160.06	174.18	175.73	174.28	178.79	177.12	174.83	174.95	172.58	171.72
11	144.71	132.87	134.21	141.41	138.48	134.59	144.69	140.25	134.52	134.07	133.43	132.07	140.55	138.69	137.41
12	143.42	137.44	140.59	140.97	137.26	133.08	141.64	138.92	136.95	144.61	140.81	138.4	139.84	138.29	137.59
Average	174.57	172.01	170.44	173.64	171.76	169.91	174.85	172.99	171.49	173.95	172.58	170.98	173.58	171.6	170.98

TABLE 2
BONE DENSITIES THROUGH 3 MEASUREMENTS FOR 5 PATIENTS IN THE FLAPLESS TECHNIQUE GROUP

	Patient 1			Patient 2			Patient 3			Patient 4			Patient 5		
Point	3. month	12. month	18. month	3. month	12. month	18. month	3. month	12. month	18. month	3. month	12. month	18. month	3. month	12. month	18. month
1	231.76	228.05	232.8	255	251.56	253.21	254.17	254.56	254.8	254.8	253.73	254.01	253.88	254.2	253.65
2	208.79	219.69	217.45	226.07	227.22	226.69	229.3	229.44	230.04	231.59	230.67	231.58	235.67	236.47	232.91
3	222.6	215.41	212.92	240.13	242.42	240.9	240.08	241.42	242.17	244.12	243.77	243.99	247.53	248.33	247.93
4	189.65	185.35	185.01	196.96	185.56	184.54	197.58	196.96	196.35	190.37	188.38	188.17	190.77	188.2	187.69
5	188.84	187.3	186.92	169.11	169.65	163.01	180.42	178.6	178.22	185.9	184.93	184.56	185.39	184.62	183.74
6	186.97	185.63	184.9	171.36	180.13	178.63	181.64	181.04	180.74	184.55	183.41	183.2	184.06	183.93	183.53
7	164.52	164.08	163.96	157.68	155.75	155.44	163.27	164.28	164.16	174.71	175.36	175.06	173.61	173.07	171.49
8	157.15	160.43	158.24	159.76	159.13	158.41	164.88	164.58	164.4	173.43	174.11	173.58	171.94	172.38	171.15
9	151.28	150.27	149.53	120.07	120.46	118.3	141.09	140.9	140.84	163.27	163.24	162.89	155.07	154.75	153.57
10	149.71	150.42	148.71	122.76	125.58	123.17	142.37	141.89	141.79	160.76	161.39	160.85	153.26	153.57	152.94
11	133.1	132.07	130.56	105.01	108.06	107.63	125.99	125.74	125.47	127.69	126.5	126.23	130.43	129.76	128.4
12	131.58	130.01	128.72	108.5	109.5	107.21	126.07	125.94	125.86	124.95	125.49	124.73	128.82	128.7	128.07
Average	161.42	160.62	159.62	145.69	145.98	144.04	158.15	157.77	157.54	165.07	164.76	164.36	163.71	163.22	162.29

of four images in the series of the follow-up, differences in the exposition on the same series of four images that were taken in the follow-up period). Measuring points were positioned: first point was placed 1mm apical of the implant in the middle line, and the rest of 8 points were placed on the precise positions between 4. and 5., 9. and 10., 13. and 14., and between 18. and 19. of the screw thread, on each side of the dental implant. All the received densitometry results were processed in the Excel (OpenOffice 2005 for Windows XP) and they were compared regarding to the technique of implant placement.

Results

The validity of results in measured densities for all 5 patients, in which the implants were inserted using two-stage technique, through all 3 measurements are shown in Table 1. The validity of results in measured densities through 3 measurements in all 5 patients, in which the implants were inserted using flapless technique, are shown in Table 2.

For easier analogy of measured densities, we used average densities for each technique according to stage of

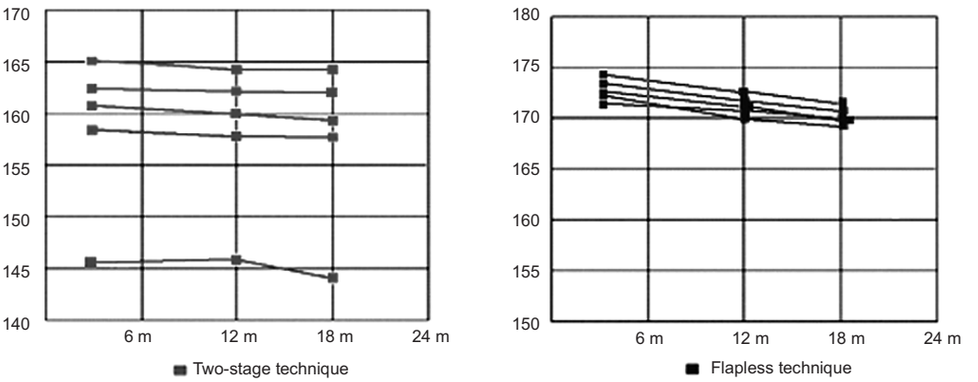

Fig. 2. Avarage values of bone density around inserted implants through all of 3 measurements.

measurement. Due to pilot study, the results were not statistically analyzed, but compared through the values of average densities. Average value of density in period of 3 months (first measurement) in two-stage technique was 174.1, and in flapless technique were 158.8. Second measurements were done 12 months after the implants were inserted, and the results were: 172.18 in two-stage technique, and 158.47 in flapless technique. Average value of density after 18 months (third measurement) was: in two-stage technique 170.86, and in flapless technique 157.57. All these results are shown in Figure 2. After mutual comparison of average densities, the results showed approximately the same decrease of density for both surgical techniques in the follow-up period of 18 months, conventional two-stage technique shown 3.24 and flapless technique 1.23. It shows minimal loss of density in both surgical techniques, as it is shown in the Figure 3.

Discussion

Minimally invasive surgical techniques are a current trend, not only in dental implantology but in all surgical fields. It gives an atraumatic approach for the patients which results in better and easier accomplishment of treatment, not only for the patient but for the surgeon as well. Both of surgical techniques, two-stage and flapless, are safe methods with a long term success and satisfaction for the patient[1,7,12]. Since the flapless technique is a »blind« technique, visibility and orientation are reduced, most of the authors are recommending usages of one of the navigation systems[8,9,11].

Purpose of this work was the radiographic assessment of flapless technique and determination of its clinical values in comparison with two-stage dental implant technique through computerized densitometric analysis. During this research, exclusively RVG images were used, due to their minimal radioactive emission and high image quality that are not lost upon digitalization. Other x-rays are digitizing with the scanner in the computer, after 10% of their quality is lost, which reduces objectivity of results.

For precise density measurements on each image with CADIA (Computer Assisted Densitometric Image Analysis) and for correction of negativity incurred during shooting and developing of each particularly image, it is necessary to incorporate aluminum stepwedge which has a similar atomic number as the bone and titanium[13]. That gives us unchanged values of density regardless of conditions of shooting and development of images. As a stepwedge in this study we used inserted implant, since it is made of titanium and due to its design has three different thicknesses. Those three different thicknesses ensured three correction points of constant density.

Values of densities were measured in all 10 patients through 3 months in certain time interval in 12 determined points. In some points the values of density were minimally decreased in time. After dental implant loading, values of density changes due to masticatory forces. Effect of masticatory forces can be enrolled in the changes of the bone around inserted implant with the help of densitometric analysis. Changes of the bone around inserted implant were mostly expressed on the points 7, 8, 9 and 10 which are located on the 9., 10., 13. and 14. thread of the implant. In the two-stage and flapless surgical technique, average values of bone density change (with the same indications) were approximately the same. Decrease of bone density in the two-stage technique was

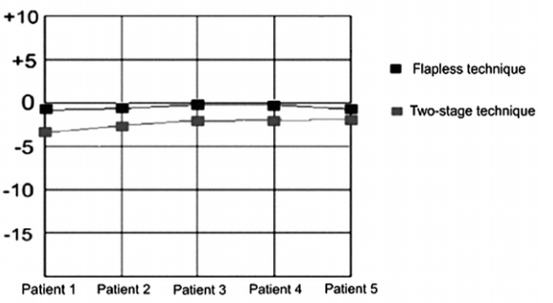

Fig. 3. Comparison of average bone densities showed approximately the same decrease of density for both surgical techniques in the follow-up period.

3.24, and in flapless technique was 1.23. Due to our knowledge, there are no published results in the recent literature regarding densitometric comparison between these two surgical techniques.

Most of the authors use the minimally invasive surgical techniques in everyday practice, including the flapless approach in dental implantology[1,4,6,8,12]. Becker et al.[6] have found that implants placed without flap reflection remained stable and exhibited clinically relevant osseointegration similar to when implants were placed using conventional flap procedures. Campelo and Camara[2] have published the most extensive study about using one-stage flapless surgical technique in dental implantology. In their 10-year retrospective study the cumulative success rate, for 770 implants using a flapless surgical technique, have varied from 74.1% to 100%, relative to the year of placement, which can be explained with a learning curve combining technology and material development in dental implantology. Survival rates in other reported studies, for flapless surgical approach, are between 91% and 98.7%[5,14,15], which indicate successful results of this technique application.

Based on our results, we can say that both of examined groups, and two different techniques in dental implantology show the same clinical values after 18 months of follow-up. Deficiency of this study is a small sample of patients, because it was a pilot study. Due to complete validation of our statement, it will be needed to continue research and include more patients.

Conclusion

From the results attained by the computerized densitometric analysis of RVG images during the period of 18 months, it can be concluded that flapless technique in everyday clinical usage has the same result as the two-stage dental implant technique.

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DENZITOMETRIJSKA USPOREDBA FLAPLESS I DVOFAZNE TEHNIKE UGRADNJE DENTALNIH IMPLANTATA – PILOT STUDIJA

SAŽETAK

Flapless tehnika je kirurška tehnika ugradnje dentalnih implantata bez odizanja mukoperiostalnog režnja i ima mnoštvo prednosti: kraći kirurški tretman, minimalno krvarenje, smanjena postoperativna nelagoda za pacijenta, mogućnost imedijatnog opterećenja ugrađenog implantata te znatno kraće vrijeme kompletne implanto-protetske rehabilitacije. Svrha ovog rada bila je radiološka procjena uspješnosti i kliničke vrijednosti flapless tehnike u odnosu na dvofaznu tehniku ugradnje dentalnih implantata pomoću kompjutorizirane denzitometrijske analize. Uzorak se sastojao od 10 pacijenata kod kojih je nedostajao zub u premolarnoj regiji gornje čeljusti, koji je nadomješten ugradnjom dentalnog implantata. Prvoj skupini od 5 ispitanika, s indikacijom za flapless ugradnju, ugrađeni su implantati flapless tehnikom. Drugoj skupini od 5 ispitanika implantati su ugrađeni dvofaznom tehnikom. Svi implantati su bili opterećeni 3 mjeseca nakon ugradnje metal-keramičkom krunicom. Pacijenti su praćeni u periodu od 18 mjeseci na osnovu kliničkog pregleda i snimaka učinjenih RVG tehnikom 3, 12 i 18 mjeseci nakon ugradnje. Nakon međusobne usporedbe prosječnih denziteta, smanjenje prosječnih denziteta bilo je približno jednako za obje ispitivane tehnike: kod dvofazne tehnike iznosilo je 3,24, dok je kod flapless tehnike iznosilo 1,23. Na osnovi dobivenih rezultata može se zaključiti da je flapless tehnika u svakodnevnoj kliničkoj praksi jednakovrijedna metoda naspram klasične dvofazne tehnike ugradnje dentalnih implantata.