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Research Article

Dimensional Change of Alveolar Bone and Soft Tissue Modelling after Placement of Post-Extraction Implants with Immediate Loading

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Abstract

The success of immediate loading dental implants depends on the management of the bone tissue and peri implant soft tissues. A significant problem is the loss of peri implant soft and hard tissues. The aim of this study is to present the reabsorption of crestal bone in 25 alveolar post extraction sites with immediate loading implants with PEEK - based abutment. The study confirmed this technique reduces the crestal reabsorption of the bone around the implant and therefore it's indicated to reduce bone remodelling and the consequential collapse of the soft tissues of the extraction site.

Keywords: *Tissue Preservation; Single Tooth Immediate Implant Restauration; Aesthetics Area; P.E.E.K.; Horizontal Bone Reabsorption*

Introduction

After dental extraction the healing process of the dental alveolus occurs with bone remodelling that leads to a dimensional reduction of the bone crest. After the extraction the wound healing process consist of 5 steps: formation and maturation of blood coagulum (day 1); organization of the coagulum by capillaries (4 - 5 days); formation of a temporary matrix (14 - 16 days); osteoblast organization of the temporary matrix and complete epithelial closure of the alveolus (until 6 weeks); bone modelling/remodelling (5 - 10 weeks) [1]. Nowadays there are studies that have begun to quantify the bone loss [2] and to describe the management of the extraction socket [3]. A recently published systematic review of post extraction soft and hard tissue changes revealed a significant width reduction of hard tissue of 3.79 mm [4], on both maxilla and mandible. An 11% - 22% reduction of vertical ridge height and 29% - 63% of widths was stated after 6 months. This study revealed that the main reduction occurs in the first 3 - 6 months. The soft tissue structure around the implant differs biologically and physiologically from the supporting periodontium of the tooth. Between implants the papilla stands with no Sharpey fibers originating from the cementum, therefore its volume and shape is naturally reduced and altered [5,6].

To minimize the bone loss, extraction socket preservation (ESP) has been introduced, where bone graft is performed at the time of

extraction. However, the efficacy of ESP has been controversial, and the procedure might be unnecessary in some cases and its implementation should be considered based on the condition of the extraction sockets and surrounding tissues [7]. Extraction sockets are classified into four different types according to the bone loss degree and to the need of ESP (Table 1). Alveolar ridge preservation and post-extraction preservation of the socket are used simultaneously with ESP [8,9].

Class	Description
1	4 - wall defect, intact bone housing, no wall involvement
2	3 - wall defect, 3 intact walls, 1 wall with dehiscence or fenestration
3	Type 1: adequate height, inadequate width Type 2: 2 intact walls, 2 - walls with dehiscence or fenestration
4	1 - wall defect, inadequate vertical height, inadequate horizontal width

Table 1: *Classification of extraction sockets. Young-Kyun Kim., et al.: Extraction socket preservation. Jkorean Assoc Oral Maxillo facial Surg. 202.*

Nowadays, many oral surgeons have started to insert dental implants immediately after dental extraction to reduce the treatment time, the number of invasive interventions, the discomfort of the patient, and to reduce the loss of post - extraction hard tissue as well.

Immediate loading has been reported to have similar survival and success rates compared to delayed implant placement after socket healing [10,11].

According to our clinical experience, also confirmed by other authors [12], to obtain a predictable results and reduce the extent of bone and tissue remodelling around the implant site, three are the clinical steps that must be followed: atraumatic extraction of the tooth without creating a bone defect must be performed; the implant must be placed 2 - 4 millimetres down the crestal hedge and with high torque insertion; loading a temporary crown screwed onto the implant.

Many authors acknowledge the positive aspects of this therapeutic approach: the reduction of treatment time and patient discomfort. However, there are needed more studies to confirm the benefits in post - extraction reabsorption of the ridge. Different authors measured the reduction of vertical crestal [13-17]. On table 2 is demonstrated the crestal heigh variation according to different authors (Table 2).

Authors	Vertical crestal volume change after 3-6 months
Tonetti-Jung., *et al*. (2019)	1,67 m
Botticelli D, Persoon LG, Linde J., *et al.* (2006)	2,6 - 2,8 mm
Amato., *et al*. (2018)	= 0,3 mm
Tomasi., *et al*. (2010)	2,14 mm
Paolantonio, Dolci, Scarano., *et al*. (2001)	Not different from implants placed in healed, mature bone

Table 2: *Comparison of different crestal height variation according to different study groups.*

Materials and Methods

A group of 35 post extraction sites to rehabilitate with immediate load implants was examined.

All extracted teeth were irrecoverable.

Post extraction sites excluded from this study:

- In presence of suspicion of traumatic tooth extraction with damage to the buccal cortex;
- In case of cortex less than 1 mm thickness, even if intact;
- In presence of large apical lesions with compromission of the buccal cortex;
- In presence of periodontal lesions;
- In absence of buccal cortex on pre - operative CBCT.

After the application of the exclusion criteria 25 sites were included in the study. All of them were rehabilitated with the positioning of an implant with immediate loading. The implants were 11.5 - 13 mm long with a diameter between 3.75 and 4.2 mm. All the implants were Avenir® type.

The surface of these implants is obtained with a sandblasting and double acidification process. Applying microscopic topography, it was demonstrated the implant surface obtained through this method facilitate the platelet activation and clot retention.

After the surgery was connected a standard PEEK (poly-ether-ether-ketone) abutment and roughly prepared with a diamond burr within the patient's mouth then finished outside the mouth by the dental lab (Enzo Stella® Dental Laboratory). A provisional was created for each implant according to the technique already tested in our other studies [18]. The measurement with CBCT took place between three and four months after the surgery.

To evaluate the bone loss, the position of the implant was measured in comparison to the bone crest at the time of the insertion (time 0) and after three - four months.

The operative steps were:

1. Pre-operative evaluation of the site; clinically [Figure 1] and radiologically [Figure 2-4].
2. Atraumatic extraction of the element.
3. Insertion of the implant 2 - 4 mm below the crestal hedge and within high torque [Figure 5].
4. Impressions with silicone.
5. Immediate loading (24 - 48 hours) with P.E.E.K. based abutment and provisional [Figure 6].
6. Evaluation after three - four months [Figure 7 and 8].
7. Definite restauration with crown.

Figure 1: *Pre-operative dental status of the patient.*

Figure 2: *Cone beam computed tomography of an upper incisor with a horizontal fracture.*

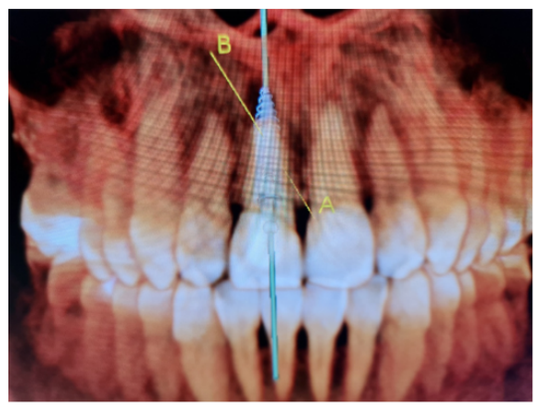

Figure 3: *Cone beam computed preoperatory study.*

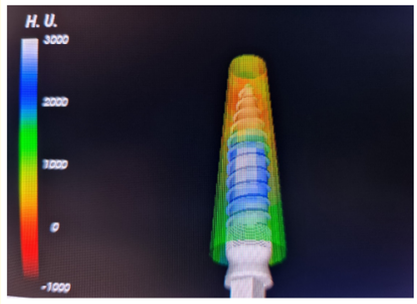

Figure 4: *Cone beam computed preoperatory assessment of bone density around the implant site.*

Figure 5: *.E.E.K based abutment for immediate loading implant site.*

Figure 6: *Immediate loading with provisional.*

Figure 7: *Tissues status after three months.*

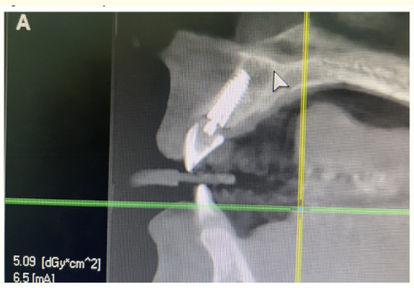

Figure 8: *Cone beam computed tomography after three months.*

Results

25 implants were placed in the position of pre-maxilla zone, from central incisive to second premolar, and in the symphysis area (lateral incisive) [Table 3].

Number of implants	Position	Average torque	Dimensional change (crestal reabsorption)
3	1.1/2.1	66,6 N	0,44 mm
8	1.2/2.2	63 N	0,38 mm
2	1.3/2.3	55 N	0,60 mm
5	1.4/2.4	75,25 N	0,55 mm
1	1.5/2.5	70 N	0,70 mm
6	3.2/4.2	66,6 N	0,34 mm
25	All	66,418 N	0,4384 mm

Table 3: *Dimensional change of crestal hedge after three months.*

The technique was performed in patients with the age between 18 and 74 years. No significant differences were stated according to the age [Table 4]. More than half of the patients were smokers [Table 5]. None of them was suffering of systemic disease. Twelve of the patients were female and thirteen males [Table 6]. No significant differences between smokers and no smokers group were stated. No significant differences between sex were stated neither.

Number of implants	Age	Dimensional change (crestal reabsorption)
2	18 - 30	0,36 mm
2	30 - 40	0,49 mm
4	40 - 50	0,41 mm
9	50 - 60	0,43 mm
8	60 - 75	0,46 mm

Table 4: *Dimensional change of crestal hedge according to the age.*

Number of implants	Smoker	Dimensional change (crestal reabsorption)
10	Not	0,37 mm
15	Yes	0,48 mm

Table 5: *Dimensional change of crestal hedge according to smoke habit.*

Number of implants	Sex	Dimensional change (crestal reabsorption)
13	Male	0,42 mm
12	Female	0,46 mm

Table 6: *Dimensional change of crestal hedge according to sex.*

None of the implants was lost after three months.

The average reduction of crestal hedge was state to be 0,4384 mm; the greatest reabsorption was measured with the lowest torque insertion (canines) and second premolar position. The lowest reabsorption, instead, was stated in symphysis area.

Discussion

In this study, a vertical reduction of the bone crest was detected for post - extraction implant with immediate loading. Our working group established an average reduction of 0.4384 mm of the bone crest around the implant after three to four months. These results are consistent with the results published from other authors.

Conclusion

Therefore, even with a small number of cases, this study demonstrates that the post-extraction implant placement technique with immediate loading and PEEK - based abutment can reduce the reabsorption of bone tissue in the post - extraction socket.

More detailed studies with longer follow up of the patients are needed to confirm the advantages of this technique in the clinical practice. Even though there is limited number of scientific publications on this matter we clearly see the potential benefits of PEEK - based abutment for the patient.

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