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Research Article

Three Different Approaches of Immediate Implant Placement in Esthetic Zone - A Clinical Audit Retrospective Study

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Abstract

Aims and Objective: To compare the stability of hard and soft tissue around immediate implant with three different treatment modalities, bone grafting in the jumping distance, collagen sponge, and put nothing.

Materials and Methods: Fifteen male and female patients, who needed immediate implant with immediate restoration in the esthetic area, were randomised assigned into 3 groups. Group A (control group): (min. of 5 patients) used Botiss Cerabone® (Straumann GmbH, Freiburg, Germany) to graft the jumping distance. Group B (min. of 5 Patients) used collagen sponge Gelatamp® (Roeko, Coltène/Whaledent AG, Altstätten, Swiss) to fill the jumping distance and Group C (NGM): (min. of 5 patients) without any bone graft or collagen sponge to fill the jumping distance.

Result: There was significant difference between means of buccal bone thickness at implant shoulder immediately after surgery to 3 months after surgery P-value = 0.04. There was no significant difference between means of buccal bone thickness at mid-implant immediately after surgery to 3 months after surgery P-value = 0.21. There was no significant difference between means of buccal bone thickness at implant shoulder 3 months after surgery to mid-implant 3 months after surgery P-value = 0.41.All 9 implants were presented with PES ranging from 9 to 13 with the mean of 10.67 mm (± 1.58). Only 2 implants (22.22%) presented with PES 13, which was the highest PES among all implants in this study.

Conclusion: with in the limitation of this case series, negative buccal bone thickness change was discovered. The buccal bone thickness at the implant shoulder resorbed more significantly than the mid-implant point. Xenograft used to fill the jumping distance did not prevent the buccal bone resorption during healing if the remaining buccal bone thickness was less than 1.0 mm.

Keywords: Dental Implant; Esthestic Zone; Retrospective

Abbreviation

GBR: Guided Bone Regeneration; BMPs: Bone Morphology Proteins; PES: Pink Esthetic Score; HA: Hydroxyapatite; TCP: Tricalcium Phosphate; CBCT: Cone Beam Computed Tomography's; Ncm: Newton Centimeter; Mm: Milimeter; CS: Collagen Sponge; NGM: No Grafting Material; CG: Control Group; et al: et alii (Latin) in English and others; SD: Standard Deviation; ISO: Implant Shoulder Immediately After Surgery; IS3: Implant Shoulder 3 Months After Surgery; MI0: Mid-Implant Point Immediately After Surgery; MI3: Mid-Implant Point 3 Months After Surgery; MB0: Mean of Implant Shoulder and Mid-Implant Point Immediately After Surgery; MB3: Mean of Implant Shoulder and Mid-Implant Point 3 months after surgery; IM: Immediate Restoration; HIV: Human Immunodeficiency Viruses.

Introduction

Implant dentistry is gaining popularity to both dental clinician and patients due to its predictable treatment outcome. Dental implant has been used wisely to replace failed tooth or teeth in many aspects such as over denture to restore completely edentulous al-

veolar ridges, missing tooth, or teeth both for function and esthetic reasons. However, the time frame and expense of dental implant procedure are still the issue to both clinicians and patients [1].

In most of the cases, the failed tooth needs to remove and wait for proper healing approximately 3 months of both hard and soft tissue before implant installation [2]. In esthetic area, patient really cannot wait without the temporary. Patient and clinician even want to have implant and tooth at the same time. That is why immediate implant in fresh extraction socket gains more and more popularity in implant dentistry nowadays [3].

Immediate implant in esthetic zone is a big challenge in implant dentistry both the technical and financial problems [4]. Most of the immediate dental implant in fresh extraction socket needs bone graft to fill in the jumping distance to prevent the buccal bone resorption subsequently gingival recession. Using that type of grafting material is cost expensive and risk of infection transmission [5].

The purpose of this study was to determine the survival and success rate of Ankylos® Implants placed immediately into fresh extraction socket augmentation or not, by clinically evaluating the peri-implant soft tissue, using clinical parameters and by radiographically evaluating the buccal bone plate thickness – immediately and 3 months after surgery.

Aim

Other treatments modalities are proposed to reduce the treatment fee and eliminate the risk of infection and transmission of the grafting material. Instead of using xenogeneic or allogenic bone grafting material to graft the jumping distance a collagen sponge can be used to promote and stabilize the blood clot in the jumping distance, which later on form as the bone to stabilize outer soft tissue for esthetic point of view. Another treatment option is not to use any kinds of grafting material to fill up the jumping distance during immediate implant placement. Will these two proposed treatment approaches provide predictable result as the treatment of using bone grafting material to fill in the jumping distance? The aim is to compare the stability of hard and soft tissue around immediate implant with three different treatment modalities, bone grafting in the jumping distance, collagen sponge, and put nothing.

Methods

This study was performed to evaluate the buccal bone wall and soft tissue stability of immediate implant in esthetic zone in three difference treatment modalities, put nothing, collagen sponge, and bone grafting material in jumping distance. Buccal bone wall and soft tissue around the implant area are critical parameters, which defined the predictable outcome of immediate implant in esthetic zone. The Implant placement were classified in to 3 group. Group A (C) (control group):) used Botiss Cerabone® (Straumann GmbH, Freiburg, Germany) to graft the jumping distance. Group B (Collagen sponge = CS): used collagen sponge Gelatemp® (Roeko, Coltène/Whaledent AG, Altstätten, Swiss) to fill the jumping distance. Group C (No grafting material = NGM): without any bone graft or collagen sponge to fill the jumping distance. Peri-implant hard tissue evaluation. The following radiographic parameters performed by a CBCT (MyRay, Hyperion X9, Imola, Italy) were evaluated for each patient immediately after surgery and 3 months:

- Presence of radiolucency
- The buccal bone wall thickness in mm at two different points (at the implant shoulder and the mid-point of the implant).
- Mid-point of each implant was identified on CBCT which further used as the middle point of measuring the mid buccal bone wall thickness. The middle point was measured from the implant shoulder to the exactly middle point each implant's length used as shown in figure 3 and figure 4.

Peri-implant soft tissue evaluation

The stability of the implant will be measured at the two different times (immediately and at 3 months after implant-surgery).

As well as:

- Presence or absence of pain
- Presence or absence of suppuration
- Presence or absence of mobility
- Presence or absence of keratinized mucosa
- Pink Esthetic Score (PES) proposed by Fürhauser, Florescu., *et al*. 2005.

Digital intra-oral photograph will be taken before the surgery, immediately after surgery and 3 months after surgery for peri-implant soft tissue investigation based on PES. The PES was investigated on 7 variables on the peri-implant soft tissue and compared with natural adjacent teeth: mesial papilla, distal papilla, soft-tis-

Figure 1: Botiss cerabone®, Straumann GmbH, Freiburg, Germany).

Figure 2: Gelatamp®, Roeko, Coltène/Whaledent AG, Altstätten, Swiss.

Figure 3: CBCT immediately after implant placement with immediate provisional restoration on region of #22. Buccal wall was measured at 2 different points. 2.2 mm was the thickness of buccal bone wall at the point of implant shoulder. 5.5 mm was the mid-point of the implant (implant length was 11.0 mm) and 1.9 mm was the buccal bone thickness of the mid-point of the implant.

Figure 4: CBCT 3 months after implant surgery in the region of #22 with final prosthesis with E-max crown cement-retained. Buccal wall was measured at 2 different points. 2.0 mm was the thickness of buccal bone wall at the point of implant shoulder. 5.5 mm was the mid-point of the implant (implant length was 11.0 mm). 1.7 mm was the buccal bone thickness of the mid-point of the implant.

sue level, soft tissue contour, alveolar process deficiency, soft tissue colour and texture as shown in figure 5 and figure 6. All variables were examined and compared by the surgeon using a 0-1-2 scale, 0 = lowest and 2 = the highest level. The possible maximum score of the experiment PES was 14 (Furhauser, Florescu., *et al*. 2005).

Figure 5: Pink Esthetic Score evaluation (1= Mesial Papilla, 2=Distal Papilla, 3= level of soft-tissue margin, 4= soft-tissue contour, 5=Alveolar process, 6= Soft tissue colour, 7= soft-tissue texture).

Figure 6: Pink esthetic score evaluation (5= Alveolar process deficiency) occlusal view.

The recorded data of buccal bone thickness changes at different points and times were submitted to SPSS software to test the normality distribution of the data using Shapiro-Wilk Test. Then the means of buccal bone thickness change would be compared between immediate after implant surgery and 3 months after implant surgery. After that the mean of bone thickness at implant shoulder was compared to the mean of buccal bone thickness of the mid-implant point after 3 months using Student T-test with 95% confidence intervals (P values < 0.05).

The descriptive data of PES, which included mean, ± SD and percentages, were calculated for the result of 3 months after surgery.

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Result

Subjects included

All 9 implants were successfully integrated at 3 months after implant placement with immediate restoration in this study.

Buccal Bone Thickness Evaluation

The mean of buccal bone thickness at different points and times are summarized in table 2 and figure 1.

All buccal bone thickness data were normal distribution p-value > 0.05 as in table 3.

The results from Paired t-test shown that

- There was significant difference between means of buccal bone thickness at implant shoulder immediately after surgery to 3 months after surgery P-value = 0.04.
- There was no significant difference between means of buccal bone thickness at mid-implant immediately after surgery to 3 months after surgery P-value = 0.21.
- There was no significant difference between means of buccal bone thickness at implant shoulder 3 months after surgery to mid-implant 3 months after surgery P-value = 0.41.
- However, There was significant different between means of buccal bone thickness (average of 2 points) immediately after surgery to 3 months after surgery P-value = 0.04 as shown in table 4.

No of implants	Exact region	Impl. Length (mm)	Diameter (mm)	Healing mode	Insertion Torque	Implant surgery point shoulder (mm)	Implant surgery Point middle of the implant (mm)	3 months after surgery Point shoulder (mm)	3 months after surgery point middle of the implant (mm)	3 months after surgery attached Gingiva (mm)	PES 3 months after surgery
1	#11	9.5	3.5	IM	> 35 Ncm	2.4	1.7	1.6	1.3	2.5	10
2	#21	9.5	3.5	IM	> 35 Ncm	1.7	1.3	1.3	0.7	2.5	10
3	#22	11	3.5	IM	> 35 Ncm	2.2	1.9	2	1.7	3	12
4	#21	9.5	3.5	IM	> 35 Ncm	1.9	1.9	1.5	1.1	4	13
5	#24	11	3.5	IM	> 35 Ncm	3.1	3.1	3.1	3.1	3	13
6	#12	11	3.5	IM	> 35 Ncm	2.8	2.4	1.9	1.5	2	10
7	#21	11	3.5	IM	> 35 Ncm	2.6	1.9	1.9	1.6	2	9
8	#22	11	3.5	IM	> 35 Ncm	2.8	1.9	2.2	1.6	2	10
9	#21	14	3.5	IM	> 35 Ncm	3.2	3.0	2.3	2.7	4	9

Table 1: Raw data of immediate implant with immediate restoration Grafted with Cerabone.

IM = Immediate Restoration; Ncm = Newton Centimetre; Mm = Millimetre; PES = Pink Esthetic Score

No	Region	Buccal Bone Thickness at Implant shoulder (mm)		Buccal Bone Change at Implant Shoulder (mm) in 3 months	Buccal Bone Thickness at Mid Implant (mm)		Buccal Bone Changed in Mid-Implant (mm) in 3 months
		Immediate after implant Placement	3 Months after implant placement		Immediate after implant Placement	3 Months after implant placement	
1	#11	2.4	1.7	0.7	1.6	1.3	0.3
2	#21	1.7	1.3	0.4	1.3	0.7	0.6
3	#22	2.2	1.9	0.3	2	1.7	0.3
4	#21	1.9	1.9	0	1.5	1.1	0.4
5	#24	3.1	3.1	0	3.1	3.1	0
6	#12	2.8	2.4	0.4	1.9	1.5	0.4
7	#21	2.6	1.9	0.7	1.9	1.6	0.3
8	#22	2.8	1.9	0.9	2.2	1.6	0.6
9	#21	3.2	2.3	0.9	3	2.7	0.3
		Mean of Buccal Bone Change at Implant Shoulder in 3 months (mm)		0.48	Mean Buccal bone changed at mid-implant in 3 months (mm)		0.36
		SD		0.35	SD		0.18

Table 2: Buccal bone thickness changed at Implant Shoulder and Mid-Point in 3 months after implant Placement.

Mean value of buccal bone thickness at different points and times

Chart one shows that the first column, which is the buccal bone thickness at the implant shoulder immediately after surgery has the major value followed by no. 2, which is the buccal bone thickness at the Implant shoulder at 3 months after surgery and no. 3, which is the buccal bone thickness at Mid-implant point immediately after surgery. No. 4 (buccal bone thickness at Mid-implant point 3 moths after surgery) shows the lowest value of all time points.

Chart 1: Mean Value of Buccal Bone Thickness at Different Points and Times.

	Shapiro-Wilk		
	Statistic	df	Sig.
IS0	.956	9	.759
MI0	.874	9	.137
IS3	.929	9	.470
MI3	.899	9	.247

Table 3: Tests of Normality.

Soft tissue evaluation

All 9 implants were presented with PES ranging from 9 to 13 with the mean of 10.67 mm (± 1.58). There were 2 implants (22.22%) presented with PES 9, which was the lowest PES among all implants in this study. Four implants (44.44%) presented with PES 10, 1 implant (11.11%) presented with PES 12. Only 2 implants (22.22%) presented with PES 13, which was the highest PES among all implants in this study. No one of the nine implants was presented with PES 14.

The vertical attached gingiva width of all implants was ranging from 2.0 mm to 4.0 mm with mean of 2.78 mm (± 0.79) 3 moths after implant placement.

Group: (mean ± SD)	Equality of Varian: Sig.	T-test: Sig. (2-tailed)
IS0 (2.52 ± 0.51)	0.76	0.04
IS3 (1.98 ± 0.53)		
Group: (mean ± SD)		
MI0 (2.21 ± 0.6)	0.77	0.21
MI3 (1.70 ± 0.73)		
Group: (mean ± SD)		
IS3 (1.98 ± 0.53)	0.67	0.41
MI3 (1.70 ± 0.73)		
Group: (mean ± SD)		
MB0 (2.44 ± 0.50)	0.97	0.04
MB3 (1.84 ± 0.63)		

Table 4: Independence t-test to compare means of buccal bone thickness at different points and times.

*IS0 = Implant shoulder immediately after surgery.

*IS3 = Implant shoulder 3 months after surgery.

*MI0 = Mid-implant Point immediately after surgery.

*MI3 = Mid-implant Point 3 months after surgery.

*MB0 = Mean of implant shoulder and Mid-implant point immediately after surgery.

*MB3= Mean of Implant shoulder and Mid-implant point 3 months after surgery.

No. of implants	Position of implant	3 months after surgery Attached Gingiva (mm)		PES 3 months after surgery	
1	#11	2.5		10	
2	#21	2.5		10	
3	#22	3		12	
4	#21	4		13	
5	#24	3		13	
6	#12	2		10	
7	#21	2		9	
8	#22	2		10	
9	#21	4		9	
		Mean	2.78	Mean	10.67
		SD	0.79	SD	1.58

Table 4: Attached Gingiva width and Pink Esthetic Score.

Discussion

The goal of modern implant dentistry is to provide patient maximum esthetic, less invasive, less treatment timeframe and high predictability. Conventional implant dentistry usually produces more patient discomfort and compromises esthetic outcome after failed tooth extraction and healing. This treatment protocol usually needs additional surgical interventions to re-establish patient esthetical demand and longer treatment timeframe. Furthermore, soft and hard tissue undergo remodelling and recession after tooth extraction. Horizontal alveolar ridge change is reported more prominent comparing to vertical aspect [6]. Thus, Immediate implant with immediate restoration is one of the most popular treatment protocols among dental implant surgeons in esthetic area. This treatment modality has been proposed and claimed to minimize the alteration of hard and soft tissue architecture. However, some dental implant surgeons have different interventions in the jumping distance, graft or not graft with any bone substitutes. The first result of this investigation shown that there was negative buccal bone thickness change at 3 months after surgery. Thus, the mean buccal bone reduction in 3 months after surgery was observed of 0.48 ± 0.35 mm (SD) and 0.36 ± 0.18 mm (SD) at implant shoulder and mid-implant point respectively. This finding is according with the previous study in 2016, where the means of horizontal bone reduction of 0.48 ± 0.76 (SD) and 0.19 ± 0.84 (SD) at 2 mm and 4 mm from the implant shoulder respectively (Schropp., *et al.*). Furthermore, these 2 investigations presented with similar results of different amounts of buccal bone thickness change at different points of measurements. After failed tooth extraction, the remaining buccal bone plate presented with different thicknesses from the coronal to the apical part of the extraction socket. The coronal part, mostly with the thickness of lest than 1.0 mm, usually presented with thinner bone plate compared to middle part and apical part of the extraction socket. This thin coronal bone plate is vulnerable to the resorption after tooth extraction [7]. however, in this present investigation shown that there was no significant difference of bone thickness change between implant shoulder point and mid-implant point at 3 months after surgery. Only 9 participants were investigated and this small amount of sample size might not be able to find the statistic significant different. Additionally, overall buccal bone thickness in 3 months was significantly thinner compared to the overall buccal bone thickness immediately after immediate implant surgery. This finding was also supported by previous review study in 2014 [8]. The gap between the implant surface and

the buccal bone plate was filled with the grafting material, Botiss Cerabone® (Straumann GmbH, Freiburg, Germany). However, this grafting material use did not entirely prevent the remaining thin buccal bone plate from resorption after extraction followed with immediate implant and immediate restoration. This finding was also reported by previous studies [9,10]. Only one of nine implants in this study presented without any buccal bone thickness change in 3 months after surgery. The thick remaining buccal bone wall after tooth extraction in thick biotype condition could explain this promising result. This thick buccal bone, remaining after tooth extraction, was reported with minimal thickness change during healing which might not be able to identify the differences on CBCT measurement [2]. Furthermore, no one of the nine implants underwent completely buccal bone resorption in 3 months after implant surgery. These remaining buccal bones are critical for long-term implant stability and esthetic outcome [11]. Cerabone® (Straumann GmbH, Freiburg, Germany) filled in the gap between the implant surface and buccal bone plate of the fresh extraction socket could be the main reason of this promising result. The thin buccal bone plate especially at coronal part might be completely resorbed (or partially resorbed in the thick buccal bone plate remaining after failed tooth extraction) 3 months after tooth removal and implant surgery. Thus, only Cerambone® (Straumann GmbH, Freiburg, Germany) filled in the jumping distance was detected on CBCT measurement in one third coronal of implants. This finding was also reported form previous study [12]. The limitation of this investigation on CBCT is that the remaining Cerabone® presented on the one third coronal of the implant could be integrated-bone graft or the bone substitute just embedded in the soft tissue and prevented the soft tissue recession. These 2 different perspectives cannot clearly identify by CBCT.

The second outcome was negative change of peri-implant soft tissue found in this study. Base on PES, the peri-implant soft tissue was carefully evaluated on 7 parameters in order to analyse the overall esthetic outcome of immediate implant with immediate restoration. All these 7 parameters range from score 0 (the poorest esthetic outcome) to 14 (the best esthetic outcome). The PES in this study was ranging from 9 to 13 with the mean PES of 10.67 ± 1.58 (SD). The mean PES of 10.67 is considered of good esthetic result. This finding is according to the previous systematic review published in 2006, which stated that immediately placed and restored single-tooth implants in the anterior maxilla revealed excellent result [13]. Thus, this treatment protocol might help to support and preserve the peri-implant soft tissue after the tooth removal. Two implants presented with PES of 13 and 1 implant presented with PES of 12. These 3 implants out of 9 implants were considered with the excellent result in term of esthetic. Four implants presented with PES of 10 and 2 implants with PES of 9. These 6 implants out of 9 implants were considered with moderate esthetic outcome base on PES. These compromised results were detected on the deficiency of alveolar contour and distal papilla around the implant 3 months after surgery. The possible reason of deficiency of alveolar contour and shortness of distal papillae might be coming from the negative change of buccal bone thickness after healing. This result is according to Yoshino S., *et al*. in 2014 which stated that immediate implant with immediate restoration and done graft in the socket presented with facial contour deficiency [14]. However, patients themselves mostly have not detected this alveolar process deficiency. The low PES in this investigation was detected on implants with insufficient soft tissue support by too much under contour (from the gingival margin to the alveolar crest) of provisional prosthesis and improper abutment gingival height during healing. This insufficient soft tissue support had negatively impact to the soft tissue during healing after the failed tooth extraction. Thus, pressure from the lip and food could be the main reason of alveolar contour deficiency when the immediate provisional prosthesis was not done properly to support the soft tissue around immediate implant [15]. Not one of the 9 implants presented with the gingival margin recession and soft tissue texture, colour changed comparing to the adjacent teeth based on PES. All implants were presented with adequate attached gingivae which ranging from 2 mm to 4 mm. This adequate attached gingiva width is important to prevent gingival recession and provide long-term peri-implant soft and hard tissue stability [16,17]. On the contrary, some previous studies had found no significant different of soft tissue changes around implant. Tortamano, Camargo., *et al*. did a prospective study in 2010 of immediate implant placement and restoration in the esthetic zone with 18 months of follow-up. They found that there was no statistic different of peri-implant soft tissue between before and 18 months after immediate implant placement and restoration [4]. Furthermore, in another previous study had also found no significant different soft tissue around implant. Only 3 parameters of the peri-implant soft tissue stability were investigated: mesial papillae, distal papillae and clinical crown of the implant prosthesis [18]. However, this present study found that the peri-implant soft tissue underwent the negative change especially on the buccal contour of the implant areas, which compromised the esthetic outcome of this treatment protocol. The different findings of peri-implant soft tissue outcomes can be explained by using dif-

ferent evaluation protocols of the peri-implant soft tissue stability. In this present study, the peri-implant soft tissue was investigated more detail on 7 different parameters including: 1 = Mesial Papilla, 2 Distal Papilla, 3 = Level of Soft-tissue Margin, 4 = Soft-tissue Contour, 5 = Alveolar Process, 6 = Soft Tissue Colour, 7 = Soft-tissue Texture, following the "Pink Esthetic Score evaluation" protocol published by Fürhauser, Florescu., *et al*. in 2005 [19]. This negative finding might be related to the buccal bone resorption after healing. This buccal bone resorption might further result in the negative effect of gum recession in longer-term follow up. The main limitations of this study are the small sample size and short follow up period. Thus, larger sample size and longer period of investigation both on hard and soft tissue around implant need to be done to be able to have clear conclusion of this protocol.

Conclusion

Within the limitation of this study, the conclusion can be drawn: Negative buccal bone thickness change was discovered in this study. The buccal bone thickness at the implant shoulder resorbed more significantly than the mid-implant point. Xenograft, Cerabone® (Straumann GmbH, Freiburg, Germany), used to filled the jumping distance did not prevent the buccal bone resorption during healing if the remaining buccal bone thickness was less than 1.0 mm. This buccal bone changed compromised the alveolar contour leading to the overall esthetic outcome. However, based on the PES the overall esthetic outcomes of these 9 implants were ranging from the moderate to the excellent.

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