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Soft and hard tissue assessment of immediate implant placement: a case series

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Abstract

Objectives: The aim of this prospective study was to evaluate clinically and radiographically the success and esthetic result of immediate implant placement at the time of extraction.

Material and methods: Twelve patients with 14 titanium screw-shaped implants (13–16 mm length and 4.3 or 5 mm diameters) were placed in the extraction sockets. Defects after implant placement were recorded, and then filled up with deproteinized bovine bone mineral, bioabsorbable collagen membrane, and absorbable pins. The defect was again re-evaluated at second-stage surgery. Clinical and radiographic parameters of the peri-implant conditions were assessed at the moment of prosthesis placement and at 1-year follow-up.

Results: The cumulative implant survival and success rate was 100% after a 1-year observation period. Analysis of the esthetic result showed that the mean pink esthetic score (PES) was 11.1 (SD 1.35) at 1-year follow-up. At 1 year, 64.3% papillae had a score of 2 and the remaining 35.7% score 3 according to the Jemt (1997) papillary index. Optimal value of width of the keratinized mucosa was recorded in 13 (92.9%) implant cases in both periods of follow-up. At 1-year follow-up, the linear distance between implant-shoulder to the bone peaks remains stable with a mean of 2.62 $\pm$ 0.2 mm at the mesial and 2.9 $\pm$ 0.58 mm at the distal aspect.

Conclusion: Careful evaluation of potential extraction sites before immediate implant installation promotes optimal implant esthetics.

The progressive involution of the alveolar bone begins following tooth loss, and it is accompanied by a reduction in both the quality and quantity of hard and soft tissues. To estimate the appropriate time for implant insertion, it is essential to understand the healing events that occurred after tooth extraction (Bianchi & Sanfilippo 2004). It was shown that after extraction of natural teeth, the greatest reduction of the alveolar bone occurs in the first 6 months to 2 years (Carlsson & Rosenfeld 1967; Araujo & Lindhe 2005; Araujo et al. 2005). An estimate of 25% decrease in faciopalatal width occurs within the first year (Carlsson & Persson 1967; Tallgren 1972; Misch 1990; deLange 1995). For this reason, within the last decades, the 'gold standard' implant treatment protocol has been challenged by experiments, which aimed at shortening the treatment period and by reducing the number of surgical procedures. The literature has demonstrated that it is no longer needed to wait for complete healing of the extraction socket before implant placement (Lazarra 1989; Knox et al. 1991; Lundgren et al. 1992; Becker & Becker 1994; Lang et al.

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1994; Wilson et al. 1998; Rosenquist & Ahmed 2000; Hämmerle & Lang 2001; Nemcovsky et al. 2002; Juodzbalys 2003; Bianchi & Sanfilippo 2004). With this surgical approach, it allows a better final rehabilitation because it facilitates morphological ridge contour preservation as well as accurate prosthetic implant installation – maintaining the natural tooth angle (Werbitt & Goldberg 1992). However, the study of Araujo et al. (2005) showed that the placement of an implant in the fresh extraction site obviously failed to prevent the re-modelling that occurred in the walls of the socket. It is suggested that the resorption of the socket walls that occurs following tooth removal must be considered in conjunction with implant placement in fresh extraction sockets.

Nevertheless, surgical procedure planning in the case of immediate implant placement must fulfill several pre-set clinical conditions. These include the following: implant primary stability, qualitative osseointegration, proper prosthetic location, and esthetic result. An absolute requirement is that 3–5 mm of implant must be inserted into the host bone to gain initial implant stability (Nemcovsky et al. 2002; Juodzbalys 2003).

Proper placement of an implant into a fresh alveolus will in most cases result in a gap between the occlusal part of the implant and the bone walls. To ensure osseointegration, various guidelines for the immediate implantation technique have been suggested. These include, but are not limited to, socket augmentation using various reconstructive materials, such as application of membranes, grafting materials, and bone-inductive substances (Lazarra 1989; Block & Kent 1992; Becker & Becker 1994; Lang et al. 1994; Shearer 1995; Steenberghe et al. 2000; Hämmerle & Lang 2001; Nemcovsky et al. 2002).

Although implant success, as measured through fixture osseointegration and restoration of function, is high, the procedures available to create esthetic implant 'success' are not always predictable (Kazor et al. 2004). To ensure optimal esthetic implant rehabilitation, the following prerequisites are considered essential: adequate bone volume (horizontal, vertical, and, contour), optimal implant position (mesio-distal, apico-coronal, bucco-lingual, and angulation), stable and healthy periimplant soft tissues, esthetic soft tissues contours, and ideal emergence profile (Jovanovic 1997; Kazor et al. 2004). The level of bone support and the soft tissue dimensions around the implant-supported single-tooth restoration are factors suggested to be important for the esthetic outcome of implant therapy (Belser et al. 1998).

The aim of this case series study was to evaluate clinically and radiographically the esthetic outcome of immediate implants placed into extraction socket using the simultaneous guided bone regeneration (GBR) technique.

Material and methods

Patients and implants

Between June 2003 and October 2004, 12 patients, eight men and four women (age 17–49 years, mean = 28), who received dental implants in the Department of Maxillofacial Surgery, University of Kaunas, were consecutively enrolled in the investigation. The general health status of all patients included in the study had been deemed to be satisfactory. Heavy smokers (more than 10 cigarettes a day) were excluded.

Fourteen titanium screw-shaped implants (Replace Select®, Nobel Biocare, Goteborg, Sweden) 13–16 mm in length with 4.3 or 5 mm diameters were immediately installed after extraction. Table 1 lists the causes for teeth extraction. They were root fracture, perforation, periapical infection, and untreatable caries. All surgeries were performed under local anesthesia. Totally, they were eight upper central incisors and six upper lateral incisors.

Surgical protocol

Tooth extraction and site assessment

After local anesthesia, teeth were gently extracted and extreme care was exercised to avoid fracture of the socket walls. In order to achieve optimal esthetic implant rehabilitation, the following soft tissue conditions were evaluated: soft tissue quantity, quality, and biotype. Soft tissue contour was characterized as adequate or compromised. The keratinized gingival width on the buccal side in the treatment area was determined using a millimeter standard periodontal probe (Hu-Friedy UNC, Chicago, IL, USA). Possible vertical changes of contour were recorded between planned extract tooth/root and adjacent teeth.

Table 1. **Data for patients, defect sites, and implants**

Serial #	Gender	Age (years)	Tooth #	Reason for tooth extraction	Implant length (mm)	Implant diameter (mm)
1	Male	24	11	Periapical infection	13	5
2	Male	30	11	Root fracture	13	4.3
3	Male	18	21	Root fracture	16	4.3
4	Female	42	12	Periapical infection	13	4.3
5:1			11	Root fracture	13	4.3
5:2	Male	31	21	Periapical perforation	16	4.3
6	Female	49	11	Root fracture	16	4.3
7:1			11	Root fracture	13	5
7:2	Male	28	12	Root fracture	16	4.3
8	Male	22	22	Periapical infection	13	4.3
9	Female	26	21	Periapical perforation	16	4.3
10	Male	19	22	Root fracture	16	4.3
11	Male	24	12	Caries	13	5
12	Female	27	21	Caries	13	4.3
Mean		28				

Mean, average of all patients.

Proper mesial and distal papilla appearance was evaluated when distinct papilla was noted. Soft tissue quality was determined as good when there were no recorded variations of color, consistence, and texture, and there was no periodontal infection. Gingival tissues biotype was characterized as thick ($\geq$ 1 mm), or thin ($<$ 1 mm) gingival tissues.

The height of the alveolar process and the available remaining bone for dental implant insertion above the extraction socket apex was estimated by the orthopantomogram, taking into consideration an average X-ray magnification of 20% (Cranex-3, Soredex, Finland). The socket height measurements were taken in a vertical plane at the points of the extraction socket, from the tip of the extraction socket margin to the nasal sinus in the upper jaw. The height of the available remaining bone for dental implant insertion was measured from the socket apex to the maxillary or nasal sinus.

The width of the extraction socket was measured with a millimeter standard periodontal probe intra-orally in mesio-distal and labio-palatal directions at the socket margin. The vertical position and bone loss of the labial plate was recorded from the cemento-enamel junction (CEJ) line of the adjacent teeth to the tip of the extraction socket labial plate. Intra-dental bone peak height was recorded as the distance from the tip of the intra-dental bone peak to the alveolar process crest mid-line. The mesio-distal dimension between adjacent teeth was measured in the mesio-distal direction between the most prominent points at the CEJ level. Measurements were recorded to the nearest 1 mm mark.

Extraction socket facial bone thickness was estimated with ridge-mapping calipers. Measurements were performed in a vertical plane in the labial plate at points 1 to 6 mm from the labial plate tip. This technique minimized discrepancies. The smallest measurement was accepted as the width of the socket labial plate. Extraction socket contour and possible tooth/root labial angulation were evaluated using a diagnostic wax-up.

Dental implant placement and intra-operative examination

All implants were placed in a similar manner. Briefly, implants were placed in the optimal three-dimensional position: apico-coronally, 2–3 mm below the adjacent CEJ line (Saadoun & Landsberg 1997); bucco-lingually, 3–4 mm from the outside buccal flange (Kazor et al. 2004); and mesio-distally, $\geq$ 1.5 mm away from adjacent teeth (Ohrnell et al. 1988; Adell et al. 1990).

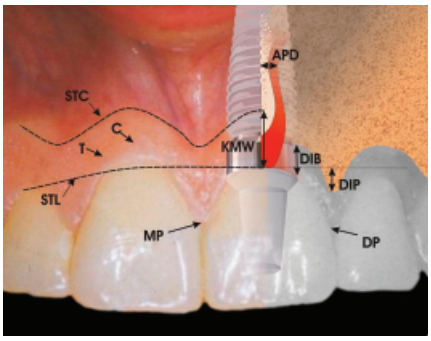

Fig. 1. Clinical (left side) and radiographic measurements (right side) of peri-implant soft and hard tissues: mesial papilla (MP), distal papilla (DP), soft tissue level (STL), soft tissue contour (STC), keratinized mucosa width (KMW), soft tissue color (C), soft tissue texture (T), the distance between implant–shoulder to the alveolar bone level (DIB), and the distance between implant–shoulder to the bone peaks (DIP).

At the time of implant placement, the vertical dehiscence defect extension from the shoulder of the implant to the first bone-to-implant contact was measured. The clinical measurements were assessed in millimeters at six sites around each implant: mesio-buccal (MB), buccal (B), disto-buccal (DB), disto-palatal (DP), palatal (P), and mesio-palatal (MP), using a millimeter standard periodontal probe. Measurements were recorded to the nearest 1 mm mark. Figure 1 illustrates all clinical measurements recorded in this study.

The remaining defects and dehiscences after implant placement were filled up, using deproteinized bovine bone mineral (Bio-Oss®, Geistlich AG, Wolhusen, Switzerland). The Bio-Oss® and implant cover screw were covered with a collagen membrane (Bio-Gide®, Geistlich AG). The membrane was extended onto the intact bony walls of the defect and held securely in place by resorbable pins (Resor Pin®, Geistlich AG). Soft tissue deficiency was corrected using connective tissue grafting. Connective tissue was retrieved from the palatal vault (Bianchi & Sanfilippo 2004).

After the soft tissue adaptation, complete coverage of the extraction wound was obtained using closure with monofilament sutures. One hour before surgery, the patients were given 2 g V-penicillin and post-operatively 2 g was given twice a day for 7 days. Chlorhexidine 0.2% oral rinses were prescribed twice daily for 2 weeks. The sutures were removed after 10 days. After 6 months, re-entry surgery was performed. The same clinical measurements were again recorded.

Implant success and esthetic result evaluation

The suprastructures consisted of 14 single cemented crowns that were seated 6 months post-surgically. Implant esthetic result evaluation was performed after prosthetic rehabilitation and at 1-year follow-up.

The criteria of success set for this study were chosen according to Albrektsson et al. (1986) and included the following: absence of persistent subjective complains, such as pain, foreign body sensation, and/or dysesthesia; absence of peri-implant infection with suppuration; absence of mobility; absence of a continuous radiolucency around the implant; and vertical bone loss less than 1.5 mm in the first year of function.

The health and stability of soft tissues was evaluated using the modified plaque index (MPI) and the modified bleeding index (MBI) proposed by Mombelli et al. (1987). Peri-implant probing depth (PD) was performed at four sites for each implant, buccal, palatal, mesial, and distal.

Interproximal marginal bone level was measured from standardized periapical radiographs that were obtained using a customized Rinn film holder (XCP® Instruments, Rinn Corporation Elgin, IL, USA) with a rigid film-object-X-ray source coupling to a beam-aiming device in order to achieve reproducible exposure geometry. The evaluation of the radiographs was performed in a linear fashion using a standardized computerized system to determine the mesial and distal distance from the implant shoulder to the alveolar bone level (DIB). Wherever there was evidence of two different bone levels, the one situated more apically was measured. Bone peaks height was evaluated by calculating the linear distance between implant-shoulder to the bone peaks (DIP), mesially and distally to the implant.

Esthetic and harmonious implant-supported restoration conformance to the pre-existing dentition was evaluated according

to Furhauser et al. (2005). The pink esthetic score (PES) was evaluated at 1-year follow-up. The PES is based on seven variables: mesial papilla, distal papilla, soft tissue level, soft tissue contour, alveolar process deficiency, soft tissue color, and texture. Each variable was assessed with a 2–1–0 score, with 2 being the best and 0 being the poorest score.

Dental papilla preservation was evaluated clinically using a papillary index described by Jemt (1997). The papillary index designates five different levels of papilla height. Measurements were made from the reference line connecting the highest gingival curvatures of the implant crown restoration and the adjacent tooth or crown on the buccal side. The mesial and distal papillae were evaluated for completeness, incompleteness, or absence. All other variables were assessed by comparison with a reference tooth, i.e., the corresponding tooth (anterior region) or a neighboring tooth (pre-molar region). The highest possible score reflecting a perfect match of the peri-implant soft tissue with that of the reference tooth was 14.

Additionally, the width of the keratinized mucosa (KMW) on the buccal side was evaluated in millimeters.

Statistical analysis

Simple statistical analyses were performed using the SPSS/PC + version 10.0.1 program (SPSS Inc., Chicago, IL, USA). Means and standard deviations were calculated. The Wilcoxon's matched pairs signed rank test was applied to detect differences between diagnostic and re-entry measurements. The level of statistical significance was set at $P = 0.05$.

Results

Peri-implant parameters and implant success

Diagnostic extraction socket measurements after implant placement showed that the largest mean vertical defect of 5.17 mm (SD 0.75 mm, range 4–6 mm) was found in case no. 11 (Table 2). The mean vertical defect extension of all sites was 4.15 mm (SD 0.7 mm, range 2.5–5.8 mm). After 6 months of healing, at re-entry, the mean vertical extension of all sites was 0.45 mm (SD 0.3 mm, range 0–1.1 mm). The considerable decrease in bone defect of 89.6% (SD 7.9%) was statistically significant ($P < 0.05$).

At the moment of prosthesis placement and 1 year after prosthetic rehabilitation, all implants were stable and painless, and no discomfort and/or altered taste was recorded. There was no sign of continuous radiolucency around the implants. The cumulative implant survival and success rate was 100% after the 1-year observation period.

Most of the patients exhibited good oral hygiene performance during both follow-up periods: a MPI score 0 was registered for 71.4% and score 1 for 28.6% of implant sites at the moment of prosthesis placement. One year later, score 0 was registered for 64.3% of implant sites. MBI score 0 was registered for 78.6% of the implant sites and remained stable after 1 year of function. The frequency distribution of various PDs showed that at the time of prosthesis placement, all implant sites had a PD ranging between 2.1 and 3 mm. One year later, 71.5% implant sites with a PD ranging between 3.1 and 3.5 mm dominated.

Analysis of radiographic bone level showed that the mean DIB was 0.57 mm (SD 0.3 mm) at the period of prosthesis placement (Table 3). This demonstrated good peri-implant defect fill after GBR. At 1-year follow-up, the mean DIB was 1.72 mm (SD 0.43 mm). Nine out of 14 (64.3%) of implant sites demonstrated a marginal bone level between 0.1 and 0.5 mm at the period of prosthesis placement (Table 3). The same percentage 64.3% of implant sites (9/14) was noted, with DIB levels ranging between 1.1 and 2.0 mm after 1 year. The registered mean vertical bone loss for all implants after 1 year of function was 1.16 mm (SD 0.25 mm; Table 3). The highest number (78.6%) of implant sites (11/14) demonstrated a vertical bone loss of 1.1–1.5 mm. At the moment of prosthesis placement, the mean DIP for all patients was 2.96 mm (SD 0.43 mm, range 2.2–3.6 mm) at the mesial aspect and 3.28 mm (SD 0.60 mm, range 2.0–4.1 mm) at the distal aspect (Table 4). At 1-year follow-up, DIP was almost stable and the mean DIP was 2.62 mm (SD 0.2 mm, range 2–3.1 mm) at the mesial aspect and 2.9 mm (SD 0.58 mm, range 1.9–4 mm) at the distal aspect.

Table 2. **Diagnostic and re-entry vertical defect measurements, including mean values and ranges (mm), and percentage of defect fill**

Serial #	Diagnostic vertical defect extension (mm)			Re-entry vertical defect extension (mm)			Defect fill (%)
	Mean	SD	Range	Mean	SD	Range	
1	3.83	1.47	2–6	0.33	0.52	0–1	91.3
2	5	1.79	3–8	0.33	0.52	0–1	93.3
3	4.67	1.37	3–7	0.50	0.55	0–1	89.3
4	2.67	0.82	2–4	0	0	0–0	100
5:1	4.17	0.75	3–5	0.33	0.52	0–1	92
5:2	4.50	1.05	3–6	0	0	0–0	100
6	4.83	1.33	3–7	1	0.89	0–2	79.3
7:1	4.33	1.86	2–6	0.33	0.52	0–1	92.3
7:2	3	1.26	1–4	0	0	0–0	100
8	4	0.89	3–5	1	0.89	0–2	75
9	4.17	1.60	2–6	0.50	0.55	0–1	88
10	3.83	1.47	2–5	0.33	0.52	0–1	91.3
11	5.17	0.75	4–6	0.83	0.75	0–2	83.9
12	4	1.41	2–6	0.83	0.75	0–2	79.2
Mean	4.15		0.45		89.6		
SD	0.70		0.30		7.93		

Mean, mean of all patients; SD, standard deviation.

Table 3. **Marginal bone level (DIB) and marginal bone loss (− DIB) measured in radiographs for 14 implants at the moment of prosthesis placement and 1 year of function (DIB = mesial and distal distance from implant shoulder to the alveolar bone level; − DIB = vertical bone loss)**

Serial #	Implant location (tooth no.)	DIB prosthesis placement (mm)	DIB after 1 year (mm)	− DIB after 1 year (mm)
1	11	0.4	1	0.6
2	11	0.5	1.3	0.8
3	21	0.6	2	1.4
4	12	0.3	1.7	1.4
5:1	11	0.4	1.6	1.2
5:2	21	0.2	1.6	1.4
6	11	1.2	2.4	1.2
7:1	11	0.4	1.5	1.1
7:2	12	0.3	1.4	1.1
8	22	1	2.1	1.1
9	21	0.5	1.8	1.3
10	22	0.4	1.3	0.9
11	12	0.9	2.4	1.5
12	21	0.9	2.1	1.2
Mean		0.57	1.72	1.16
SD		0.3	0.43	0.25

Mean, mean of all implant sites; SD, standard deviation.

Table 4. **Intra-dental bone peaks height (DIP) measured in radiographs for 14 implants at the moment of prosthesis placement and 1 year of function (DIP = mesial (M) and distal (D) distance from implant shoulder to the intra-dental bone peaks)**

Serial #	Implant location (tooth No.)	DIP prosthesis placement (mm)		DIP after 1 year (mm)	
		M	*D*	*M*	*D*
1	11	2.9	3	2.8	2.8
2	11	3.3	3.6	3.1	3
3	21	3.2	4	2.9	3.8
4	12	2.6	2.7	2.3	2.5
5:1	11	3.5	4.1	2.9	4
5:2	21	2.8	3.3	2.6	3.2
6	11	3.3	3.6	3	3.4
7:1	11	3.1	3.4	2.7	3.1
7:2	12	3.6	3.9	3	3.7
8	22	2.2	2	2	1.9
9	21	2.3	2.5	2	2.4
10	22	2.5	2.9	2.5	2.8
11	12	2.9	3.4	2.3	3.2
12	21	3.2	3.6	2.6	3.5
Mean		2.96	3.28	2.62	2.9
SD		0.43	0.6	0.36	0.58

Mean, mean of all implant sites; SD, standard deviation.

Esthetic results

At 1-year follow-up, the mean PES was 11.1 (SD 1.35). Analysis of PES showed that in most cases there were incomplete mesial and distal papillae and alveolar process deficiency: nine (64.3%) and six (42.9%) cases, respectively. A minor discrepancy of soft tissue margin level of 1–2 mm was registered in three (21.4%) cases (Table 5).

Analysis of the Jemt (1997) papillary index showed no class 0, class 1, or class 4 inter-proximal papillae at 1-year follow-up. Eighteen (64.3%) papillae had a score of 2, while the remaining 10 papillae (35.7%) had a score of 3.

It was considered that the optimal mean value of KMW for esthetic result should be more than 2 mm. This result was recorded in 13 (92.9%) implant cases in both periods of follow-up. Only in one case was KMW 1 mm.

Discussion

Data from our study indicated an 89.6% (SD 7.9%) mean vertical defect reduction after immediate implant placement into an extraction socket. Clinical parameters such as PD, MPI, and MBI remained unchanged (or low value), suggesting stable peri-implant tissue conditions. Furthermore, all sites presented stable crestal bone levels. The mean vertical bone loss for all implants after 1 year of function was 1.16 mm (SD 0.25 mm). This is in line with previously reported data (Albrektsson et al. 1986, Schropp et al. 2005). Soft s grafting ensured sufficient vestibular keratinized mucosa width (more than 2 mm) in 92.9% cases and good emergence crown alignment was achieved. At 1-year follow-up, the mean PES was 11.1 (SD 1.35) and this is consistent with the study of Furhauser et al. (2005), where the mean PES was 9.46 (± 3.81 SD). Furthermore, the cumulative implant survival and success rate for all pooled implants was 100% after the 1-year observation period. This is in agreement with previously published papers (Lazarra 1989; Becker & Becker 1994; Lang et al. 1994; Mensdorf-Pouilly et al. 1994; Rosenquist & Ahmed 2000; Hämmerle & Lang 2001; Nemcovsky et al. 2002; Bianchi & Sanfilippo 2004). These findings suggest that successful immediate tooth replacement with dental implants using GBR is possible especially when the extraction site is carefully evaluated and planned. Furthermore, this implantation method reduces the time from tooth extraction to complete rehabilitation, when compared with classical delayed and late implantation protocols. Resorption of the thin buccal wall and the alveolar crest after extraction may be reduced by a timely insertion of the implant (Werbitt & Goldberg 1992).

Placement of an implant into a fresh extraction socket will, in most cases, result in a gap between the occlusal part of the implant and the bony walls. When dehiscence bony defects were exceeding 2 mm, they were grafted with deproteinized bovine bone xenografts (Bio-Oss®, Geistlich AG). The small peri-implant bone defects were completely healed without the use of GBR procedures and this is consistent with Covani et al. (2003). Hence, it is essential to evaluate the bone volume: horizontal, vertical, and contour before implant placement. To achieve implant primary stability, available bone beyond the extraction socket margin should be at least 3 mm (Nemcovsky et al. 2002; Juodzbalys 2003).

Accepted minimal width of the extraction socket labial plate was 1–2 mm. This agrees with Spray et al. (2000) and Kazor et al. (2004): a buccal bone wall thickness of at least 1–2 mm is critical, which may necessitate hard tissue augmentation.

It has been demonstrated that the presence or absence of bone crest influences

Table 5. **PES evaluation scores for 14 implant restorations at 1 year of function**

Serial #	Mesial papillae	Distal papillae	Level of soft tissue margin	Soft tissue contour	Alveolar process deficiency	Soft tissue color	Soft tissue texture	Mean score
1	1	1	2	2	2	2	2	12
2	1	1	2	1	2	2	2	11
3	1	1	1	2	1	2	2	10
4	2	2	1	2	1	1	1	10
5:1	2	2	2	2	2	2	2	14
5:2	1	1	1	2	2	1	2	10
6	1	1	2	2	2	2	1	11
7:1	2	2	2	1	2	1	1	11
7:2	2	2	2	2	1	2	2	13
8	1	1	2	2	1	1	2	10
9	1	1	2	1	1	2	2	10
10	2	2	2	2	1	2	2	13
11	1	1	2	2	2	1	1	10
12	1	1	2	1	2	2	2	11
Mean of all implant restorations								11.1
SD								1.35

SD, standard deviation; PES, pink esthetic score.

the appearance of papillae between implants and adjacent teeth (Choquet et al. 2001). Jemt (1997) proposed an index to assess the size of the inter-proximal gingival papillae adjacent to single implant restorations. Our data showed that 18 (64.3%) papillae had a score of 2 while the remaining 10 papillae (35.7%) had a score of 3 according to the Jemt (1997) papillary index. No class 0, class 1, or class 4 inter-proximal papillae at 1-year follow-up were noted. This implies that the technique that we used here was able to maintain the papillae height and appearance.

A PES to assess the esthetic and harmonious implant-supported restoration conformance to the pre-existing dentition was evaluated according Furhauser et al. (2005). The mean PES was 11.1 (SD 1.35) at 1-year follow-up. In most cases, there were incomplete mesial and distal papillae and alveolar process deficiency: nine (64.3%) and six (42.9%) cases, repectively. A minor discrepancy of soft tissue margin level of 1–2 mm was registered in three (21.4%) cases. This is in agreement with Schropp et al. (2005), who reported early placement of single-tooth implants may be preferable to a delayed implant placement technique in terms of early generation of inter-proximal papillae and the achievement of an appropriate clinical crown height. However, no difference in papilla dimensions was seen at 1.5 years after seating of the implant crown (Schropp et al. 2005).

Another prerequisite to successful implant rehabilitation, both functionally and esthetically, is the proper location of the implant fixture and restoration in the edentulous space (Kazor et al. 2004). Implants should be placed in the optimal position mesio-distally, apico-coronally, and bucco-palatally. The mesio-distal dimension between adjacent teeth should be 6–9 mm to ensure minimal (1.5 mm) distance between implant fixture and adjacent teeth (Ohrnell et al. 1988; Adell et al. 1990). Natural buccal and proximal restorative contour can be ensured by correctly orienting the implant in a bucco-palatal position. A minimum space of 2 mm should be maintained on the buccal side in front of the external implant collar surface. Pursuance of the above-mentioned requirements in our study ensured good functional and esthetic results.

Conclusions

Careful evaluation of potential extraction sites before immediate implant installation promotes optimal implant esthetics. Extraction sites with compromised soft tissue and bone volume can be successfully corrected using guided bone regeneration and connective tissue graft.

要旨：
目的：本前向き試験の目的は抜歯後即時インプラント埋入の成績と審美的結果を臨床的およびX線像によって評価することであった。
材料と方法：患者12人において合計14本のチタン製スクリュー・インプラント（13–16ｍｍ長、4.3または5.0ｍｍ径）を抜歯窩に埋入した。インプラント埋入後の欠損部に除蛋白牛骨ミネラルを充填し、生体吸収性コラーゲン・メンブレンと吸収性ピンを用いた。二次手術時に欠損の再評価を行った。インプラント周囲の臨床的及びX線上のパラメーターを補綴物装着時と1年後の観察時に評価した。
結果：1年間の観察期間後の累積インプラント存続率と成功率は100%であった。審美的結果の分析では、ピンク・エステティック・スコア（PES）は1年後に平均11.1（SD1.35）であった。
Jemtの乳頭インデックス（1997）に基づくと、1年後に歯間乳頭の64.3%はスコアが2、残り35.7%は3であった。2回の評価時に、13本のインプラント（92.9%）で、最適な角化粘膜の幅が記録された。1年後の評価時に、インプラント・ショルダーから骨頂までの直線距離は、近心側が2.62±0.2ｍｍ、遠心側が2.9±0.58ｍｍで、安定していた。
結論：インプラント即時埋入に先立つ、抜歯予定部位の入念な評価は、インプラントの最適な審美性を促進する。

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