Comparative Study of Wide-Diameter Implants Placed After Dental Extraction and Implants Positioned in Mature Bone for Molar Replacement

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***Objective**: The aim of this study was to compare wide-diameter implants placed in mature bone versus implants inserted in postextraction bone.* ***Material and Methods**: A retrospective case study was made; the sample was composed of subjects who had had wide implants placed in the molar area between 2003 and 2005. Two groups were formed: implants placed in mature bone and implants in postextraction bone. A protocol was prepared in which patient age, sex, oral hygiene, implant length, type of prosthesis, and antagonist dentition were collected. After 12 months, data relating to the clinical and radiologic conditions of the implants and the success rate (criteria of Buser et al) were recorded. A statistical analysis of the variables was made (*t *test, Pearson correlation coefficient, analysis of variance, chi-square).* ***Results**: The study examined 162 implants placed in 100 patients. Of the 162 implants, 130 were placed in mature bone and 32 in postextraction bone. Four implants placed in mature bone failed in 4 patients (success rate of 96.9%). None of the implants placed in postextraction bone failed.* ***Conclusions**: The placement of wide-diameter implants in recent molar extraction sites has been shown to achieve similar results to implants placed in healed mature bone after 12 months of follow-up, within the limitations of this study.* Int J Oral Maxillofac Implants 2008; 23:497–501

Key words: *immediate implants, wide-diameter implants*

Wide-diameter implants take advantage of bone width, increasing the surface available for osseointegration.[1] Considering implant diameter, a few publications on wide-diameter implants have reported an increased failure rate,[1–4] which was mainly associated with the operators' learning curves, poor bone density, implant design and site preparation, and the use of a wide-diameter implant when primary stability had not been achieved with a standard-diameter implant. More recently, researchers have used adapted surgical preparation, new implant designs, and adequate indications and have demonstrated that implant survival rate and diameter are not related.[5–8]

Immediate placement of implants reduces the number of surgical interventions required for treatment and the time interval between dental extraction and placement of the implant-supported prosthesis.[9] The marginal gap that may occur following implant placement in an extraction socket may be resolved by hard tissue filling during healing; marginal gaps in buccal and palatal/lingual locations are resolved through new bone formation from the inside of the defects and substantial bone resorption from the outside of the ridge.[10,11]

Wagenberg and Froum[12] placed 1,925 immediate implants in 891 patients. With a 1- to 16-year follow-up, the overall implant survival rate was 96.0%, with a failure rate of 3.7% prerestoration and 0.3% postrestoration. They concluded that implant placement following tooth extraction may be considered a predictable procedure.

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The purpose of this study was to estimate the 1-year success rate and bone loss of wide-diameter implants (5.5 mm). Implants positioned in postextraction bone were compared to implants placed in mature bone after 1 year of follow-up.

MATERIALS AND METHODS

Selection of Patients

A retrospective case study was made of subjects with wide implants placed and loaded between 2003 and 2005. The inclusion criteria were healthy patients suitable for treatment with wide dental implants in the molar area (alveolar ridge minimum 10 mm wide) and a follow-up period of 12 months after implant loading. Two groups were formed: implants placed in mature bone (more than 6 months after dental extraction) and implants in postextraction bone (implant surgery the same day as dental extraction). The exclusion criteria were patients with insufficient bone width for placing a 5.5-mm-diameter implant and subjects who failed to complete the protocol or who did not attend the follow-up examinations. All patients were rehabilitated after 8 weeks in the maxilla and after 6 weeks in the mandible.

Data Collection

Patient age (at the time of implant placement), sex (male/female), and hygiene were collected from all subjects; patient hygiene was assessed before surgery using the simplified oral hygiene index.[13] Patients were categorized as *(1)* nonsmokers, *(2)* smokers of up to 10 cigarettes per day, or *(3)* smokers of 11 or more cigarettes per day.

Implant length (8.5 mm, 10 mm, 11.5 mm, and 13 mm), the type of prosthesis (single-unit crown, partial prosthesis, complete fixed prosthesis, and overdentures), and the antagonist dentition (natural dentition or fixed prosthesis on teeth, prosthesis on implants, or removable dentures) were also collected.

The definition of implant success was based on Buser et al's clinical and radiological criteria[14]: *(1)* absence of clinically detectable implant mobility, *(2)* absence of pain or any subjective sensation, *(3)* absence of recurrent peri-implant infection, and *(4)* absence of continuous radiolucency around the implant after 3, 6, and 12 months of loading.

Surgical Procedure

For patients treated with immediate implants, extractions were performed atraumatically under local anesthesia (4% articaine with adrenaline 1:100,000; Inibsa; Lliça de Vall, Barcelona, Spain), preserving the alveolar bone and interdental papillae. When a dental implant was placed into a fresh extraction site with a bone-implant gap of more than 2 mm, autologous bone obtained during drilling was used as filling; if the bone-implant gap was 2 mm or less, no regenerative materials were used. If dehiscences appeared, autologous bone was used for recovery.

Radiographic Evaluation

Radiologic exploration was carried out with an XMIND intraoral system (Groupe Satelec-Pierre Rolland, Merignac, France) and an RVG intraoral digital receptor (Kodak Dental System, Atlanta, GA). In order to reproduce the patient alignments, a rigid cross-arch bar was used with bite-registration material, and a Rinn XCP (Dentsply Rinn, Elgin, IL) rod and ring were firmly attached to the bar and placed in contact with the x-ray cone. For measurement purposes, 2 visible and easily located reference points were selected at the junction point between the implant and prosthetic restoration (Fig 1a). A straight line was traced joining these 2 reference points and was considered to represent zero height (Fig 1b). For the determination of bone loss, a perpendicular line was traced mesial and distal to the implant from zero height to first contact with the crestal bone (Fig 1c). Mesial bone loss was determined from the difference between the first and second measurement (at the time of loading and after 12 months, respectively), and the same measurement was made for distal bone loss. Implant bone loss was defined as the largest mesial and distal difference.

Statistical Analysis

The Student *t* test was used to compare the means of 2 groups corresponding to a quantitative variable, with verification of variance homogeneity in each case. Pearson's correlation coefficient was used to relate 2 quantitative variables and the chi-square test to evaluate independence between the 2 groups. Where relevant, the Games-Howell test was used to explore the significant findings of the analysis of variance (ANOVA) in detail. The pertinent mathematical hypotheses were verified in all analyses. $P \geq .05$ was considered indicative of statistical significance.

RESULTS

A total of 180 threaded DEFCON Avantblast TSA surface implants (Impladent, Sentmenat, Barcelona, Spain) were placed in 115 patients; 15 patients with 18 implants were excluded due to a lack of follow-up. The study sample thus comprised 100 patients (55 females and 45 males) with a mean age of 47.5 years (range, 20 to 76).

Fig 1a Implant reference points.

Fig 1b Zero height.

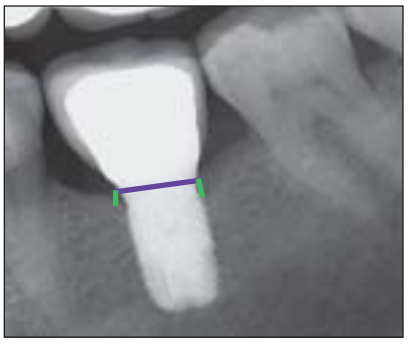

Fig 1c Mesial and distal measurement.

Table 1 Implant Length Distribution by Group

Length of implants	Nonimmediate	Immediate	Total
8.5 mm	22	1	23
10 mm	47	8	55
11.5 mm	45	11	56
13 mm	16	12	28
Total	130	32	162

Table 2 Prosthesis Distribution by Group

Type of prosthesis	Nonimmediate	Immediate	Total
Single crown	44	11	55
Fixed partial denture	51	15	66
Overdenture	2	0	2
Fixed full denture	4	1	5
Total	101	27	128

Dental hygiene was good in 28.6% of the patients, regular in 61.9%, and poor in 9.5%. A majority of the patients (59.5%) were nonsmokers, 9.5% smoked no more than 10 cigarettes a day, and 31% smoked 11 or more cigarettes a day.

A total of 162 implants were positioned: 130 in mature bone (40 in the maxilla and 90 in the mandible), and 32 in postextraction bone (9 in the maxilla and 23 in the mandible). The lengths of the implants are detailed in Table 1.

Autologous bone obtained during drilling was used to fill the space between the socket and implant in 14 immediate implants and to fill dehiscences in 18 (both in immediate and nonimmediate implants).

One hundred twenty-eight prostheses were prepared: 27 in the patients with immediate implants and 101 in the patients with implants in mature bone. Their distribution and antagonists are indicated in Tables 2 and 3, respectively.

Four implants (all positioned in mature bone) failed, yielding a 96.9% survival rate. The 4 patients with failed implants had regular or poor oral hygiene, and 3 of them smoked 11 or more cigarettes per day. Three implants failed during the osseointegration phase and 1 after placement of the prosthesis. Of the 4 failed implants, 2 measured 11.5 mm, one 8 mm, and one 10 mm in length. None of the failed implants had dehiscences that required bone regeneration. In the maxilla, 3 of 49 implants failed, while in the mandible 1 of 113 failed. None of the immediate implants failed. There was no statistically significant relationship between implant failure and any of the parameters studied.

Table 3 Prosthesis Antagonists by Group

Antagonist	Nonimmediate	Immediate	Total
Edentulous arch	1	0	1
Natural teeth	70	21	91
Fixed prosthesis	3	2	5
Removable dentures	2	0	2
Implant-supported restoration	14	3	17
Combination	11	1	12
Total	101	27	128

Overall mean implant bone loss was 0.84 mm after 1 year of loading. In the case of the immediate implants, the bone loss was 0.83 mm, versus 0.85 mm for those positioned in mature bone. No statistically significant differences were observed in the 2 groups with respect to bone loss or other study variables.

Table 4 Studies Published in the Literature on Wide-Diameter Implant Success Rates

Authors	Year	No. of patients	No. of implants	Follow-up	Percentage success
Graves et al[26]	1994	196	268	2 y	96%
Davarpanah et al[27]	1995	—	56	1 y	96%
Bahat and Handelsman[5]	1996	—	133	16 mo	97.7%
Aparicio and Orozco[3]	1998	45	185	12 mo	92.8% (97.2% in maxilla and 88.4% in mandible)
Polizzi et al[15]	2000	—	38	3 y	92%
Khayat et al[6]	2001	71	131	1 y	95%
Eckert et al[2]	2001	63	85	9 mo	76% (71% in maxilla and 81% in mandible)
Attard and Zarb[28]	2003	—	54	5 y	76%
Hultin-Mordenfeld et al[1]	2004	52	78	33 mo	89.8%
Krennmair and Waldenberger[7]	2004	63	85	41.8 mo	98.3%
Shin et al[4]	2004	82	128	12–84 mo	80.9%
Anner et al[8]	2005	43	45	23.4 mo	100%
Gentile et al[29]	2005	35	45	1 y	92.2%

DISCUSSION

In the consulted literature, the success rate of wide-diameter implants ranged from 76% to 100%, with a follow-up of between 9 months and 5 years (Table 4). In the present study, the success rate of the implants measuring 5.5 mm in diameter (immediate or positioned in mature bone) was 97.5%. Polizzi et al[15] studied the placement of wide-diameter implants for replacing a mandibular molar and recorded a success rate of 95% after 1 year of follow-up in a series of 20 implants. The study by Eckert et al[2] reported overall survival rates of 71% for the maxilla and 81% for the mandible, and Shin et al[4] obtained a cumulative survival rate of 80.9% with wide-diameter implants, a significantly lower success rate compared with 87.5% for 4-mm-diameter implants and 98.2% for 3.75-mm-diameter implants. In sites associated with poor bone density and mandibular resorption, short implants and/or wide-diameter implants might be used; in these particular situations, failure rates may be increased. Implants in these situations should then be compared with the failure rates and morbidity of advanced surgical procedures such as bone grafting, sinus lifting, and alveolar nerve transpositioning.[16]

Gomez-Roman et al[17] reported a 99.4% success rate for 164 implants placed in mature bone, versus 97.1% for 86 immediate implants; these implants were of variable lengths and diameters and were positioned in the maxilla or mandible. In contrast, in the present study, the success rate for implants in mature bone was 96.9%, while the success rate for implants in postextraction bone was 100%. Rosenquist and Grenthe[18] placed 109 immediate implants for which they reported a success rate of 93.6%. In addition to this study, a number of authors have reported 100% success when placing immediate implants, such as Lang et al,[19] who placed 16 postextraction implants; Brägger et al,[20] who placed 21 implants in 28 patients; Yukna,[21] whose study included 14 implants in 14 patients; and Goldstein et al,[22] with 38 immediate implants in 47 patients. These were all small series, with a follow-up period of 5 to 8 years.

Bone loss associated with wide-diameter implants was 0.83 mm, which is similar to the values reported by a number of other authors (range, 0.7 to 1.5 mm).[16,23,24] Schwartz-Arad[25] measured the bone loss of 326 implants from panoramic radiographs; immediate implants presented less bone loss (0.6 ± 1.18 mm) than nonimmediate implants (0.89 ± 1.24 mm; means ± SDs). In contrast to these findings, no differences between postextraction implants and implants positioned in mature bone were recorded.

CONCLUSIONS

Within the limitations of this study, the results of which must be considered preliminary because of the small sample size and relatively short follow-up period, the placement of wide-diameter implants in recent molar extraction sites has been shown to achieve results similar to the placement of implants in healed mature bone after 12 months of follow-up.

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