SURVIVAL RATE OF STANDARD IMPLANTS IN THE POSTERIOR MAXILLA

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Abstract: The present study evaluated standard implant survival and marginal bone loss in the posterior maxilla in a 2 stage-procedure based on retrospective study reporting on implants with a mean follow-up time of 1-10 years of functional loading. There were identified from a search of more than 10 years archive materials. The sample was composed of 126 patients (72 female and 54 males mean age 55) rehabilitated with 536 standard implants in the posterior maxilla between 1999 - 2008. The inclusion criteria were patients in good general health with residual bone height ≥ 10 mm of the posterior maxilla who had been rehabilitated with one to four implants. Second-stage surgery was performed in a mean of 4.3 months post implantation. Implant success was defined according to the criteria of Albrektsson et al. Not only the overall survival rate was analyzed but also the crestal bone loss 1 to 10 years of loading. Bone loss was measured on panoramic radiographs on the mesial and distal of each implant, and the largest value was selected as the bone loss. The influence of implants characteristics (type, length, diameter and coating) on implant failure and complication rates were evaluated. Patient satisfaction with the prosthesis were also evaluated. The total 10 years cumulative survival rate was 94% (32 implants were lost). The mean bone loss around implants in the posterior maxilla after 1 to 10 years of loading was 1.8 mm. All prosthesis of survival implants were stable at the end of observation period. Patients were satisfied with comfortable stability, esthetics and functionality of the prosthesis. Available indications suggest that implants placed in pristine sites enjoy the high long – term survival rates of dental implants.

Key words: standard implants, posterior maxilla, survival rate.

INTRODUCTION

Osseointegrated implants are a very reliable means of achieving prosthetic rehabilitation of edentulous patients who have adequate residual bone volume originally described by Branemark et al [1] and Adell et al [2]. The long term success rate of implants placed in the posterior maxilla is inferior to that in other areas [3 – 5]. A recent review reported a 5 – years average survival of 96% for implants from various manufacturers [6]. The insertion of dental implants requires sufficient bone volume to achieve primary stability [7] and ensure good long term results. The posterior maxilla shows some disadvantages like poor bone quality, close proximity of the maxillary sinus, higher occlusal loads and the frequency of the occlusal table; which is wider than the implant diameter resulting in mesiodistal and buccolingual cantilever and off-axis forces [8].

One reference criterion to evaluate implant success includes the assessment of changes in crestal bone level over time [9 - 12]. This has been the primary diagnostic tool used to characterize peri-implant conditions [13]. The main factor to be involved in the process of bone loss include surgical trauma to the periostium and bone [14] biomechanical imbalance related to loading [15], the size of the microgap between the implant and the abutment [16]. Small changes in the crestal bone level following implant placement may not negatively influence implant success [1, 17, 18]. Both bone quality and implant surface topography influence bone response after implantation [19] and an implant's surface properties play a significant role in its success and biocompatibility [20]. The aim of the present retrospective study was to evaluate the 10 – years cumulative survival rate (CSR) and failures of late implants

positioned in the native bone of the posterior maxilla to support fixed prosthesis.

MATERIAL AND METHODS

From 1999 to 2008, 126 patients (72 female and 54 males) aged between 28 to 84 (mean age 56 years) referred our clinic for implant placement in the posterior maxilla. A total of 536 implants were placed to replace missing maxillary premolar and molar teeth unilateral or bilateral and the surgery was performed by the same surgeon in one clinic. Radiographs, orthopantomographs and CT-scans were evaluated for bone quantity and quality. The sufficient vertical residual bone height and the buccolingual width were also determined to select the adequate implant type.

Clinical examination included evaluation of the interarch relationships to determine the adequate restorative possibilities. Patients with inadequate residual bone height were excluded from the study and referred for sinus elevation procedures and only patients with $\geq$ 10 mm residual bone height and at least 4 mm bone width were included.

Implants were used from 3 different manufacturers: 221 ITI Straumann, Switzerland, 56 Paragon, USA, CA, 259 Alpha-Bio, Israel. From the 221 ITI implants 186 ITI were titanium plasma spray-coated screws, and 35 were hohle cylinders, both were rehabilitated with solid abutments. The rest of the implants were internal hex-type implants. Amoxicillin (1.5) were administered for 7 days post surgery. For patients who were allergic to penicillin, erythromycin (1.5 mg) was the drug of choice. According to implantation protocol implants sites were prepared and accomplished with standard drills with external irrigation in the center of the alveolar ridge. Intraoperatively after preparing the implants sites, implants were determined to assure the most primary stability. Augmentation with autogenous bone without membrane was performed for 23 implant sites to cover the exposed implant neck. Patients were routinely inspected monthly prior to second-stage surgery. Radiographs of the implants sites were taken prior to second-stage-surgery and implants were exposed and healing caps were placed.

Two weeks later, implants were restored with a fixed prosthesis. The influence of implant characteristics (type, length and diameter) on survival and failure rate was evaluated. Patients included in this study were divided into four groups according to the number of implants placed in each side of the posterior maxilla. The first group included one implant replacing one missing tooth, the second group included two implants replacing two missing teeth, the third, group included three implants replacing three missing teeth and the fourth group included four implants replacing four missing teeth. The same patient could be included in two different groups.

Radiographs were taken using the paralleling technique and the marginal bone level; the distance from the level of the abutment- implant junction to the first bone - to - implant contact was measured. The known distance between the implants threads or spirals was used to ensure the calibration and determination of the exact magnification of the image. Changes in bone level over time were measured by specific software(Schick CDR, Shick Technologies).Marginal bone loss was evaluated after 12 and 24 months and yearly to 10 years of healing. Mesial, distal and mean bone loss were calculated in the posterior maxilla.

RESULTS

One hundred twenty six consecutive patients, 72 women and 54 men ranging age from 28 – 84 years (means 56 years) requesting fixed prosthesis rehabilitation were treated. All were affected by missing teeth and required reconstruction with standard implants without augmentation procedures.

The rate of the implants and implant location according to insertion year is shown in Table 1.

Table 1. Implants rate and Location in the posterior maxilla

Years	First premolar	Second premolar	First molar	Second molar
1999	11	10	18	11
2000	12	14	19	8
2001	14	13	13	10
2002	13	15	16	12
2003	15	17	13	7
2004	17	19	12	11
2005	14	16	15	9
2006	15	18	16	12
2007	13	13	18	10
2008	11	12	22	8
Total	**135**	**147**	**156**	**98**

Follow-up lasted from the time of implant placement until August 2008. There were 135 first premolar replacement, 147 second premolar, 156 first molar and 98 second molar replacements.

Table 2 shows the distribution of implants by length and diameter and shows the failed implants according to implant length and diameter. The mean implant length was 12.30 mm (range 10 mm to 16 mm) and the mean implant diameter was 3.9 mm (range 3.3 mm to 6 mm).

Table 2. Distribution of implants by length and diameter

Implants length	No. of implants	No. of failed implants
10 mm	162	7
11.5 mm	22	5
12 mm	38	4
13 mm	198	10
14 mm	18	4
16 mm	98	2
Total	536	32
Implant diameter		
3.3 mm	24	3
3.75 mm	214	9
4.1 mm	68	6
4.2 mm	156	8
4.8 mm	28	2
5 mm	34	2
6 mm	12	1
Total	**536**	**32**

Table 3 shows a detailed survival analysis. The cumulative survival rate of the standard implants was 94%, 32 implants were lost (6%). There were no implant losses after loading (3 to 50 months follow-up).The most failed implants were registered in the first three months after implants placement (12 failed implants). In the next three months another 8 implants were failed. Between 6 to 12 months, after implants placement 9 implants were also failed. In the first, second and third year after implant placement one implant failed each year. No implant failure were registered between 4 to 10 years post implantation.

Table 3. Life table analysis

Time	No of implants	No failed	Survival rate
0-3 month	536	**12**	**97.75%**
3-6 month	524	**8**	**98.5%**
6-12 month	516	**9**	**98.25%**
1 year	515	1	99.8%
2 year	514	1	99.8%
3 year	513	1	99.8%
4 year	500	--	100%
5 year	480	--	100%
6 year	410	--	100%
7 year	380	--	100%
8 year	355	--	100%
9 year	320	--	100%
10 year	286	--	100%

Table 4 shows the characteristics of failing implants, complications were evident in 8 (25%) of 32 failing implants. There were no major complications requiring surgical intervention, few implants showed premature exposures that required the use of local antiseptic and oral antibiotics. ITI titanium plasma spray coated implants showed few minor complications.

Table 4. Characteristics of failing implants

Subject	Time of failure (months post placement)	Location	Length mm	Diameter mm	Implant type	Complication
1	13	1M	10	4.2	titanium screw	--
2	5	2M	11.5	4.2	titanium screw	yes
3	2	2M	13	4.2	titanium screw	--
4	1	2M	16	3.75	titanium screw	--
5	2	1M	16	3.75	titanium screw	--
6	12	1M	11.5	3.75	titanium screw	yes
7	3	2M	13	4.2	titanium screw	--
8	5	2M	12	4.2	titanium screw	--
9	11	2M	16	3.75	titanium hohle cylinder	--

10	9	1M	10	5	titanium screw	--
11	6	1Pre	12	4.8	titanium hohle cylinder	--
12	3	2Pre	13	3.3	titanium screw	--
13	8	1M	10	3.75	titanium screw	yes
14	11	1M	11.5	4.8	titanium screw	--
15	4	1M	13	3.75	titanium screw	--
16	3	1M	10	4.2	titanium screw	--
17	8				titanium screw	--
18	6	2M	13	4.2	titanium screw	yes
19	2	2M	12	3.75	titanium screw	--
20	3	2M	11.5	4.8	titanium screw	yes
21	6	1M	10	3.75	titanium hohle cylinder	--
22	2	1M	12	3.75	titanium screw	--
23	10	2M	11.5	4.2	titanium screw	--
24	6	2Pre	12	3.75	titanium screw	--
25	24	2Pre	11.5	3.75	titanium screw	--
26	12	2M	13	3.3	titanium screw	--
27	9	2M	16	3.3	titanium screw	yes
28	1	2M	13	3.75	titanium screw	--
29	4	1Pre	11.5	3.75	titanium screw	yes
30	32	1Pre	13	3.75	titanium screw	yes
31	8	2M	12	4.1	titanium screw	--
32	2	2M	11.5	4.2	titanium screw	--

The 10 years implant Cumulative Survival Rate was 94% (there was no change in the Cumulative Survival Rate after the 5 years).

The mean marginal bone level was calculated at baseline and at each year follow up. The mean marginal bone level at baseline was 2.0 mm apical of the reference point. The reference point was defined as the abutment implant junction and the first bone contact to implant amounted to mean value of 2 mm. Table 5 shows the radiographic marginal bone level changes from the first to ten years after implantation. Recession and attached gingiva were also measured.

Table 5. Clinical parameters and Radiographic Marginal Bone level of standard implants

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Radiographic Marginal bone level (mm)	2.0	2.8	3.7	3.3	3.4	3.0	4.2	4.8	5.0	5.2
Recession (mm)	0.0	0.3	0.8	1.2	1.8	2.0	2.3	3.0	3.5	3.8
Attached mucosa (mm)	6.0	6.0	5.8	5.6	5.4	5.7	4.9	4.8	4.6	4.2

The reduction in marginal bone, as measured from the reference point, was 4.0 mm or less at a majority of the implants. At the five years follow up the narrow implants (with a diameter of 3.3) exhibited significantly more marginal bone

loss than the standard implants (with a diameter of 4.1 mm).

DISCUSSIONS

The current data on implant survival in native bone seem to be reliable and consistent [6]. The posterior maxilla is challenging area for implant dentistry. Because of the progressive maxillary sinus pneumatisation, the bone loss is generally high in this area. Poor bone density in the posterior maxilla can affect the primary stability of implants because of insufficient contact between implant and bone [8, 21, 22]. Jaffin reported 1991 an overall failure rate of 35% in Type IV quality bone [1]. The failure rate increased to 44% in type IV in the maxilla. Drago CJ (12 Schwartz) examined osseointegration of implant with regard to anatomical location, there was a 71.4% success rate in the posterior maxilla compared to better results in other areas of the mouth [23]. However in a 5-years follow-up report on 259 implants placed in posterior partially edentulous arches the overall cumulative survival rate was 97.2% [24]. Bahat reported 1993 for 732 implants placed in the posterior maxilla a survival rate of 95.2% at 5 to 70 months after loading [25]. The failure rate in Type IV bone was only slightly higher than that in Types II and III bone (5.5 % versus 4.6%). The failure rate in the entire molar area was 5.3%, compared with 4.5% in the premolar area.

In a multicenter prospective study [26], a survival rate of 92.4% was reported in the maxilla over 3 years. A survival rate of 93.6% after 1 year was shown in 78 implants placed in the molar area for single-tooth replacement [27]. It was concluded that replacement of a single molar by a single implant can be a valid and successful surgical treatment modality with a high survival rate.

The longitudinal clinical effectiveness of osseointegrated dental implants in posterior partially edentulous patients has been studied [29]. The overall implant survival rate was 94.3%. In a survey of 1203 implants conducted by Nevins and Langer [30], the use of osseointegrated implants to replace posterior teeth in partially edentulous patients was evaluated. Of 652 implants placed in maxilla, 31 failed, for a success rate of 95.2%. In another study conducted on 1170 endosseous implants placed in partially edentulous arches, it was concluded that implant survival was independent of anatomic location [31]. Engquist et al. [2] reported a 20% failure rate of maxillary implants placed to support overdentures; 78% of the failures were in Type IV bone. Both reports suggested bone quality as a major prognostic factor for implant success.

The influence of implant surface characteristics on the survival rate of standard implants has been evaluated [28]. Similar survival rates for different implant types were reported. The results of the present study support the use of commercially pure titanium screw with titanium plasma spray coating and SLA coated implants.

32 Implants of 536 inserted implants were failed (survival rate 94%) compared to already reported results from different authors [4, 23, 25] the results of our study correlate with those results. This study provides further information on the

outcome of implantation in the Posterior maxilla.

The evaluated marginal bone level loss values are in accordance with marginal bone levels absorbed in studies documenting the longitudinal outcomes of implants placed under standard condition [32, 33]. Previous studies have demonstrated that plague and inflammation of the peri-implant tissues are associated with loss of marginal bone [34, 35]. Although no differences in the mean values regarding mucosal recession were found between our study and previous studies.

CONCLUSIONS

Standard implantation in the edentulous posterior maxilla is a predictable surgical procedure with a high 10 years survival rate of 94%. There is no influence of the different implant types included in this study on the survival rate. Standard implant insertion is relatively easy to perform in any private clinic by surgeon, who is not trained for advanced techniques.

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