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Implant-supported fixed cantilever prostheses in partially edentulous arches. A seven-year prospective study

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Abstract: The purpose of the following study was to evaluate the medium- to long-term prognosis of implant-supported cantilever fixed prostheses, and to establish to what degree this is influenced by factors such as length, type of cantilever (mesial or distal), and opposite dentition versus cantilever prostheses. This study was performed on a sample of 38 partially edentulous patients treated between January 1994 and March 2001 with 49 partial cantilever fixed prostheses supported by 100 implants. Marginal bone resorption (MBL) has been studied and used as a reference parameter to define therapeutic success. The MBL measurement was made possible by transposing X-ray images of patients selected on a PC and then using a software program. Statistical analysis was carried out for possible correlation between peri-implant bone resorption and the parameters considered in this study: length and type (mesial or distal) of cantilever and opposite dentition to cantilever prostheses. Seven years after loading cantilever prostheses, the overall cumulative implant survival rate (OCSR) was 97%, and the prostheses success rate is 98%. Mesial cantilever prostheses registered a lower success rate (97.1%) than distal cantilever prostheses (100%). Furthermore, a better prognosis was not observed when the opposite dentition of the prostheses comprised natural teeth, or fixed prostheses on natural teeth, when compared with the cases in which opposite teeth were implant-supported fixed prostheses. The authors concluded that medium-term prognosis of implant-supported cantilever fixed prostheses and traditional implant-supported fixed prostheses was comparable. However, a thorough pre-treatment analysis of risk factors regarding implant-supported prosthesis survival is important.

Over the past 15 years, prosthetic restoration of edentulous jaws with endosseous implants radically changed dental practice (Brånemark *et al.* 1985; Albrektsson *et al.* 1988; Albrektsson 1988; van Steenberghe 1989; Adell *et al.* 1990; Buser *et al.* 1991). Endosseous implants were conceived to take the place and function of natural roots. In the case of unfavourable local conditions of the residual edentulous ridges, two options may be considered: (i) Pre-implant reconstructive and/or regenerative procedures; (ii) Rehabilitation of partially edentulous site with cantilever fixed prosthesis.

On the one hand, reconstructive procedures present a higher rate of biological costs due to the necessity of bone harvesting and grafting procedures, the use of semi-permeable barriers, etc. On the other hand, implant-supported cantilever prostheses allow a simpler rehabilitation procedure as several studies have demonstrated (Rodríguez *et al.* 1994; Shackleton *et al.* 1994; Jimenez-Lopez *et al.* 1999; Becker & Kaiser 2000).

The aim of this study was to evaluate the medium-term prognosis of implant-supported cantilever fixed prostheses, and to what extent implant survival is influenced

by factors such as cantilever length, type of cantilever (mesial or distal) and dentition opposite to cantilever prosthesis.

Material and methods

Patient selection

Thirty-eight patients (16 males and 22 females), ages 21–71 years (mean age 51 years), were treated consecutively from

January 1994 to March 2001 (Table 1). Some of these patients attended the Dental Clinic of Biomedical Sciences Institute, S. Paolo Hospital, University of Milan, Italy and some a private out-patient regime.

Inclusion criteria were: (i) partial edentulism; (ii) absence of local inflammation; (iii) absence of oral mucosal disease; (iv) adequate oral hygiene; (v) recovery time of at least 6 months for patients subjected to

tooth extractions; (vi) adequate bone volume at the implant site (enough for placement of implant at least 3.3 mm in diameter and 8 mm in length) evaluated with juxta-gingival radiographs and clinical evaluation; (vii) informed patient's consent.

Exclusion criteria were: (i) patients with systemic diseases (such as heart, coagulation, and leukocyte diseases or metabolic

Table 1. Clinical features of accepted patients

Pat no.	Age	Sex	Implant Type	Size	Diam. (mm)	Length (mm)	Cantilever Type	Length (mm)	Last clinical control Probing depth Plaque index Bleeding by probing Mobility and percuss	Last instrumental evaluation Juxta-gingival X-ray
1	77	M	ITI	36–37	4.1	10	M	7.05	1 year	1 year
2	71	M	ITI	35–36	4.1	10	M	6.03	1 year	1 year
			ITI	44-45-46	4.1	10	D	6.59	1 year	1 year
3	70	F	ITI	14–15	3.3	10	D	7.88	1 year	1 year
4	48	F	Brå	45–46	3.75	10	M	4.96	1 year	1 year
5	37	M	ITI	35–36	4.1	10	M	4.86	1 year	1 year
			ITI	45–46	4.1	14–10	M	4.98	1 year	1 year
6	37	M	Brå	36–37	5	10	M	6.56	2 years	2 years
7	43	F	ITI	24–25	4.1	10–14	D	7.55	2 years	2 years
8	58	F	Brå	36–37	3.75–5	10	M	5.51	2 years	2 years
9	36	F	ITI	36–37	4.1–3.3	12	M	7.98	2 years	2 years
10	71	F	ITI	43–44	4.1	10	D	6.33	2 years	2 years
11	37	F	ITI	45–46	4.1	10	M	5.67	2 years	2 years
12	32	M	ITI	46–47	4.1	12	M	4.32	30 months	30 months
13	46	M	Brå	12-13-14-16	3.75	13	M	5.95	30 months	30 months
			Brå	22-23-24-26	3.75	13	M	5.65	30 months	30 months
14	40	F	ITI	25–26	3.5–4.1	12	M	4.14	30 months	30 months
15	43	M	ITI	46	4.1	10	M	3.67	30 months	30 months
16	46	F	ITI	26	4.1	12	M	3.48	3 years	3 years
			ITI	36	4.1	10	M	5.64	30 months	30 months
			ITI	46	4.1	10	M	2.97	30 months	30 months
17	52	M	ITI	26–27	4.1	10	M	5.22	3 years	3 years
			ITI	46	4.1	10	M	5.50	3 years	3 years
18	56	M	ITI	25	4.1	12	M	4.39	3 years	3 years
19	52	F	ITI	14–15	4.1	12–14	D	6.32	3 years	3 years
			ITI	24–25	4.1	14–12	D	5.93	3 years	3 years
20	55	M	ITI	37	4.1	12	M	3.98	4 years	4 years
			ITI	45	4.1	8	D	6.02	4 years	4 years
21	57	F	ITI	24–25	4.1	12–10	D	7.84	4 years	4 years
22	46	M	ITI	25–26	4.1	10	M	4.29	4 years	4 years
23	46	F	ITI	22-23-25-26	4.1	12-14-12-12	M	6.83	4 years	4 years
24	82	F	ITI	25–26	4	10	D	6.48	5 years	5 years
25	66	F	ITI	34–35	4.1	8–10	D	8.41	5 years	5 years
26	54	F	ITI	14–15	4.1	10–8	D	4.99	5 years	5 years
27	55	F	Brå	24-25-26	3.75	10	M	7.33	5 years	5 years
28	49	M	ITI	36–37	4.1	10	M	5.38	5 years	5 years
29	53	F	ITI	13-14-15	4.1	12-14-8	M	4.66	6 years	6 years
			ITI	35–36	4.1	10–10	M	5.87	6 years	6 years
30	41	M	ITI	15–16	4.1	10–8	M	6.52	6 years	6 years
31	41	M	ITI	45–46	4.1	8	M	5.49	6 years	6 years
32	46	F	ITI	46	4.1	12	M	4.48	6 years	6 years
33	53	F	ITI	24–25	3.3	10–8	D	7.43	6 years	6 years
34	45	F	ITI	12-13-15	4.1	10-8-10	D	7.21	7 years	7 years
49			ITI	23-24-25	3.3	10-8-10	D	7.90	4 years	4 years
35	55	M	ITI	35–36	4.1	12	M	6.54	7 years	7 years
36	45	F	Brå	14–16	3.3	10	M	5.37	7 years	7 years
			Brå	25	4	12	D	4.13	7 years	7 years
37	55	M	ITI	45–46	4.1	12	M	5.72	7 years	7 years
38	49	F	ITI	44-45-46	4.1	10	M	4.16	7 years	7 years

disorders; (ii) history of radiation therapy in the head and neck region; (iii) current treatment with steroids; (iv) neurological or psychiatric handicap that could interfere with good oral hygiene; (v) immunocompromised status, including infection with human immunodeficiency virus; (vi) severe clenching or bruxism; (vii) unfavourable intermaxillary relation; (viii) smoking habit (more than 15 cigarettes/day) (Bain & Moy 1993; Bain 1996; Lindquist *et al.* 1996); (ix) drug or alcohol abuse; (x) patients with reduced compliance (Noack *et al.* 1999).

Examinations

Thirty-two out of the 38 patients were restored with ITI[®] (Institute Straumann, Waldenburg, Switzerland) implant-supported prostheses, while six patients were restored with Brånemark System[®] (Nobel Biocare, Göteborg, Sweden) implant-supported prostheses.

The following data were recorded:

- placed implants: 100 (80 ITI[®] and 20 Brånemark System[®]);
- loaded implants: 100 (80 ITI[®] and 20 Brånemark System[®]);
- average of implants per patient: 2.6 (range 3);
- partial fixed prostheses used to restore the 38 patients: 49;
- evaluated cantilevers: 49 (34 mesial and 15 distal);
- mean follow-up: 3.9 years after prosthetic loading.

The follow-up period for each patient was calculated from the implant loading date.

Clinical assessment

Peri-implant tissue was evaluated as follows: (i) suppuration (Mombelli *et al.* 1987); (ii) plaque index (score 0–3) in agreement with Mombelli *et al.* (1987 and Mombelli & Lang (1994); (iii) probing pocket depth and probing attachment level (Lang *et al.* 1994); (iv) bleeding on probing (score 0–3) (Mombelli *et al.* 1987); (v) mobility index (score 0–2) (Mombelli *et al.* 1987), or by using the Periotest (Siemens AG, Banskheim, Germany); (vi) percussion with evidence of metal (functional ankylosis) or dull sound (fibrous-integration in the area of placed implants) (Esposito *et al.* 1998); (vii) persistent pain or paresthesia.

All cases showing peri-implant inflammation were treated according to the guidelines suggested by Mombelli & Lang (1998).

Instrumental procedures

Instrumental investigations carried out in this study included juxta-gingival radiographs, subsequently stored on a PC and analyzed with a software program (Image J). The following parameters were measured:

- cantilever length;
- peri-implant bone resorption (Marginal Bone Loss, MBL) starting from implant loading time. Measurements were made mesial and distal to each implant. However, mesial measurement were considered more significant (Lundgren & Laurell 1993, 1994; White *et al.* 1994; Tashkandi *et al.* 1996).

Prosthetic treatment

After a 3-month minimum period for mandible sites with 1 or 2 bone quality, and a 6-month maximum period for maxillary sites with 3 or 4 bone quality (Lekholm & Zarb 1985), patients were called back for a pre-prosthetic evaluation.

For ITI[®] implants: after healing screw removal (3–6 months after fixture placement), the abutments were screwed with a 35-N torque. Solid or OCTA abutments with cast-to parallel gold copings were used for cemented prostheses, and OCTA abutments with only cast-to gold copings were used for screw-retained prostheses.

For Brånemark[®] implants: after reopening the implant site (3–6 months after fixture placement), healing abutments were screwed. Cast-to (AurAdapt[™]) or preparable (TiAdapt[™]) abutments were used for cemented prostheses; pre-fabricated abutments (EsthetiCone[™]) were used for screw-retained prostheses.

All the cantilever prostheses were made of gold alloy and porcelain, and cemented or retained by a titanium screw, in agreement with the manufacturer's instructions.

Soldering was never performed. Prostheses fixation was performed by zinc ox phosphate or zinc-eugenol oxide cement (cemented prostheses) and electronic or manual dynamometer (screw-retained prostheses).

Statistical analysis

Mean cantilever length was compared in patients who did not reach therapeutic

success with the one used in successfully restored patients. Then, the relationship between MBL and cantilever length was evaluated using the least squares method (Bossi *et al.* 1992a).

The above statistical method was also used to check the following null hypothesis: bone resorption observed around the most stressed prosthetic fixture either with mesial or distal cantilever is comparable. Patients were divided into two groups (prostheses with 'mesial' and 'distal' cantilevers), and data were referred to the cantilever nearest resorption.

Assumptions were: (i) normal distribution for the two groups or populations; (ii) number of patients lower than 30 (14) for one of the two groups; (iii) same variance for the two groups. The distribution of differences between means was *t*-type. Student's *t*-test was therefore used to ascertain the aforesaid null hypothesis (using two degrees of freedom) (Blaud & Altman 1986; Bossi *et al.* 1992b).

Lastly, a hypothesis test of the difference between two means (*Z*-test of normal standardized distribution performed with one degree of freedom, Barberi 1962; Salvatore 1991) was used; initial null hypothesis was the following: MBL data for natural opposite dentition or natural teeth fixed-on prostheses are comparable with implant fixed-on prostheses.

Study-scales measuring

Juxta-gingival radiographs at time of first (0 years-loading) and at last evaluation (Figs 1, 2, 3 and 4) were considered for each implant-supported prosthesis. Performing juxta-gingival radiographs and loading them on a PC were considered with data found in literature (Eggen 1976; Lang & Hill 1977; Gröndal *et al.* 1984; Jeffcoat *et al.* 1984; Brägger 1988; Papapanou *et al.* 1988; Albandar 1989; Haussmann *et al.*



Fig. 1. RX of cantilever fixed prosthesis supported by ITI[®] implants (Institute Straumann, Waldenburg, Switzerland); 0 years-load.



Fig. 2. RX of cantilever fixed prosthesis supported by ITI® implants (Institute Straumann, Waldenburg, Switzerland); last control.



Fig. 3. RX of cantilever fixed prosthesis supported by Brånemark System® implants (Nobel Biocare, Göteborg, Sweden); 0 years-load.



Fig. 4. RX of cantilever fixed prosthesis supported by Brånemark System® implants (Nobel Biocare, Göteborg, Sweden); last control.

1989a, 1989b; Benn 1990; Hausmann *et al.* 1991; Reddy *et al.* 1992; Weber *et al.* 1992; Esposito *et al.* 1993; Brägger 1994). A standardized protocol was performed. Highlighted parameters (cantilever length and MBL degree) was measured by juxta-gingival radiographs.

The distance between implant neck and the most apical point of each fixture, along an ideal line running parallel to the long fixture axis (red vertical line) was used to set the measurement system. This procedure was carried out for each juxta-gingival radiograph, considering some reference measurements as: (i) implant neck height (yellow vertical line) equal to 2.8 mm for ITI® implants. For Brånemark® implants (NP, RP, WP) the neck length selection (1, 2 or 3 mm) was based on the thickness of the patient's gingival mucosa; (ii) implant neck diameter (red horizontal line) equal to

4.8 mm for ITI® implants, 3.5 mm for NP Brånemark® implants (hexagon diameter of 2.4 mm), 4.1 for RP Brånemark® implants (hexagon diameter of 2.7) and 5.1 mm for WP Brånemark® implants (hexagon diameter of 3.4 mm).

Figure 5 explains cantilever length measurement. Only one operator performed these study measurements.

Success, survival and failure

Implant success restorations were calculated on the following parameters (Albrektsson *et al.* 1986; Buser *et al.* 1990; Roos *et al.* 1997; Noack *et al.* 1999):

- bone resorption in measurement areas within 1 mm during the first year after implant placement, and 0.2 mm per year in subsequent years;
- no mobility and symptoms concerning abutments and implants;
- probing depth within 3 mm for each implant site (mesial, distal, buccal, lingual-palatal).

Prosthetic success was calculated on the following parameters:

- no permanent cantilever prostheses or supporting fixtures warpage or breakage.

Survivals (OCSR according to Jemt & Leckholm 1993) include:

- therapeutic success;
- exceeding peri-implant bone resorption rate in functional and asymptomatic *in situ* prostheses;
- functional and asymptomatic *in situ* prostheses thought showing a peri-implant probing MBL rate that exceed the maximum limits established by the present study.

Implant failure was calculated on the following parameters:

- implant mobility whether or not joined with MBL;
- peri-implantitis affecting abutment-implant;
- abutment-implant symptoms whether or not joined with MBL.

Prostheses failure was attributed to the following problems:

- pontic permanent warpage or breakage;
- porcelain veneer permanent warpage or breakage;

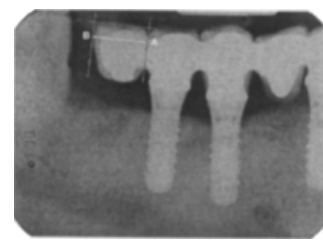


Fig. 5. Cantilever length measuring: a point A (the most coronal part of the metal connector), vertical red lines (tangent to the A and B points and perpendicular to the line crossing the occlusal plane of the adjacent teeth), a point B (the farthest metal connector point) and a yellow line A-B (cantilever length) are drawn.

- abutment, implant or connecting screw breakage;
- abutment loosening, fixing screw impairment or prosthesis decementation.

Results

Computer measurements of juxta-gingival radiographs produced the following data (Table 2):

- mean length of the 49 considered cantilevers: 5.77 mm (± 1.31 mm SD);
- mean length of the 34 mesial cantilevers: 5.33 mm (± 1.14 mm SD);
- mean length of the 15 distal cantilevers: 6.77 mm (± 1.17 mm SD);
- mean resorption around the cantilever nearest implant (cantilever proximal side);
- 0.82 mm (± 0.62 mm SD);
- mean resorption around the cantilever farthest implant (cantilever proximal side);
- 0.69 mm (± 0.55 mm SD).

Success, survival and failure

A four-year mean follow-up showed these indexes (Table 3a and b):

- prosthetic success in 97.3% of patients and in 98% of cantilever prostheses;
- implant success in 84.2 % of patients and in 88% of placed implants;
- implant survival in 97.4% of patients and in 97% of placed implants, including four cases in which radiographic and perimplant check-ups showed bone resorptions and/or probing depth considered exceeding, even although there was not inflammation, symptoms or mobility;

Table 2. Outcome of analyzed parameters

Parameter	Outcome
Mean cantilever length	Mesial mean cantilever length: 5.33 mm
Distal mean cantilever length: 6.77 mm	
Mean cantilever length on the whole: 5.77 mm	
MBL (marginal bone loss): fixture position	Peri-implant medium MBL (cantilever nearest fixture) Cantilever proximal side: – 0.82 mm
Peri-implant medium MBL (cantilever farthest fixture) Cantilever proximal side: – 0.69 mm	
MBL (marginal bone loss): mesial and distal cantilever prostheses	Medium MBL (mesial cantilever nearest fixture) Side cantilever proximal side: – 0.81 mm Medium M.B.L. (distal cantilever nearest fixture)
Cantilever proximal side: – 0.93 mm	
MBL (marginal bone loss): different opposite denture	Opposite denture: natural teeth/natural teeth fixed prosthesis Peri-implant medium MBL
Cantilever proximal side: – 0.72 mm	
Opposite denture: implant fixed prosthesis	
Peri-implant medium MBL	
Cantilever proximal side: – 0.78 mm	

Table 3(a). Study results – prosthetic success and failure

	Patient No.	%	Cantilever prosthesis No.	%	Cantilever type M	%	D	%	Opposite denture Natural teeth	%	Implant fixed prosthesis	%
Success	37	97.3	48	98	33	97.1	15	100	35	97.2	13	100
Failure	1	2.6	1	2	1	2.9	0	0	1	2.8	0	0
Total	38	100	49	100	34	100	15	100	36	100	13	100

Table 3(b). Study results – implant success, survival and failure

No.	Patient		No.	Implant	
	%			%	
Success	32		84.2	88	88
OCSR	36		94.7	97	97
Failure	2		5.3	3	3
Total	38		–	100	–

OCSR, Overall cumulative survival rate (success + survival) (Jemt & Lekholm 1993)

One implant failed (1-year loading) because of impairment of the fixture-abutment fixing screw; two implants failed (4-year loading) because of peri-implantitis; treated later.

- prosthetic failure in 2.6% and in 2% of cantilever prostheses, including one case featuring loosening of the primary titanium abutment (Brånemark® implant 10 mm × 3.75 mm) with impairment of the fixture-abutment fixing screw;
- implant failure in 5.3% of patients and in 3% of placed fixtures including one case showing peri-implantitis 4 years after implant loading. Causal mechanic therapy and local antibiotic therapy followed by guided bone regeneration were performed;
- in the seven non-successful therapy patients, the mean cantilever’s length was 6.25 mm (range 2.8 mm).

Cantilever length

The least squares regression line was calculated in order to determine an actual relationship between cantilever length and MBL extension, and also if cantilever length somehow influenced the prognosis of implant supporting fixtures.

Each 1 mm cantilever length increase resulted in a 0.099-mm resorption increase around the implant (considering a 58% variation coefficient) (Table 2). Nevertheless, this relationship was valid only for the cantilever nearest fixtures.

Mesial and distal cantilevers

Medium MBL index was not significantly different (Student’s *t*-test with 95% con-

fidence level) for distal and mesial cantilever prostheses. However, distal cantilever prostheses medium MBL index was higher than mesial (–0.93 mm against –0.81 mm, Table 2).

However, one prosthetic failure was noticed: more specifically, failure regarding a mesial cantilever prosthesis (2% of all cantilevers and 2.9% of mesial ones).

Opposite dentition

Cantilever nearest implant was considered to evaluate bone resorption (MBL). Two types of dentition opposite to the cantilever prostheses were considered: natural teeth or fixed prosthesis supported by natural teeth (29 patients) and implant-supported pros-

theses (nine patients) (Table 2). Mean values obtained for these two groups were, respectively, 0.72 and 0.78 mm. Implant success rate was 97.2% and 100%, respectively.

Z-test of normal standardized distribution (considering 95% confidence level) did not show any significant resorption difference between the two groups. Initial null hypothesis was confirmed.

Discussion

The study of Jemt & Leckholm 1993) concerning implant-supported prostheses in partially edentulous arches can be taken as a reference. In that study the overall cumulative survival rate was 97.2%. These data are consistent with those obtained in the present study (97%).

The success rate of 98% of cantilever prostheses is consistent with results obtained by Shackleton *et al.* 1994) and those of Naert (1992) (respectively 100% and 96.5% for cantilever total fixed prostheses after 7 years), and Albrektsson (1988) (respectively 99.7% and 96.1% for mandibular and maxillary site).

However it must be stressed that a cantilever fixed prosthesis will guarantee a good medium-to-long-term prognosis if a number of rules are observed: cantilever length (Naert *et al.* 1992; Shackleton *et al.* 1994; White *et al.* 1994; Young *et al.* 1998) and correct prosthesis function (Beyron 1973; Skalak 1983; Lundgren *et al.* 1987; Falk *et al.* 1989; Taylor *et al.* 1991; Hobkirk & Psarios 1992; Stewart *et al.* 1992; Hoshaw & Brunsky 1993; Weinberg *et al.* 1993; Benzing *et al.* 1995; Matsui *et al.* 1996).

Data registered in the present study about cantilever length are consistent with limits recommended in literature (Naert *et al.* 1992; Shackleton *et al.* 1994; White *et al.* 1994; Young *et al.* 1998).

There are no available studies in the international literature concerning the behaviour of mesial cantilever prostheses as compared with distal cantilever prostheses. However, it can be argued that biomechanical loads applied to the cantilever will be more intensive whether this is mesial or distal (Lundgren *et al.* 1989; Tashkandi *et al.* 1996). So different compressive and tensile stress will be transferred to the implant-supported prostheses (considering sites, cantilever length and framework manufacture as being equal).

Data found in Table 2 do not show the lower failure risk exposure for a mesial cantilever prosthesis; conversely, failure concerns two first pre-molar mesial cantilever prostheses.

In addition, statistical analysis confirmed that bone resorption means are comparable for mesial and distal cantilever prostheses (respectively 0.81 and 0.93 mm).

Important experimental studies (Chapman *et al.* 1989; Lundgren & Laurell 1993, 1994) based on implant-supported prostheses showed the importance of receptors situated in opposite dentition. These receptors (mechanoreceptors, baroreceptors and nociceptors) are capable of perceiving a possible mechanical overload during mastication. Overloads should be controlled by neuromuscular feedback systems; where there is no sensitive innervation, for example in cantilever implant-supported prostheses, no biomechanical forces control can be exercised during mastication.

The present study results however, seem not to show the importance of these periodontal ligament receptors. No big differences in peri-implant bone resorption were found. The only prosthetic failure observed in the present study was related to a bridgework having natural teeth as opposite dentition.

The results of this lead to the following conclusions:

- (i) Appropriately sized mesial or distal cantilever is not a significant medium-to-long-term prognosis worsening factor; the cantilever prosthesis prognosis, although poorer than the prognosis of implant-supported prosthesis without cantilevers, can be also accepted if manufacturer instructions are observed (Cibirca & Razzoog 1992; Jemt *et al.* 1994; Jemt & Lie 1995; Takayama 1996; Sadowsky *et al.* 1997; Hellden & Derand 1998; Duyck *et al.* 2000; McAlarney & Stavropoulos 2000).
- (ii) Cantilever produces a negative effect on implant-supported prosthesis or on supporting implants; it mostly appears as MBL for cantilever nearest implant, and especially along the proximal side of that implant (Rangert *et al.* 1989; Rodriguez *et al.* 1993; Rangert *et al.* 1995; Sertgoz & Gunvener 1996;

Rangert *et al.* 1997; Stegaroiu *et al.* 1998).

- (iii) Cantilever length is not a worsening factor for prosthesis and implant-support prognosis. A minimum bone resorption increase around cantilever nearest implant is related to cantilever length increase.
- (iv) MBL indexes referred to the nearest mesial or distal cantilever fixture are not significantly different. However, more studies have to be performed on this matter and on further survey.
- (v) Natural teeth or fixed prosthesis on natural teeth opposite dentition is not an a priori-improving prognosis factor for an implant-supported prosthesis.

Résumé

Cette étude a eu pour but d'évaluer le pronostic à moyen et long terme de prothèses fixées en porte-à-faux sur implants, et à quel degré celui-ci est influencé par des facteurs tels que longueur, type de porte-à-faux (mésial ou distal) et dentition opposée vs prothèses en porte-à-faux. Cet étude a été effectuée sur un échantillon de 38 patients partiellement édentés traités entre janvier 1994 et mars 2001 avec 49 prothèses fixées en porte-à-faux ancrées sur 100 implants. La résorption marginale (MBL) a été étudiée et utilisée comme paramètre de référence pour définir le succès thérapeutique. Les mesures MBL ont été rendues possibles en transposant sur ordinateur images RX des patients sélectionnés et en utilisant ensuite un logiciel. L'analyse statistique a été effectuée pour découvrir les relations possibles entre la résorption osseuse paroiplantaire et les paramètres considérés dans cette étude: longueur et type (mésial ou distal) de porte-à-faux et dentition opposée aux prothèses avec porte-à-faux. Sept années après la mise en place de ces prothèses, le taux de survie implantaire cumulatif total était de 98% et le taux de succès des prothèses de 100%. Les prothèses avec porte-à-faux mésial avaient un taux de succès plus faibles 97% que celles avec un porte-à-faux distal (100%). De plus il n'y avait pas de meilleur pronostic lorsque la dentition opposée à ces prothèses comprenait des dents naturelles ou des prothèses fixées sur dents naturelles comparées aux cas où les dents protagonistes étaient des prothèses fixées sur implants. Le pronostic à moyen terme des prothèses fixées avec porte-à-faux ancrées sur implants et les prothèses fixées traditionnelles ancrées sur implants sont donc comparables. Cependant une analyse prétraitement très poussée des facteurs de risque concernant la survie de la prothèse ancrée sur implant est importante.

Zusammenfassung

Implantatgetragene festsitzende Extensionsbrücken in teilbezahnten Kiefern.
Eine prospektive Studie über 7 Jahre.

Das Ziel der folgenden Studie war, die mittelfristige und langfristige Prognose von implantatgetragenen festsitzenden Extensionsbrücken zu ermitteln und den Einfluss verschiedener Faktoren wie Länge und Art der Extension (mesial oder distal) und Bezahlung im Gegenkiefer der Extensionsbrücke auf die Prognose der Extensionsbrücken zu untersuchen.

Die Studie wurde an einer Auswahl von 38 teilbezahnten Patienten durchgeführt, welche zwischen Januar 1994 und März 2001 mit 49 Extensionsbrücken auf 100 Implantaten versorgt waren.

Die marginale Knochenresorption (MBL) wurde untersucht und als Referenzparameter zur Definition eines therapeutischen Erfolges verwendet. Die MBL-Messungen wurden durchgeführt, indem ausgewählte Röntgenbilder der Patienten in einen PC eingesehen und dann mit Hilfe eines Programmes ausgewertet wurden.

Es wurde eine statistische Analyse durchgeführt, um mögliche Korrelationen zwischen der periimplantären Knochenresorption und den in dieser Studie vorgeschlagenen Parametern (Länge und Art (mesial oder distal) des Extensionsgliedes und Gegenbezahlung der Extensionsbrücke) besteht.

Nach sieben Jahren Belastung der Extensionsbrücken betrug die generelle kumulative Implantatüberlebensrate (OCSR) 97% und die Erfolgsrate der Rekonstruktionen betrug 98%. Brücken mit einem mesialen Extensionsglied zeigten eine geringere Erfolgsrate (97.1%) als Brücken mit einem distalen Extensionsglied (100%).

Es hatte keinen Einfluss auf die Prognose, wenn die Antagonisten der Extensionsbrücken aus natürlichen Zähnen, aus festsitzenden Brücken auf natürlichen Zähnen oder aus implantatgetragenen festsitzenden Rekonstruktionen bestanden.

Die Autoren ziehen die Schlussfolgerung, dass die mittelfristige Prognose von implantatgetragenen Extensionsbrücken mit der von traditionellen implantatgetragenen Brücken vergleichbar ist. Es ist jedoch

wichtig, vor der Behandlung eine genaue Analyse der Risikofaktoren bezüglich der Erfolgsaussichten einer implantatgetragenen Rekonstruktion durchzuführen.

Resumen

La intención del siguiente estudio fue evaluar el pronóstico de medio a largo plazo de prótesis fijas en extensión implantosportadas, y hasta que grado esto es influido por factores tales como la longitud, el tipo de extensión (mesial o distal), y dentición oponente frente a la prótesis en extensión.

Este estudio se llevó a cabo en una muestra de 49 pacientes parcialmente edéntulos tratados entre enero de 1994 hasta marzo de 2001 con 49 prótesis fijas en extensión soportadas por 100 implantes.

La reabsorción de hueso marginal (MLB) ha sido estudiada y usada como parámetro de referencia para definir el éxito terapéutico. La medición de la MLB fue posible por la transposición de imágenes radiográficas de los pacientes seleccionados en un PC y luego usando un programa de software.

El análisis estadístico de se llevo a cabo en las posibles correlaciones entre la reabsorción de hueso periimplantario y los parámetros considerados en este estudio: longitud y tipo (mesial o distal) de la extensión y dentición oponente a la prótesis en extensión.

Siete años tras cargar la prótesis en extensión, el índice tota acumulativo de éxito (OCSR) fue del 97%, y el índice de éxito de la prótesis fue del 98%. Las prótesis con extensión hacia mesial registraron un índice de éxito mas bajo (97.1%) que las prótesis con extensión distal (100%).

Mas aún, no se observó un mejor pronóstico cuando la dentición oponente de la prótesis constaba de dientes naturales o prótesis fija sobre dientes naturales, al compararla con los casos en que la

dentición oponente constaba de prótesis fija implantosportada.

Los autores concluyen que el pronóstico a medio plazo de prótesis fijas en extensión implantosportadas es comparable con el de las prótesis fija implantosportada tradicional. De todos modos, es importante llevar a cabo un análisis pretratamiento de los factores de riesgo con respecto a la supervivencia de prótesis implanto soportadas.

要旨

本研究では、インプラント支持のカンチレバー型固定式補綴物の中期及び長期予後を評価し、カンチレバーの長さやタイプ(近心か遠心か)、カンチレバー型補綴物に適合する歯列の状態などの要素がどの程度予後に影響するかを評価した。

本研究は1994年1月から2001年3月までの期間に治療を受けた部分無歯顎患者38人で、100本のインプラントが支持する49のカンチレバー型固定部分義歯について調査した。

辺縁骨の吸収(MBL)を検査し、治療の効果を判定する基準パラメーターとして用いた。MBLの測定は、選択した患者のレントゲン像をPC上で重ね合わせ、ソフトウェア・プログラムを用いて行った。統計解析ではインプラント周囲骨の吸収と、本研究で調べた次のパラメーター間の相関性について調べた:カンチレバーの長さやタイプ(近心か遠心か)、カンチレバー型補綴物の適合歯列の状態。カンチレバー型補綴物に荷重7年後のインプラントの総累積成功率(OCSR)は97%であったが、補綴物の成功率は98%であった。近心側のカンチレバーの方が(97.1%)、遠心側のものより(100%)成功率が低かった。さらに、適合歯列が天然歯列または天然支台に装着した固定式補綴物であった場合、インプラント支持の固定式補綴物の場合に比べ、より良い予後は観察されなかった。結論として、インプラント支持のカンチレバー型固定式補綴物の中期予後は、従来のインプラント支持固定義歯に匹敵するものである。しかし、インプラントが支持する補綴物の生存に関するリスク因子を術前に徹底的に分析する必要がある。

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