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# Patient-reported outcomes of dental implant therapy in a large randomly selected sample

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## **Abstract**

### Background

In addition to traditional clinical parameters, the need to include patient-reported assessments into dental implant research has been emphasized.

### Aim

The aim of the present study was to evaluate patient-reported outcomes following implant-supported restorative therapy in a randomly selected patient sample.

### Material & Methods

4716 patients were randomly selected from the data register of the Swedish Social Insurance Agency. A questionnaire containing 10 questions related to implant-supported restorative therapy was mailed to each of the individuals about 6 years after therapy. Associations between questionnaire data and (i) patient-related, (ii) clinician-related and (iii) therapy-related variables were identified by multivariate analyses.

### Results

3827 patients (81%) responded to the questionnaire. It was demonstrated that the overall satisfaction among patients was high. Older patients presented with an overall more positive perception of the results of the therapy than younger patients and males were more frequently satisfied in terms of esthetics than females. While clinical setting did not influence results, patients treated by specialist dentists as opposed to general practitioners reported a higher frequency of esthetic satisfaction and improved chewing ability. In addition, patients who had received extensive implant-supported reconstructions, in contrast to those with small reconstructive units, reported more frequently on improved chewing ability and self-confidence but also to a larger extent on implant-related complications.

### Conclusion

It is suggested that patient-perceived outcomes of implant-supported restorative therapy are related to (i) age and gender of the patient, (ii) the extent of restorative therapy and (iii) the clinician performing the treatment.

## **Introduction**

Research on dental implant therapy has traditionally focused on clinical and radiographic parameters. In addition to these outcomes, the need to include patient-reported measures into dental implant research has been emphasized (Locker 1998; Allen 2003; Strassburger et al. 2006).

Treatment with implant-supported overdentures has been shown to significantly increase oral-health related quality of life (Awad et al. 2014) and improve results in terms of comfort and esthetics (Cune et al. 1997). Self-perceived oral health status affects quality of life in general (McGrath & Bedi 1998; Locker et al. 2000).

Results from questionnaire studies among partially dentate subjects provided with implant-supported restorations revealed that about 90% were satisfied after 5-16 years (Pjetursson et al. 2005; Simonis et al. 2010). Although a high degree of patient satisfaction was reported, the interpretation of results is influenced by the selection and size of patient samples. Current information available on patient-reported outcomes is largely based on efficacy evaluations rather than on evaluation of effectiveness, i.e. the care provided to the general population under conditions found in general practice (Berglundh & Giannobile 2013). Hence, this limits the external validity as well as the analyses of potential factors related to the degree of satisfaction.

The adult population in Sweden is provided with a federal financial support for dental care. In 2003, the reimbursement system was modified, increasing the federal subsidies for implant-supported restorative therapy for patients  $\geq 65$  years of age. Out-of-pocket expenditure for this group was limited to about \$1000, regardless of the extent of the implant therapy. In contrast, patients  $< 65$  years had to cover about half of the actual costs themselves. The majority of implant therapy in Sweden was performed in patients  $\geq 65$  years between 2003 and 2008 when the reimbursement system was changed.

Both public and private providers offer dental care in Sweden. The federal reimbursement administered by the Swedish Social Insurance Agency (SSIA) is similar, regardless of the clinical setting.

Using the data register of the SSIA, the aim of the present study was to evaluate patient-reported outcomes following implant-supported restorative therapy in a randomly selected patient sample.

## **Material & Methods**

The protocol for this register-based questionnaire study was approved by the regional Ethical Committee, Gothenburg, Sweden (Dnr 290-10).

### *Study population*

The data register of the SSIA was searched for subjects who had been granted financial support for implant-supported restorative therapy in 2003. Subjects between 65 and 74 years of age in 2003 were identified and from this pool of about 23000 individuals, 3000 were selected following a simple random sampling procedure. A second sample, comprised all subjects in the age of 45-54 years (n=1716). Thus, the total study sample included 4716 patients in two age groups, all provided with implant-supported restorative therapy.

### *Data Register*

Information about gender, type of implant-supported dental prostheses and clinicians involved in the treatment was extracted from the data register of the SSIA and entered into a database. Patients were categorized according to the type of implant-supported restorative therapy, i.e. (i) single crown, (ii) partial jaw restoration, or (iii) full-jaw restoration. In case of multiple reconstructions, the patient was classified according to the most extensive restoration. Further categorization included anterior/posterior and maxillary/mandibular location. Restorative therapy involving the region 13-23 or 33-43 was considered as anterior.

Clinicians involved in the treatment were categorized with regard to (i) private or public dental clinical setting and (ii) general practitioner or registered specialist by the Swedish National Board of Health and Welfare at the time of treatment. For surgical treatment, specialists in oral/maxillofacial surgery and periodontics were considered, while prosthetic treatment involved specialists in prosthodontics, stomatognathic physiology and periodontics.

### *Questionnaire*

A questionnaire was developed and mailed to all patients about 6 years following the completion of the implant-supported restorative therapy. A reminder was sent 4 weeks later. The questionnaire consisted of ten questions of multiple-choice character. The initial 7 questions (primary questions) related to the degree of satisfaction, while the remaining three questions (secondary questions) were aiming at background information. The participants were also invited to give written comments related to the implant therapy.

### *Data analysis*

Demographic data and information on the implant-supported restorative therapy were expressed in mean values and frequency distributions. Questionnaire data were reported as frequency distributions and analyzed for associations with (i) patient-related, (ii) clinician-related and (iii) therapy-related variables.

Chi-Square testing was used for initial bivariate analyses. Significant factors from the bivariate testing were entered as independent variables into a multivariate logistic regression model for each of the questions. Answers to each question were transformed into dichotomous values, indicating positive or negative answers, and were entered as the dependent variable. For the factor "clinician", two categories were established: (i) "general", if both surgical and prosthetic therapy had been performed by a general practitioner and (ii) "specialist", if either or both of the procedures had been performed by a specialist. Supportive care was considered "regular" if the patient reported annual follow-up visits. Two secondary questions (questions 8 and 9) were entered as independent factors into the analyses (Table 1).

The coefficients of the parameter estimates were transformed into odds ratios (OR). In addition, 95% confidence intervals were calculated. All statistical tests were conducted at a significance level of  $p < 0.05$  (SPSS 21.0, SPSS Inc., Chicago, IL, USA).

## Results

Characteristics of the random sample and the respondents are described in Table 2. A total of 3827 patients (81%) responded to the questionnaire. The response rate was higher for the older age group (83%) than the younger individuals (77%). The proportion of females in the random sample and among the respondents was 54% and 55%, respectively. No differences were detected between responders and non-responders in terms of (i) clinical setting, (ii) clinicians and (iii) type of therapy.

Information on clinicians is presented in Table 3. Private clinical setting dominated (64 %). Surgical treatment had predominantly been carried out by specialists (74 %), while the prosthetic part of the therapy had mostly been performed by general practitioners (76 %).

The distribution of single crown, partial and full jaw restorations is illustrated in Table 4. In comparison to the younger age group, the 65-74 year group showed a larger proportion of full (34% vs. 14%) and partial jaw restorations (49% vs. 34%), while single-implant restorations were less common (17% vs. 52%). In addition, the number of implants per patient was larger in the older than in the younger age group (4.9 vs. 2.6).

### *Questionnaire*

The results of the descriptive analysis of the questionnaire data are presented in Table 5. The majority of patients were satisfied with the overall (question 1: 94%) and the esthetic result (question 2: 94%) of the implant-supported restorative therapy. About two thirds of all respondents reported that the therapy had improved their chewing ability (question 3) and self-confidence (question 4). 31% of all patients reported experience of complications with their implant-supported restorations (question 5). More than 80% considered that the therapy was worth the cost (question 6) and that, given the same circumstances, they would consider implant therapy again (question 7). In 55% of all cases, a dental professional had recommended the implant therapy (question 8). Tooth extraction had been performed less than 6 months prior to implant therapy in about 50% of the patients (question 9), while the corresponding time period was longer than two years in 11%. Regular follow-up visits were reported by 79% of the patients (question 10).

### *Multivariate regression analyses*

The results from the multivariate logistic regression analyses are reported in Table 6. Overall satisfaction (question 1) was rated higher in the older than the younger age group (OR 2.1). Males (OR 1.5), older subjects (OR 2.1) and patients who had received reconstructions in anterior locations only (OR 2.0) were more frequently satisfied in terms of esthetics than females, younger

subjects and patients with restorative therapy in a posterior location (question 2). Conversely, patients treated by general practitioners reported esthetic satisfaction less frequently than patients treated by specialists (OR 0.7).

Improved chewing ability (question 3) was more commonly reported by older patients (OR 2.2) and by patients who had received partial jaw as opposed to single crown restorations (OR 2.0). Patients reporting less frequently on improved chewing ability had been treated by general practitioners (OR 0.8), had received reconstructions only in anterior locations (OR 0.6) or in the maxilla (OR 0.6) and had tooth extraction performed less than 6 months prior to therapy (OR 0.7).

Improved self-confidence (question 4) was positively associated with older age (OR 1.3), partial jaw restorations when compared to single crowns (OR 1.8), as well as initiative towards therapy taken by the patient as opposed to dental professionals (OR 1.7), while the opposite was found for restorations only in anterior locations (OR 0.5) and tooth extraction <6 months prior to therapy (OR 0.6).

Patient-reported complications were more common among patients with partial jaw than with single crown restorations (OR 1.4) and more frequent among those with full jaw as opposed to partial jaw or single crown restorations (OR 1.6).

Positive answers to the questions on whether the patient considered the cost of the implant therapy worthy (question 6) and would consider implant therapy again (question 7) were more frequent in the older patient group (OR 1.5-2.2) and among patients who had taken the initiative towards therapy (OR 1.3-1.6) as opposed to an initiative taken by dental professionals. Patients with partial jaw restorations reported that they would consider implant therapy again more frequently than patients with single crown restorations (OR 1.4). The initiative to implant therapy taken by the patient rather than dental professionals (question 8) was negatively associated with a short time period (< 6 months) between tooth extraction and implant therapy (OR 0.7). A period of edentulism (question 9) <6 months was less frequent (OR 0.6) among patients treated in a public than in a private clinical setting.

Regular follow-up visits (question 10) were less frequently reported by (i) males (OR 0.7), (ii) patients treated in a public than in a private clinical setting (OR 0.6) and (iii) patients treated with full jaw as opposed to partial jaw or single crown reconstructions (OR 0.6). Patients in the older age group (OR 2.1) and patients treated with partial jaw as opposed to single crown restorations (OR



1.5) reported regular follow-up visits more frequently.

## **Discussion**

In the present study data on patient-reported outcomes 6 years after implant-supported restorative treatment in a large, randomly selected group of patients were evaluated. It was demonstrated that the overall satisfaction among patients was high and that several factors influenced reported outcomes. Older patients presented with an overall more positive perception of the results of the therapy than younger patients and males were more frequently satisfied in terms of esthetics than females. While clinical setting did not influence results, patients treated by specialist dentists as opposed to general practitioners reported a higher frequency of esthetic satisfaction and improved chewing ability. In addition, patients who had received extensive implant-supported reconstructions, in contrast to those with small reconstructive units, reported more frequently on improved chewing ability and self-confidence but also to a larger extent on implant-related complications. It is suggested that patient-perceived outcomes of implant-supported restorative therapy are related to (i) age and gender of the patient, (ii) the extent of restorative therapy and (iii) the clinician performing the treatment.

Few studies have evaluated patient-reported outcomes in implant dentistry assessed in long-term follow-up. Pjetursson et al. (2005) and Simonis et al. (2010) used questionnaires to assess patient satisfaction following implant therapy after 5-16 years. It was reported that more than 90% of all patients were satisfied with the treatment outcome, a figure that corroborates the findings presented in the current study. While the patients in the studies by Pjetursson et al. (2005) and Simonis et al. (2010) represented so-called convenient samples of small sizes, the material in the current study included more than 3800 randomly selected patients who, in addition, were treated in varying clinical settings and by a multitude of clinicians. It may be suggested that the present study sample not only constitutes a true cohort (Tonetti & Palmer 2012), it also applies to everyday clinical practice, i.e. an evaluation of effectiveness rather than efficacy (Berglundh & Giannobile 2013).

Cune et al. (1995; 1997) selected over 5000 Dutch patients provided with implant-supported restorative therapy from an insurance database. Similar to the findings in the present study, specialist dentists had performed 68% of the implant surgeries while general practitioners had mostly carried out the prosthetic part of the therapy. Patient-centered outcomes were positive but based only on a subsample of 460 patients. In addition, only patients with implant-supported overdentures were included.

The questionnaire used in the present study was self-developed and was not assessed in terms of validity and reliability (McGrath et al. 2012). The questions were simply phrased and similar to

those used by Pjetursson et al. (2005) and Simonis et al. (2010). It should also be noted that the present data included assessments of patient satisfaction from a single time point only. Information on the restorative therapy was extracted from the data register of the SSIA. Details regarding implant brands as well as design and retention of supraconstructions were not accessible.

A critical value in mail-distributed, self-reported questionnaire studies is the response rate (Locker 2000). Although not addressing questions related to implant therapy, Carlsson et al. (2008) in a questionnaire study on attitudes toward dental appearance in 17000 randomly selected Swedish adults reported a response rate of 72%. Johannsen et al. (2012) mailed questionnaires to 400 patients 1-2 years after implant-supported restorative therapy performed at one dental clinic and presented a response rate of 61%. Hence, the response rate of 81% in the current study on 4716 subjects should be considered high.

In the present study subjects in the older age group were more frequently satisfied, both from an overall and from an esthetic perspective. These observations are partly in agreement with findings described by Siadat et al. (2008) who evaluated patient satisfaction in 55 patients provided with implant-supported mandibular overdentures. They reported that older patients were more satisfied in terms of esthetics, while no differences were observed for the degree of overall satisfaction. The present study also demonstrated that females were less frequently satisfied in regard to the esthetic outcome. This finding is in contrast to results reported by Pan et al. (2008). They assessed patient satisfaction in subjects treated with implant-supported mandibular overdentures and reported no gender differences 12 months after prosthesis delivery. The results obtained in the present study further revealed that the type of clinician, i.e. specialist versus general practitioner, influenced the esthetic appreciation of the therapy but not the general satisfaction. This finding is partly in agreement with results presented by Esfandiari et al. (2006). They compared patient ratings of satisfaction after implant treatment and reported that no differences were found between those treated by experienced specialists or recently graduated dentists. It should be noted, however, that the comparison between categories of clinicians in the study by Esfandiari et al. (2006) was limited to the prosthetic part of therapy. In addition, no specific assessment of the esthetic appreciation was performed.

In a study on 40 patients receiving implant-supported restorative therapy Yi et al. (2001) demonstrated a high degree of patient satisfaction in terms of oral function and no differences between patients provided with full or partial jaw restorations were observed. Although the results of the present study are in agreement with the study by Yi et al. (2001), it should be noted that

patients with partial jaw restorations reported improved chewing ability and self-confidence more frequently than patients with single crown restorations. The study by Yi et al. (2001) did not include single crown restorations.

Although the results in the present study revealed that the overall satisfaction among patients was high, 31% of all patients had experienced an implant-related complication. Data on self-reported complications are rarely reported. On the other hand, it should be noted that the present results corroborate findings presented in systematic reviews on clinical and radiographic outcomes of implant-supported restorative procedures on single crowns (Jung et al. 2012) and fixed dental prostheses (Pjetursson et al. 2012). In the reviews it was reported that extensive restorations were associated with a higher risk of complications when compared to single crowns.

The results of the present study revealed that 79% of all patients reported regular (annual) follow-up visits following implant therapy. This frequency is lower than that presented in a study on 400 Swedish implant-carrying subjects by Johannsen et al. (2012). They observed that 93% of all patients reported annual follow-up visits. It should be noted, however, that the observation period in the study by Johannsen et al. (2012) was 1-2 years, whereas the present study described a period of 6 years.

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Table 1: Factors analyzed in bivariate and multivariate analyses.

Gender	Male / Female
Age group	45-54 years / 65-74 years
Clinician	General practitioner / Specialist
Clinical setting	Public dental clinic / Private dental clinic
Implant-supported restorative therapy	Single crown / Partial jaw / Full jaw restoration
Location	Anterior (only) / Other
Jaw	Maxilla / Mandible / Both
Question 8 Who suggested the implant therapy?	Myself / Dental professional
Question 9 How long before implant therapy was the tooth extraction performed?	<6 months / ≥6 months

Table 2: Characteristics of the random sample and the respondents.

	Age Group	n	Female (%)
Random sample	45-54	1716	58
	65-74	3000	52
	<b>Total</b>	<b>4716</b>	<b>54</b>
Respondents	45-54	1325	60
	65-74	2502	52
	<b>Total</b>	<b>3827</b>	<b>55</b>

Table 3: Clinical setting and clinicians providing the implant therapy (respondents).

Age Group	n	Clinical Setting				Clinician - Surgical Treatment			Clinician - Prosthetic Treatment		
		Public	Private	Mix	Unclear	General practitioner	Specialist	Unclear	General practitioner	Specialist	Unclear
45-54	1325	46%	44%	9%	1%	22%	73%	5%	71%	28%	1%
65-74	2502	17%	74%	6%	3%	23%	73%	3%	79%	21%	0%
<b>Total</b>	<b>3827</b>	<b>27%</b>	<b>64%</b>	<b>8%</b>	<b>1%</b>	<b>23%</b>	<b>74%</b>	<b>3%</b>	<b>76%</b>	<b>23%</b>	<b>1%</b>

Table 4: Distribution of provided restorations (respondents).

Age Group	Number of restorations	Full jaw restorations (Number of restorations and patients)	Partial jaw restorations (Number of restorations and patients)	Single restorations (Number of restorations and patients)	Average number of implants per individual (Standard Deviation)
45-54	1606	222 / 188	545 / 444	839 / 764	2.6 (2.3)
65-74	3791	1301 / 1045	1848 / 1307	642 / 518	4.9 (2.9)
<b>Total</b>	<b>5397</b>	<b>1523 / 1233</b>	<b>2393/ 1751</b>	<b>1481 / 1282</b>	<b>4.1 (3.0)</b>



Table 5: Primary and secondary questions: frequency distributions of answers; shading indicates dichotomous grouping for bi- and multivariate analyses (n = 3827).

Primary questions		Fully satisfied	Rather satisfied	Not satisfied	No answer	
	1	Are you satisfied with the overall result?	66.6%	27.0%	5.4%	1.0%
	2	Are you satisfied with the esthetic result?	64.7%	29.2%	4.4%	1.7%
			Greatly improved	Somewhat improved	No improvement	No answer
	3	Has the implant therapy improved your chewing ability?	53.9%	16.0%	28.1%	2.0%
			Much more secure	Somewhat more secure	No improvement	No answer
	4	Has the implant therapy improved your self-confidence?	50.5%	14.8%	32.3%	2.4%
			Never	Yes, but rarely	Yes, frequently	No answer
	5	Have you experienced any complications?	64.6%	24.7%	6.0%	4.7%
			Yes	Doubtful	No	No answer
6	Was the implant therapy worth the cost?	84.4%	9.7%	3.1%	2.8%	
7	Would you consider implant therapy again?	83.4%	10.5%	2.7%	3.4%	
Secondary questions		Myself	Dental professional	No answer		
	8	Who suggested the implant therapy?	41.2%	54.6%	4.2%	
			< 6 months	6 months - 2 years	> 2 years	No answer
	9	How long before implant therapy was the tooth extraction performed?	48.1%	27.8%	10.6%	13.5%
			Yearly	Every second year	No	No answer
10	Have you attended regular follow-up visits?	79.1%	10.1%	8.7%	2.1%	

Table 6: Multivariate logistic regression analyses: Odds ratio (Confidence Interval 95%)

			Gender	Age group	Clinician	Clinical setting	Implant-supported restorative therapy		Location	Jaw	Question 8 Suggestion	Question 9 Tooth extraction
			Male vs. female	Older vs. younger	General practitioner vs. specialist	Public vs. private	Full vs. partial jaw/single	Partial jaw vs. single	Anterior (only) vs. other	Maxilla vs. mandible	Myself vs. dental professional	<6 months vs. ≥6 months
		significant in bi- and multivariate analysis ( $p < 0.05$ )										
1	Overall satisfaction	Odds ratio - positive answer		2.11 (1.54; 2.88)								
2	Esthetic satisfaction	Odds ratio - positive answer	1.46 (1.06; 2.03)	2.07 (1.47; 2.92)	0.66 (0.47; 0.94)				1.97 (1.10; 3.53)			
3	Chewing ability	Odds ratio - positive answer		2.16 (1.78; 2.62)	0.81 (0.66; 0.98)			2.02 (1.61; 2.54)	0.55 (0.37; 0.81)	0.60 (0.49; 0.74)	1.79 (1.50; 2.14)	0.65 (0.55; 0.78)
4	Self-confidence	Odds ratio - positive answer		1.26 (1.07; 1.50)				1.82 (1.48; 2.25)	0.49 (0.35; 0.69)		1.67 (1.43; 1.96)	0.60 (0.51; 0.70)
5	Complications	Odds ratio - answer: "yes"					1.55 (1.15; 2.08)	1.42 (1.15; 1.75)				0.80 (0.69; 0.93)
6	Was the implant therapy worth the cost?	Odds ratio - positive answer		2.15 (1.71; 2.70)							1.26 (1.02; 1.57)	1.29 (1.05; 1.60)
7	Would you consider implant therapy again?	Odds ratio - positive answer		1.46 (1.18; 1.80)				1.40 (1.07; 1.83)			1.58 (1.28; 1.94)	
8	Suggestion	Odds ratio - answer: "myself"										0.65 (0.56; 0.75)
9	Tooth extraction	Odds ratio - answer: "<6 months"				0.64 (0.54; 0.75)					0.63 (0.54; 0.73)	
10	Follow-up visits	Odds ratio - answer: "regular"	0.73 (0.61; 0.87)	2.05 (1.66; 2.52)		0.59 (0.49; 0.80)	0.55 (0.38; 0.78)	1.52 (1.17; 1.98)			0.76 (0.64; 0.91)	