Patient Evaluation of Treatment with Fixed Prostheses Supported by Implants or a Combination of Teeth and Implants

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Purpose: **The objective of this study was to compare treatment outcomes among subjects with complete arch fixed prostheses in the maxilla, supported by implants or a combination of natural teeth and dental implants.**

Materials and Methods: **Twenty-one subjects with maxillary tooth- and implant-supported fixed prostheses and 21 subjects with maxillary implant-supported fixed prostheses were identified and included in the study. All abutment teeth in the group with tooth- and implant-supported prostheses were provided with cemented copings that incorporated threads for vertical locking screws. Frameworks were fabricated with a gold alloy that was veneered with acrylic resin or ceramic materials. All frameworks were screw-retained to implants and copings. Frameworks in the group with implant-supported prostheses were fabricated with milled titanium or gold alloy to which denture teeth and resin base material were applied. All prostheses had a minimum of 8 units, at least 4 of which were in one quadrant. Subjects in both groups were mailed a questionnaire consisting of 15 questions focused on various factors related to treatment outcome, such as oral function and patient satisfaction.**

Results: **The response rate was 86%. Both groups reported a high satisfaction rate for most items with few regretting their choice of treatment. Most individuals in both groups reported great improvement in chewing ability and few reported phonetic disturbances. No statistically significant differences were found between the groups.**

Conclusion: **The results of the present study showed similarity in questionnaire responses between the 2 groups of participants. High satisfaction was reported both among subjects who received a complete arch fixed prosthesis in the maxilla supported by dental implants only, as well as among those whose prostheses were supported by a combination of natural teeth and dental implants.**

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EXCELLENT LONG-TERM follow-up results have been reported for patients receiving treatments with implant-supported complete arch fixed prostheses.[1-5] Using this technique, patients with reduced masticatory function and poor esthetics may be successfully rehabilitated and evidence suggests an improved life quality after dental implant therapy.[6-11] Implants in the maxilla have shown somewhat lower survival rates, however, when compared to the mandible.[2,12-14]

Reports from North America and countries in Western Europe indicate that the incidence of edentulism among older individuals is decreasing.[15-18] Among partially edentulous individuals, treatment options using natural teeth and dental implants together as abutments for fixed prostheses have shown good long-term results.[19,20] Compared to treatment with removable dentures, fixed prostheses supported by implants, or by natural teeth and implants together, may provide improvement in chewing ability, oral comfort, and life quality. The mobility and periodontal health

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of abutment teeth, framework dimension, and distance between implant and abutment tooth are important factors, however, and should always be considered in planning such treatments.[21]

There are different tactile functions involved when comparing a natural tooth with a dental implant.[22] Mechanoreceptors in the periodontal ligament contribute to the tactile function of teeth, providing information about the forces striking the individual tooth.[22,23] Although implants lack such receptors, some exteroceptive functions from receptors in mucosa and the jawbone do exist.[22-24] It is unknown to what extent patients with tooth- and implant-supported prostheses perceive receptors in the periodontal ligament during chewing.

Speech is another important aspect of oral function. Studies of speech performance in patients with maxillary implant-supported fixed prostheses suggest that phonetic problems may occur.[25-27] The extent to which similar problems exist among individuals with tooth- and implant-supported prostheses in the maxilla has not been studied.

The objective of the present study was to compare and evaluate treatment outcomes among subjects with complete arch fixed prostheses in the maxilla, supported either by implants alone or by a combination of natural teeth and dental implants. The hypothesis of the study was that there are no differences between these 2 groups in terms of self-assessed oral function, comfort, or personal perception of esthetic appearance.

Materials and Methods

All 77 patients treated with maxillary Tooth- and Implant Supported fixed Prostheses (TISP) in the Department of Prosthetic Dentistry, Central Hospital in Skövde, Sweden from 1989 to 2002 were identified from patient records. Of those, 21 individuals fulfilled the criteria for inclusion in this study, which were:

1. Each subject should have a minimum of 2 natural teeth serving as abutments for the prosthesis together with the implants.
2. The prosthesis should have a minimum of 8 units of which at least 4 are in one quadrant.
3. The subject should have worn the prosthesis for at least 12 months.

An identical procedure was used to identify subjects who had been treated with maxillary complete Implant Supported Prostheses (ISP). Twenty-one subjects who matched the subjects in the TISP group with respect to age, gender, and time they had worn their prosthesis were randomly selected from the pool of 233 subjects who fulfilled the criteria for inclusion in the study. Except for the first criteria, the inclusion criteria for the subjects in the ISP group were identical with those of the TISP group.

Figure 1. Complete maxillary tooth- and implant-supported prosthesis with a gold-alloy framework and acrylic resin veneers, designed with copings on the abutment teeth and vertical screw joints.

All abutment teeth among the subjects in the TISP group were provided with cemented gold alloy copings designed with threads for vertical locking screws (Fig 1). Gold alloy prosthesis frameworks were fabricated with acrylic or ceramic veneers and were screw retained to implant abutments and copings (Fig 2). For subjects in the ISP group, milled titanium or cast gold alloy frameworks were fabricated with acrylic resin denture teeth and base material (Fig 3). Information about reason for choosing the treatment, the patient's medical condition, cause of tooth loss, and existing dentition in the mandible was available and included.

A questionnaire with 15 questions about the treatment was sent to all subjects in both groups. Those who had not responded within 3 weeks were sent a reminder and a new questionnaire. The questions addressed factors related to treatment outcome, such as oral function and patient satisfaction, and were the same or similar to those used in other surveys on patients' attitudes.[6-11]

All items had visual analog scale (VAS) response alternatives ranging from a negative to a positive with a high numeric value representing a more positive opinion. The VAS was later coded in 10 equidistant steps by the author. For example, for item No. 5, "Was it difficult to adapt to the prosthesis after placement?" the VAS ranged from the negative "Yes, very" to the positive "No, not at all." The responders were invited to add their own comment to each answer if they wished.

Figure 2. Occlusal view of a complete maxillary tooth- and implant-supported prosthesis.

Statistical Methods

Data were analyzed using descriptive statistics. Mann-Whitney U test was used for testing significance since the variables were not normally distributed. The level of significance was set at $p \leq 0.05$. All data analyses were performed using SPSS, version 6.1 for the Macintosh.

Results

Thirty-six individuals responded, 17 in the TISP group and 19 in the ISP group, yielding a response rate of 86%. Of those who responded in the TISP group, the mean age was 71.4 years (range 58–85 years); 8 were men and 9 were women. Among the responders in the ISP group, the mean age was 73.4 years (range 57–84 years); 8 were men and 11 were women. Of the non-responders, 1 had moved, 3 had died, and the others simply did not reply.

Figure 3. Complete maxillary implant-supported prosthesis fabricated with a milled titanium framework, resin denture teeth, and base material.

The mean length of time a prosthesis had been in service was 7.9 years (range 1–13 years) for the TISP group and 8.3 years (range 1.5–13 years) for the ISP group (Tables 1 and 2). Difficulties in accepting a removable denture represented the most common reason for treatment choice (Table 3). Both groups expressed a high satisfaction rate for most items and few regretted their treatment choice (statement No. 15, Table 4). Subjects in both groups reported that they seldom used their teeth other than for chewing (No. 9). Subjects in both groups reported a great improvement in chewing ability after prosthodontic treatment, and few reported phonetic disturbances. Although the survey demonstrated minor differences in satisfaction with esthetics in favor of the ISP group and small preference for the TISP group relative to prosthesis hygiene, neither of these differences was statistically significant ($p > 0.05$).

Discussion

The use of dental implants in the rehabilitation of edentulous or partially edentulous patients is a successful treatment modality and improves oral function and life quality;[6–8] however, no patient-based assessments after treatment with fixed prosthodontics in the maxilla where natural teeth and implants are used together as abutments have been reported.

The results from the present study showed a striking similarity in most responses between the two treatment groups. Even if the prosthodontic treatment may have been somewhat more complicated for the subjects in the TISP group, this did not seem to have influenced patient reaction to these prostheses. An overall high satisfaction rate was seen for the questions regarding oral function, esthetics, and adaptation. The results are similar to the findings in other studies on patient satisfaction after implant treatment.[6–8] In a patient opinion survey, edentulous patients rehabilitated with a fixed implant-supported prosthesis in the maxilla reported significant improvement in eating comfort, esthetics, and overall satisfaction compared to when they wore conventional dentures.[8]

Although the subjects in the TISP group had a few remaining teeth in the maxilla which could have been of value for the retention of a removable denture, they had about the same assessment after treatment as did the subjects in the ISP group, all

Table 1. Distribution of Abutment Teeth (A), Implants (I), Pontics (P), and Time in Service for Fixed Tooth- and Implant-Supported Maxillary Prostheses (n = 17)

		*No. and Positions of Units**											
Prosthesis no.	Time in service (years)	16	15	14	13	12	11	21	22	23	24	25	26
1	13	P	I	P	P	I	A	A	P	A	A	A	P
2	12	P	I	P	I	P	A	A	P	I	P	I	P
3	12		P	I	P	A	P	I	I	A	P	P	
4	12	A	P	I	A	I	P	P	P	I	I	P	
5	10	P	I	I	P	I	A	A	P	P	I	I	P
6	10		P	A	A	I	P	A	I	I	I	P	
7	10		P	I	I	I	A	I	I	A	I	P	
8	8	I	I	I	I	A	A	I	I	P	I	I	
9	7		P	I	P	A	A	A	P	I	I	P	
10	7	A	A	P	A	A	I	P	I	I	I	P	
11	6		P	I	I	A	A	A	P	P	I	P	
12	6		P	A	A	I	P	P	P	I	I	I	
13	5		I	I	I	P	A	A	P	A	P	P	A
14	5		P	P	I	I	P	A	A	A	I	I	I
15	3	P	I	I	I	P	A	A	I	A	I	I	P
16	2	P	I	P	A	I	A	I	P	I	P	I	P
17	1	I	I	I	I	P	P	A	I	A	I		

*Fédération Dentaire Internationale tooth-numbering system.

of whom were fully edentulous in the maxilla. If any differences between the two groups in evaluation of oral function had occurred immediately after prosthesis connection, such differences were not demonstrated in this survey. It should be recognized that the prostheses had been in service for more than 5 years among most subjects in both groups at the time of the study.

Speech difficulties have been reported after prosthodontic treatment with implant-supported prostheses.[5,7,21-23] Although such difficulties are reported to decrease after the patient has adapted to the prosthesis, some patients continue to experience speech difficulties several years after treatment.[5,7,21] In the present study, the number of subjects reporting phonetic disturbances after treatment was surprisingly low in both groups and contrasted with the findings in other studies. In a previous report 33% of those interviewed described phonetic problems soon after prosthesis insertion and almost 20% reported ongoing problems after 7–10 years.[7] Those with maxillary prostheses reported significantly more speech problems compared to those who had prostheses in the mandible.

One survey question asked about oral function other than chewing (question 9) and was included to evaluate if such activities existed. Responses to this question demonstrated that few subjects acknowledge such activities (Table 4). Several of

Table 2. Distribution of Number of Implants, Units, and Time in Service for Maxillary Implant-Supported Prostheses (n = 19)

Prosthesis No.	*No. of Implants*	*No. of Units*	*Time in Service (years)*
1	6	12	13
2	6	12	12
3	4	10	11
4	6	12	10
5	6	12	10
6	5	12	10
7	5	10	8
8	5	12	7
9	4	10	7
10	6	11	7
11	6	12	6
12	6	10	6
13	6	12	5
14	4	10	4
15	6	12	3
16	6	12	3
17	6	12	3
18	5	12	1.5
19	6	12	1

Table 3. Distribution of Patients on Their Reported Reasons for Treatment with Fixed Restorations (n = 36)

Reason for Treatment	*TISP Group (n = 17)*	*ISP Group (n = 19)*
Psychological	2	-
Severe gag reflexes	2	1
Problems when eating	4	9
Difficulties accepting a removable denture	9	9

Table 4. Distribution of Mean Values of Responses to Questionnaire Questions

Variable	*TISP Group (n = 17)*	*SD*	*ISP Group (n = 19)*	*SD*	*Both Groups (n = 36)*	*SD*
1. "In all, are you satisfied with the function of the prosthesis after it was placed?"	8.2	2.0	8.8	1.6	8.5	1.8
2. "Are you often reminded that you have an artificial device in your mouth?"	8.2	2.7	8.4	2.4	8.2	2.5
3. "Do you experience your present prosthesis as more artificial compared with your previous dental status?"	9.0	2.0	8.7	1.5	8.7	1.5
4. "How do you manage to chew your food, compared with the situation before the treatment?"	8.5	1.8	8.4	1.7	8.4	1.7
5. "Was it difficult to adapt to the prosthesis after placement?"	8.8	1.6	8.7	1.8	8.8	1.7
6. "Does your prosthesis feel 'more natural' today compared to the situation immediately after placement?"	5.7	3.6	6.5	3.7	6.2	3.6
7. "Does the prosthesis feel clumsy in your mouth?"	8.5	2.4	9.2	1.5	8.8	2.0
8. "Can you chew all kinds of food without difficulty?"	8.9	1.6	9.5	1.0	9.2	1.4
9. "Do you often use your teeth for other things than to chew, for example to bite off a sewing thread or similar?"	1.3	0.6	2.2	2.5	1.8	1.9
10. "Has your speech been affected after you received the prosthesis?"	8.2	2.6	8.6	1.8	8.5	2.3
11. "Do you have permanent lisping problems or difficulties pronouncing certain words or letters?"	8.9	1.9	9.0	1.4	9.0	1.7
12. "Can you maintain good hygiene around the prosthesis?"	9.1	1.2	7.4	3.2	8.2	2.6
13. "Are you satisfied with the esthetic appearance of the prosthesis?"	7.6	3.1	9.1	1.3	8.4	2.5
14. "Has the outcome of the treatment fulfilled your expectations?"	8.1	2.6	9.4	1.2	8.8	2.1
15. "Have you ever regretted choosing this treatment?"	9.4	1.4	9.8	0.4	9.6	1.1
16. "Do you consider the time and money spent on the treatment worthwhile?"	9.2	1.6	9.3	1.2	9.2	1.4
17. "Would you choose the same treatment today if you had the option?"	9.2	2.1	9.4	1.7	9.3	1.9

the responders stated that they were afraid to use their teeth in a way that would risk causing damage to their prosthesis, which might be a possible explanation of these low values.

When natural teeth and implants together are combined to support fixed prostheses, it is of special interest to consider the role of periodontal mechanoreceptors in oral sensory and motor functions. Earlier studies clearly indicate different sensory and motor functions for subjects with natural teeth compared to subjects who lack periodontal receptors. For example, subjects with implant-supported restorations demonstrate striking disturbances in the control of certain low-force jaw motor behaviors, compared to subjects with natural teeth.[19] Furthermore, in a comparative study of overdentures supported by natural roots or dental implants, significantly lower thresholds were observed in patients with natural roots.[21] Discriminatory ability was also higher in subjects with overdentures supported by natural roots compared to those with implant-supported overdentures. In the present study, subjects in the TISP group did not seem to evaluate factors related to oral function and speech differently than subjects wearing implant-supported prostheses. Number and position of abutment teeth differed among the subjects in the TISP group. Most had only 2 natural teeth, which together with dental implants served as abutments for their prostheses (Table 1). It is possible that the rigid connection between the multiple implants and natural teeth limited feedback from the periodontal mechanoreceptors. When a fixed partial denture supported by 1 tooth and 1 implant is loaded, factors such as flexibility of the screw joint, elasticity of the bone, and the distance between the abutment tooth and the implant influence the magnitude of the

axial movement and bending moment.[18] In such smaller, less rigid superstructures the periodontal mechanoreceptors may be more likely to play a role.

Further clinical and experimental studies are needed in order to evaluate the impact of natural teeth in combination with dental implants as abutments for fixed prosthodontics.

Conclusion

The results from the present study demonstrate no statistically significant differences in responses to a questionnaire on oral function and patient satisfaction among subjects with dental implants alone and those with a combination of natural teeth and dental implants to support fixed maxillary prostheses. High satisfaction was registered for oral function, esthetics, speech, and prosthesis adaptation.

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