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# Outcome of Treatment with Implant-Retained Dental Prostheses in Patients with Sjögren Syndrome

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The purpose of this investigation was to evaluate the outcome of treatment with implant-retained prostheses in patients suffering from Sjögren syndrome. Eight women were included in the study; all had suffered oral symptoms of Sjögren syndrome for many years. Seven patients were edentulous in both arches, and 1 patient was edentulous in the maxilla only. All patients reported poor or very poor comfort levels with their conventional dentures. It was the intention to treat each arch that showed subjective and objective denture problems with a complete fixed prosthesis after placement of 6 implants. In all, 54 Brånemark dental implants were placed in these patients. No implants were lost, but 7 implants in 4 patients were clinically not osseointegrated at the time of the abutment connection procedure. Because of nonosseointegrated implants and lack of jawbone, 3 arches were treated with an implant-retained overdenture. Fixed prostheses were made with a titanium framework of premachined components welded together (Procera) and acrylic resin teeth and flanges. Patients answered a questionnaire regarding their oral function before the onset of treatment and 1 month and 2 years after treatment. An average radiographic bone loss of 0.7 mm from the time of implant placement to 1 year after treatment was observed; additional bone loss of less than 0.6 mm was recorded 4 years after treatment. During the first year of function 2 implants lost osseointegration. No prostheses were lost or remade. Treatment with implant-retained prostheses considerably increased the prosthetic comfort and function of the patients. Two years after prosthetic treatment, only 1 patient indicated poor comfort of the prostheses, while the remaining patients reported good or very good comfort levels.

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**T**he primary oral symptom of Sjögren syndrome is xerostomia. Patients suffering from Sjögren syndrome are divided into primary and secondary cases. In patients with primary Sjögren syndrome, feelings of ocular and oral dryness are the only symptoms. In patients with secondary Sjögren syndrome, both a rheumatic or connective tissue disease (eg, rheumatoid arthritis, scleroderma, mixed connective tissue disease) are present along with the ocular and/or oral symptoms.<sup>1</sup>

Differing criteria for making the diagnosis of Sjögren syndrome exist.<sup>1–5</sup> The following objective criteria for establishing the diagnosis can be used: unstimulated salivary secretion, stimulated salivary secretion, salivary gland biopsy for estimation of focus score, salivary gland scintigram, or parotid gland sialogram. However, the sensitivity and speci-

ficity of these parameters show varying results in different centers. In a recent European multicenter study, greater importance was given to the patient's symptoms<sup>6</sup> than to the more objective criteria.

Patients with Sjögren syndrome can have extensive oral problems.<sup>7-10</sup> Because of the reduced salivary secretion rate, these patients often present with rampant dental caries.<sup>7-11</sup> Edentulous patients with Sjögren syndrome often have problems wearing dentures<sup>7,8</sup> and may complain about burning mucous membrane.<sup>7,9,10</sup> Oral infection such as candidiasis is also often observed.<sup>8-10,12</sup> Fixed prostheses retained by implants, therefore, could be especially advantageous for edentulous patients.

In the present study, oral implants were placed in edentulous patients suffering from Sjögren syndrome with the intention of treating the patients with complete fixed prostheses retained by the implants. The purpose was to evaluate the outcome of treatment with implant-retained dental prostheses in patients suffering from Sjögren syndrome.

### Materials and Methods

Eight females, 53 to 70 years of age, all of whom were members of the Danish Association of Patients with Sjögren syndrome, were included in the present study. In the selection of patients, the more symptom-based criteria given importance in a recent European multicenter study were used.<sup>6</sup> All patients suffered from dry eyes and dry mouth. All except one felt as though there was sand in their eyes, and all but a second patient used tear substitutes. All needed water when eating, and all except one needed water at bedside. The objective findings regarding Sjögren syndrome for each patient are given in Table 1. A pathologic Schirmer test was observed in 7 of the 8 patients. All patients were suffering from connective tissue disease, 7 from rheumatoid arthritis and 1 from scleroderma, and all reported a constant feeling of fatigue. All patients had had oral symptoms of Sjögren syndrome for many years—some for more than 25 years.

Seven patients were edentulous in both arches, and 1 patient was edentulous in the maxilla only. Only patients whose existing denture design was assessed to be satisfactory and for whom conventional treatment, therefore, was considered incapable of resolving prosthetic problems, were selected for the study. It was planned that implants be placed in the arches in which denture problems were present, and objective findings, including problems with creating retention/stability or mucosal soreness, were observed. It was the inten-

tion that each edentulous arch receive 6 implants and a complete, fixed prosthesis.

During a 2-year period from May 1991 to April 1993, 54 Brånemark implants (Brånemark System, Nobel Biocare AB, Göteborg, Sweden) were placed under local anesthesia according to the manufacturer's instructions. Seven implants in 4 patients were found not to be clinically osseointegrated at the abutment connection procedure or during the prosthetic treatment period. In 3 of these patients, 1 more implant was placed in an additional surgical procedure. In all arches in which implants were placed, at least 2 implants were available for prosthesis retention (Table 2).

Because of a lack of jawbone and because some of the placed implants did not osseointegrate, 3 of the arches were treated with an implant-retained complete overdenture. Table 2 shows the number of implants available in each arch and the type of prosthesis fabricated.

The fixed prostheses were made with a titanium framework of premachined titanium components welded together (Procera, Nobel Biocare AB, Göteborg, Sweden) and with acrylic resin teeth and flanges in composite resin.<sup>13</sup> The prostheses were screw-retained on standard abutments (Brånemark System). In 1 patient, the complete denture was retained with a Dolder bar (Table 2). In 2 patients, prefabricated precision attachments (CEKA REVAX, CEKA, Antwerp, Belgium) were mounted on bars. In 1 of these patients, 2 attachments were mounted on a continuous bar, and in the last patient a palatal extension bar from each of 2 implants was mounted with prefabricated precision attachments (CEKA REVAX) because of adverse position of the implants.

Plaque Index scores<sup>14</sup> were recorded and oral radiographs were taken of the implants 1 year and 4 years after completion of the treatment. Plaque Index and radiographs for patient PTA were not available 4 years after treatment.

Patients were asked to answer a questionnaire regarding problems with Sjögren syndrome and oral comfort and function before onset of treatment. One month and 2 years after completion of the treatment, the patients answered the same questionnaire. An English translation of the questionnaire is shown in Fig 1. The questionnaire completed 1 month after treatment from patient CM was not available.

### Results

It was planned that the edentulous arches in which denture problems were present should have 6

**Table 1 Objective Findings Regarding Sjögren Syndrome for Patients Before Treatment**

Test	Patient							
	GBP	IP	AMD	TS	CM	IT	HK	PTA
Schirmer	+	+	+	+	+	+	+	
Rose-Bengal	+					+		
Sialometry		+		+	-	+	+	-
Focus score		+					-	-
Scintigram								
Serology positive	ANA	ANA		ANA	ANA	ANA		SSB
Rheumatic disease	+	+	+	+	+	+	+	+

+ = indicated Sjögren syndrome; - = did not indicate Sjögren syndrome; blank = not investigated; ANA = antinuclear antibodies; SSB = antinuclear (ribonucleoprotein, La) antibodies.

**Table 2 Implant and Prosthetic Information for Each Patient**

Patient	Arch	Status	Implants placed	Implants lost	Implants available	Type of prosthesis
GBP	Maxilla	Edentulous	6	3	3	Complete overdenture with Dolder bar
	Mandible	Dentate				N/A
IP	Maxilla	Edentulous	4(1)	1(1)	3	Complete overdenture with 2 prefabricated precision attachments on 1 continuous bar
	Mandible	Edentulous	5		5	Fixed prosthesis
AMD	Maxilla	Edentulous	6		6	Fixed prosthesis
	Mandible	Edentulous	4		4	Fixed prosthesis
TS	Maxilla	Edentulous			—	Complete denture
	Mandible	Edentulous	6		6	Fixed prosthesis
CM	Maxilla	Edentulous			—	Complete denture
	Mandible	Edentulous	4		4	Fixed prosthesis
IT	Maxilla	Edentulous			—	Complete denture
	Mandible	Edentulous	6 (1)	1 (1)	5	Fixed prosthesis
HK	Maxilla	Edentulous			—	Complete denture
	Mandible	Edentulous	6		6	Fixed prosthesis
PTA	Maxilla	Edentulous	2 (1)	1	2	Complete overdenture with a palatal extension bar from each implant (on each bar 1 prefabricated precision attachment was mounted)
	Mandible	Edentulous	5	1	4	Fixed prosthesis

Parentheses indicate placed and lost implants, respectively, at an additional surgical procedure.

implants placed in each and be treated with a complete fixed prosthesis. Since the number of implants available for supporting the prosthesis in some patients was less than planned, 3 of the edentulous arches were treated with implant-retained removable dentures.

One patient had short-term (less than 1 week) postoperative complications with hematoma, infection, severe pain, and swelling following implant placement. All patients had edema and soreness of the oral mucosa during the healing period. It was difficult for the patients to wear a complete denture in the arch that had undergone surgery. The patients therefore used the denture in

this jaw minimally until after second-stage surgery. No implants were lost during the healing period, but 7 implants in 4 patients were found not to be clinically osseointegrated at the time of abutment connection or during the prosthetic treatment period (Table 2). Two of the 3 implants placed in an additional surgical procedure were not clinically osseointegrated at abutment connection.

The patients exhibited a moderate amount of plaque around the implants (an average PI of 0.4 and 0.3) both 1 and 4 years after completion of the treatment (Fig 2). An average radiographic bone loss of 0.7 mm from the time of implant placement to 1 year after treatment was observed (Fig 3). The

*Instructions:*

On the following pages are some questions concerning your general and oral health status. For each question some answers are given. Read each question thoroughly and indicate the answer you feel best describes your situation.

1. How many dentures or sets of dentures have you had previously?
  - 1
  - 2
  - 3
  - $\geq 4$
2. How is the retention/stability of your present denture(s)?
  - Very good
  - Good
  - Poor
  - Very poor
3. How is your comfort using the present denture(s)?
  - Very good
  - Good
  - Poor
  - Very poor
4. Are you able to chew all kinds of food?
  - Yes
  - No
5. Do you avoid some kinds of food because of your denture(s)?
  - Yes
  - No
6. Do you have a lack of self-assurance because of your denture(s), especially due to the risk of it loosening when you are with other people?
  - None
  - Slight
  - Severe
  - Very severe
7. Do you have speech problems because of your denture(s)?
  - None
  - Slight
  - Severe
  - Very severe
8. Do you have difficulties in cleaning your denture(s)?
  - None
  - Slight
  - Severe
  - Very severe
9. How is your satisfaction with the appearance of your denture(s)?
  - Very good
  - Good
  - Poor
  - Very poor
10. How is your satisfaction with the influence of the denture(s) on your appearance?
  - Very good
  - Good
  - Poor
  - Very poor
11. Do you have problems with your oral mucosa?
  - None
  - Slight
  - Severe
  - Very severe
12. Do you have pain in the temporomandibular joints?
  - None
  - Slight
  - Severe
  - Very severe
13. Do you have pain when you move your lower jaw?
  - None
  - Slight
  - Severe
  - Very severe
14. Do you have problems with fungi in your mouth?
  - None
  - Slight
  - Severe
  - Very severe
15. Do you have problems with dryness of your mouth?
  - None
  - Slight
  - Severe
  - Very severe
16. Do you have problems with dryness of your eyes?
  - None
  - Slight
  - Severe
  - Very severe

**Fig 1** English translation of the questionnaire that patients completed regarding their problems with Sjögren syndrome and oral and prosthetic function before treatment and 1 month and 2 years after treatment.

radiographic bone loss increased only slightly, less than 0.6 mm on average, 4 years after treatment.

During the first year of function, 2 mandibular implants lost osseointegration. One implant was lost in the mandibles of patients PTA and IT. None of the prosthetic restorations were lost or remade in the 4-year follow-up period. Treatment with implant-retained prostheses increased the oral well-being of the patients considerably. In general, the results reported after 2 years were even better than those 1 month after completion of the treatment.

According to questionnaire responses before treatment, 5 patients reported that their dentures had very poor stability (Fig 4), 2 rated it poor, and 1 was satisfied with denture stability. All reported

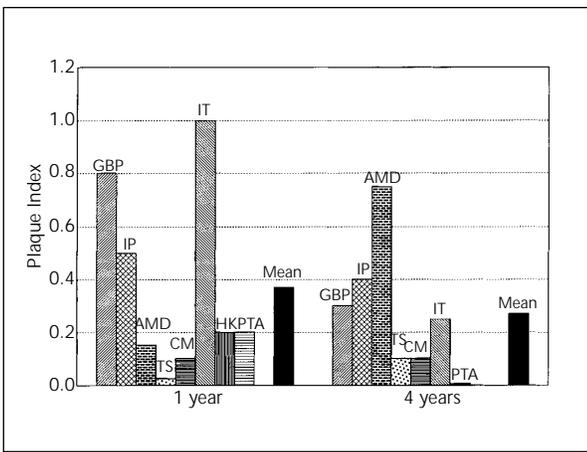


Fig 2 Plaque Index for each patient and mean for all patients 1 year and 4 years after completion of the treatment.

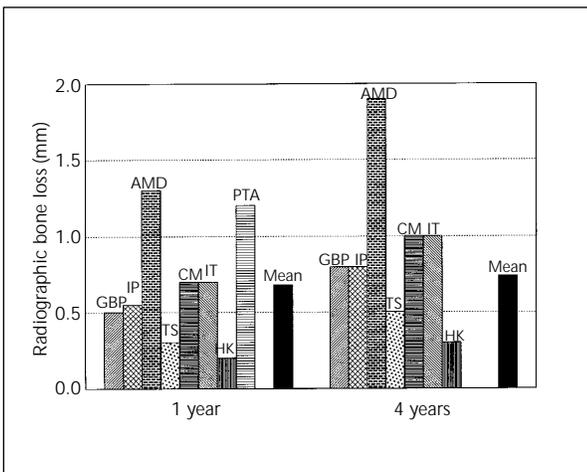


Fig 3 Radiographic bone loss for the individual patient and mean for all patients 1 year and 4 years after completion of the treatment.

that the comfort (Fig 4) of the dentures was very poor (6 patients) or poor (2 patients). Two years after treatment, all patients reported good (2 patients) or very good (6 patients) prosthesis stability. One patient indicated that the prosthesis caused some degree of discomfort, but the remaining patients stated that the comfort of their prostheses was very good (4 patients) or good (3 patients).

Before treatment, none of the patients could masticate all types of food because of problems with the dentures (Fig 5). After treatment, 4 patients indicated that they could chew all types of food and they no longer avoided any type of food because of the dentures. The treatment also positively influenced the self-assurance of the patients (Fig 6). Before treatment, all patients reported some lack of self-assurance because of the dentures, whereas 2 years after treatment, 6 reported that they never lacked self-assurance. After treatment, slightly fewer speech problems were reported than before (Fig 6). Patients reported fewer problems with cleaning the prostheses after than before treatment (Fig 6).

Patients regarded prosthesis appearance and prosthesis influence on facial appearance more favorably after treatment than before (Fig 7). For example, before treatment, 2 patients reported that the dentures had a slightly negative influence on their appearance and only 2 indicated that the influence was very good. Two years after treatment, 5 and 3 patients reported that prosthesis influence on appearance was very good or good, respectively.

A slight tendency to fewer mucosal problems and candidiasis after treatment was also indicated (Fig 8). Before treatment, 5 patients had severe or

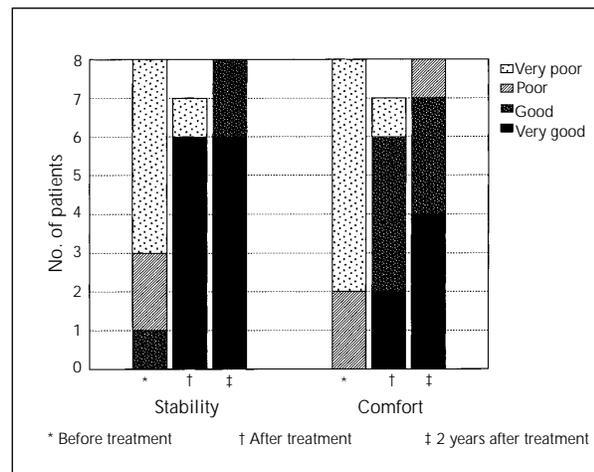
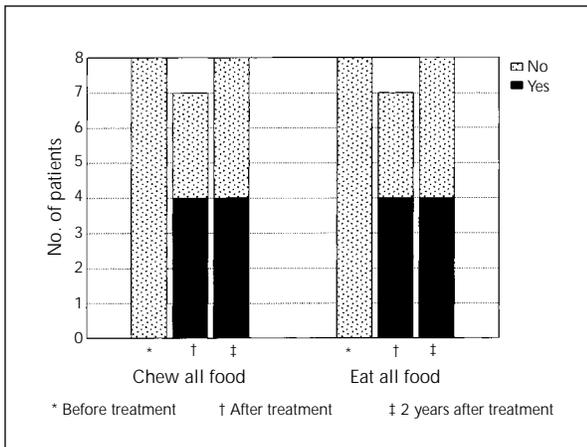
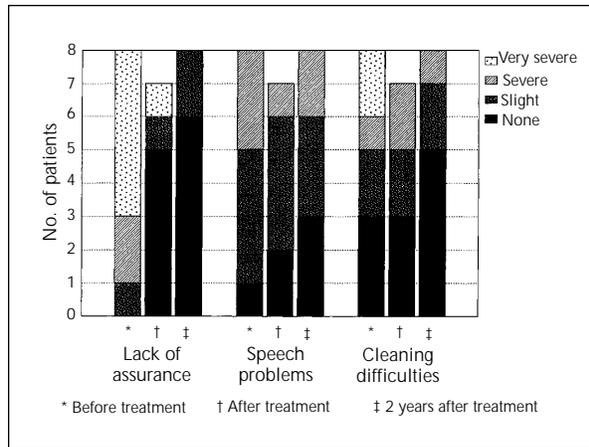


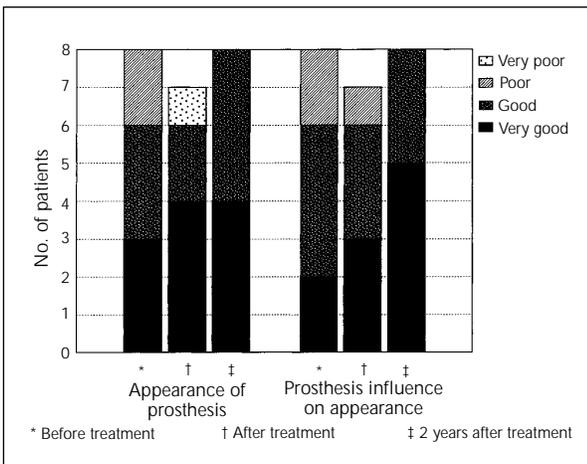
Fig 4 Patients' answers to questions concerning problems with retention or stability of prostheses and comfort using the prostheses before treatment and 1 month and 2 years after completing the treatment.



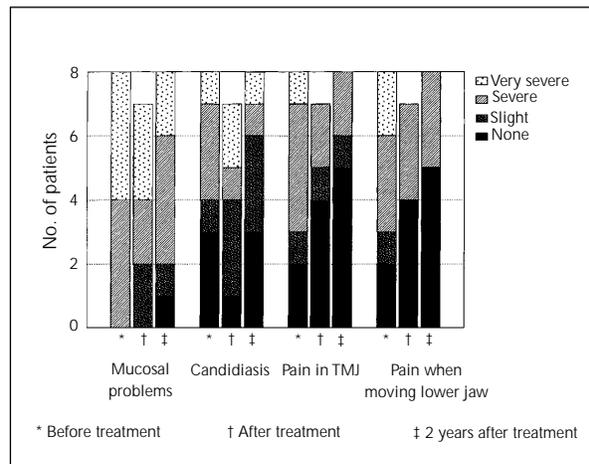
**Fig 5** Patients' answers to questions concerning ability to chew all foods and whether some foods were avoided because of the prostheses before treatment and 1 month and 2 years after completion of the treatment.



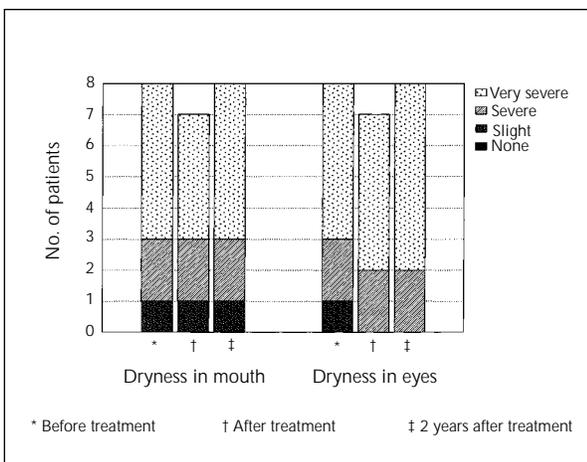
**Fig 6** Patients' answers to questions concerning lack of self-assurance because of their prostheses, speech problems related to their prostheses, and difficulties in cleaning their prostheses, before treatment and 1 month and 2 years after completion of the treatment.



**Fig 7** Patients' answers to questions related to satisfaction with appearance of the prostheses, and satisfaction with prosthesis influence on appearance, before treatment and 1 month and 2 years after completion of the treatment.



**Fig 8** Patients' answers to questions concerning problems involving the oral mucosa, problems with candidiasis, pain from the temporomandibular joints (TMJ), and pain during mandibular movement before treatment and 1 month and 2 years after completion of the treatment.



**Fig 9** Patients' answers to questions related to problems with dryness of the mouth and eyes before treatment and 1 month and 2 years after completion of the treatment.

very severe pain in the temporomandibular joints and during mandibular movements. After treatment it was reduced to 2 and 3 patients, respectively (Fig 8). Treatment did not reduce problems with dryness of the mouth or the eyes (Fig 9). Before treatment, 7 patients stated that they had severe or very severe problems with mouth dryness and dryness of the eyes. Two years after treatment, 7 and 8 patients reported severe or very severe problems with mouth dryness and dryness of the eyes, respectively.

### Discussion

The results of the present 4-year study demonstrated that the satisfaction of edentulous patients with Sjögren syndrome increased considerably when conventional dentures were replaced by implant-retained prostheses. In general, the subjective results 2 years after treatment were even better than those 1 month after completion of treatment.

The patients included in this study were all members of the Danish Association of Patients with Sjögren syndrome, who are organized under the Danish Rheumatologic Association. In this investigation, emphasis was placed on the subjective symptoms of Sjögren syndrome as inclusion criteria. This is in accordance with the results of the EEC project,<sup>6</sup> in which the validation of a simple 6-item questionnaire for determination of dry eyes and dry mouth that showed a power of good discrimination between patients and controls was used in the screening for Sjögren syndrome. Accordingly, these items were used in the selection procedure.

Patients with xerostomia often have poor denture acceptance<sup>15,16</sup> and reduced denture retention.<sup>17</sup> Even though it is well known that edentulous patients with Sjögren syndrome have severe difficulty wearing complete dentures,<sup>7,8,10,18</sup> few publications have addressed procedures for solving patients' prosthetic problems. In some publications,<sup>9,19</sup> it has been suggested that dentures with a reservoir for artificial saliva can reduce oral discomfort. Before treatment, all patients in the present study had used 3 or more dentures and generally had poor denture function.

To the authors' knowledge, only 2 case reports on dental implants in patients with Sjögren syndrome have thus far been published in the international literature.<sup>20,21</sup> The lack of reports in this field may be the result of the fact that various generalized diseases, including Sjögren syndrome, have been regarded as relative contraindications for the placement of oral implants.<sup>22</sup> In all, 4 patients with Sjögren syndrome were described in the 2 case

reports on oral implants in edentulous patients with Sjögren syndrome.<sup>20,21</sup> "Dramatic changes in comfort, function, and esthetics" were reported after treatment with a fixed prosthesis retained by 6 implants in one of these patients.<sup>20</sup> In 1 patient, 2 of 12 implants failed to osseointegrate. After 2 years in function, a third implant was lost.<sup>21</sup> In the Sjögren syndrome patients included in the present study, a higher frequency of implants not clinically osseointegrated or losing osseointegration in the first year after prosthetic rehabilitation was observed (about 16%) than in healthy patients.<sup>23-27</sup> On the other hand, bone loss around the remaining implants during the observation period was not alarmingly high. Furthermore, it should be appreciated that none of the prostheses were lost or remade during the 4-year follow-up period. Because of the small patient population of this study, the lowered implant survival rate should not be totally attributed to Sjögren syndrome.

Approximately 90% of patients with Sjögren syndrome are female,<sup>8</sup> and all patients in the present study were female. It is not known if a different result might have been expected in male patients, since the outcome of implant treatment has only been reported for 1 male patient with Sjögren syndrome.<sup>20</sup> An unfavorable circumstance with respect to implant treatment for the patients in the present study was edema and soreness of the oral mucosa during the healing period. This resulted in difficulty wearing a complete denture in the arch that had undergone surgery. Therefore, patients used the denture in this arch minimally until second-stage surgery. The reported dryness in the mouth and eyes, on the other hand, did not improve from before to after treatment. This can be used as an indicator of the fact that the patients have realistic expectations regarding the outcome of the treatment.

### Conclusion

Edentulous patients with Sjögren syndrome were most satisfied with the outcome of treatment when implant-retained fixed prostheses were used. But even the less satisfied patients, who were treated with an implant-retained complete denture in 1 arch, still reported considerably increased prosthetic comfort and function compared to the situation before treatment. Therefore, in patients whose anatomic conditions included lack of jawbone or in whom a lack of osseointegration of placed implants resulted in a less-than-optimal number of implants, it was still possible to fabricate prosthetic restorations that significantly improved the well-being of the patient.

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## References

1. Manthorpe R, Oxholm P, Prause JU, Schiodt M. The Copenhagen criteria for Sjögren's syndrome. *Scand J Rheumatol Suppl* 1986;61:19-21.
2. Fox RI, Robinson CA, Curd JG, Kozin F, Howell FV. Sjögren's syndrome. Proposed criteria for classification. *Arthritis Rheum* 1986;29:577-585.
3. Skopouli FN, Drosos AA, Papaioannou T, Moutsopoulos HM. Preliminary diagnostic criteria for Sjögren's syndrome. *Scand J Rheumatol Suppl* 1986;61:22-25.
4. Homma M, Tojo T, Akizuki M, Yamagata H. Criteria for Sjögren's syndrome in Japan. *Scand J Rheumatol Suppl* 1986;61:26-27.
5. Schiodt M, Daniels TE, Greenspan JS, Oxholm P, Prause JU, Manthorpe R. Comparing diagnostic criteria for the salivary component of Sjögren's syndrome. *Scand J Rheumatol Suppl* 1986;61:44-46.
6. Vitali C, Bombardieri S, Moutsopoulos HM, Balestrieri G, Bencivelli W, Bernstein RM, et al. Preliminary criteria for the classification of Sjögren's syndrome. Results of a prospective corrected action supported by the European Community. *Arthritis Rheum* 1993;36:340-347.
7. Bertram U. Xerostomia. Clinical aspects, pathology and pathogenesis. *Acta Odontol Scand* 1967;25(suppl 49): 1-126.
8. Scully C. Sjögren's syndrome: Clinical and laboratory features, immunopathogenesis, and management. *Oral Surg Oral Med Oral Pathol* 1986;62:510-523.
9. Vissink A, Panders AK, 's Gravenmade EJ, Vermey A. Treatment of oral symptoms in Sjögren's syndrome. *Scand J Rheumatol* 1986;61(suppl):270-273.
10. Daniels TE, Fox PC. Salivary and oral components of Sjögren's syndrome. *Rheum Dis Clin North Am* 1992;18: 571-589.
11. Newbrun E. Current treatment modalities of oral problems of patients with Sjögren's syndrome: Caries prevention. *Adv Dent Res* 1996;10:29-34.
12. Hernandez YL, Daniels TE. Oral candidiasis in Sjögren's syndrome: Prevalence, clinical correlations, and treatment. *Oral Surg Oral Med Oral Pathol* 1989;68:324-329.
13. Jemt T, Linden B. Fixed implant-supported prostheses with welded titanium frameworks. *Int J Periodontics Restorative Dent* 1992;12:177-184.
14. Silness J, Løe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal conditions. *Acta Odontol Scand* 1964;22:121-135.
15. Glass BJ, Van Dis ML, Langlais RP, Miles DA. Xerostomia: Diagnosis and treatment planning considerations. *Oral Surg Oral Med Oral Pathol* 1984;58:248-252.
16. Greenspan D. Xerostomia: Diagnosis and management. *Oncology* 1996;10(suppl 3):7-11.
17. Niedermeier WH, Kramer R. Salivary secretion and denture retention. *J Prosthet Dent* 1992;67:211-216.
18. Daniels T, Mandel I, Sciubba J. Mouth. In: Harris E (ed). *Sjögren's Syndrome Handbook*. Port Washington, New York: Sjögren's Syndrome Foundation, 1989.
19. Hirvikangas M, Posti J, Makila E. Treatment of xerostomia through use of dentures containing reservoirs of saliva substitute. *Proc Finn Dent Soc* 1989;85:47-50.
20. Binon PP, Fowler CN. Implant-supported fixed prosthesis treatment of a patient with Sjögren's syndrome: A clinical report. *Int J Oral Maxillofac Implants* 1993;8:54-58.
21. Payne AG, Lownie JF, Van Der Linden WJ. Implant-supported prostheses in patients with Sjögren's syndrome: A clinical report on three patients. *Int J Oral Maxillofac Implants* 1997;12:679-685.
22. Spiekermann H. Prerequisites. Patient selection: General and medical contraindications. In: Rateitschak KH, Wolf HF (eds). *Color Atlas of Dental Medicine. Implantology*. New York: Thieme, 1995:3-10.
23. Adell R, Eriksson B, Lekholm U, Brånemark P-I, Jemt T. Long-term follow-up study of osseointegrated implants in the treatment of totally edentulous jaws. *Int J Oral Maxillofac Implants* 1990;5:347-359.
24. Johns RB, Jemt T, Heath MR, Hutton JE, McKenna S, McNamara DC, et al. A multicenter study of overdentures supported by Brånemark implants. *Int J Oral Maxillofac Implants* 1992;7:513-522.
25. Brånemark P-I, Svensson B, van Steenberghe D. Ten-year survival rates of fixed prostheses on four or six implants ad modum Brånemark in full edentulism. *Clin Oral Implants Res* 1995;6:227-231.
26. Jemt T, Chai J, Harnett J, Heath MR, Hutton JE, Johns RB, et al. A 5-year prospective multicenter follow-up report on overdentures supported by osseointegrated implants. *Int J Oral Maxillofac Implants* 1996;11: 291-298.
27. Esposito M, Hirsch J-M, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants. (I) Success criteria and epidemiology. *Eur J Oral Sci* 1998;106:721-764.