Early Experience of Implant-Supported Prostheses in Patients with Neurologic Disabilities

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Purpose: The purpose of this prospective study was to provide a preliminary report of implant treatment in patients with neurologic disabilities. ***Materials and Methods:*** Patients had been referred to the National Orofacial Resource Centre with different disabilities, specifically neurologic disorders causing various orofacial dysfunction problems, and were suitable for prosthodontic treatment with implants. Patients were treated with single implant–supported crowns, fixed partial dentures, or complete implant-supported dentures. Implants used were threaded titanium cylinders placed under general or local anesthesia. All surgical complications in the healing period or at second-stage surgery were noted, as were all prosthodontic complications. ***Results:*** Fourteen patients were treated with 35 implants. Three implants were lost before or at second-stage surgery, and two implants were lost after loading. These complications were observed in two patients. Implant failures and other complications were observed in two patients in the mandible because of dehiscence of the mucoperiosteal flap and infection. Some patients had developed finger or oral habits, such as excessive tongue movements, that were probably responsible for these complications. One of the patients with Down syndrome possibly had reduced resistance to infections. No major complications were observed for the other 12 patients treated. ***Conclusion:*** Strict adherence to a surgical protocol is needed for the management of patients with neurologic disabilities. It is important to inform the patient's caregiver about maintenance of good oral hygiene and the increased risk of complications caused by finger or oral habits. *Int J Prosthodont 2005;18:132–138.*

Treatment with fixed reconstructions on implants has improved the comfort level and functional outcomes for edentulous patients. Implants supporting fixed prostheses have been used in edentulous situations for more than 30 years[1] and have long been used to restore teeth in partially edentulous patients[2,3] as well as for single-tooth replacements.[4–6]

Oral health care has become more important for people with serious medical conditions and disabilities, as well as for healthy individuals. In addition, people with disabilities need more comprehensive dental treatment. The poorer oral health of these individuals is attributed to a number of causes.[7] The limited oral health care available to them often leads to emergency dental visits. This often results in extraction of teeth and continuous deterioration toward edentulousness in a patient who is utterly incapable of coping with the wearing of prostheses.[8] Unfortunately, little documentation so far exists regarding rehabilitation with implant-supported prostheses in patients with disabilities.

In most of these patients, anomalies, neurologic impairment, different diseases, and trauma have affected function, anatomic structure, and general conditions. This may cause orofacial dysfunction, such as eating problems, bruxism, and drooling. The etiology of orofacial disabilities may be neurologic impairments, neuromuscular disorders, genetic syndromes, or orocraniofacial anomalies. In combination with these conditions,

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there is often a great need for oral prosthodontic rehabilitation with implant-supported prostheses. However, few studies probing this problem have been found in the literature, and most of these are case reports.

The case reports cover implants placed in a patient with Huntington's disease[9] or in patients with epidermolysis bullosa,[10] but also dental treatment of these patients[11,12]; and dental aberrations in children with osteogenesis imperfecta[13,14] and a case report with implants.[15] Other studies present case reports on implant treatment in patients with different rare disorders, such as cleidocranial dysplasia,[16] Fanconi's anemia,[17] thalassemia major,[18] Down syndrome,[19] and Papillon-Lefevère syndrome.[20] The outcome of implant placement is described, including some complications in patients with Sjögren syndrome.[21,22] The dental treatment of patients with Ehlers-Danlos syndrome[23] and incontinentia pigmenti[24,25] has also been discussed. Other case reports and studies concern orofacial complications and treatment in patients with amelogenesis imperfecta.[26,27] As ectodermal dysplasia represents a rare group of inherited disorders, a considerable number of guidelines and studies are available on implant treatment in these patients.[28–32] A review of the literature on implant placement in patients with conditions such as osteoporosis, diabetes mellitus, xerostomia, and ectodermal dysplasias has also been presented.[33]

In an attempt to reduce inequalities in oral health care, the Swedish Parliament decided in 1998 to increase the financial support for "necessary dental care." The service was provided to patients with disabilities who were dependent on nursing personnel or others in their activities of daily life, including oral hygiene procedures. The legislation concerns patients with mental disabilities, either congenital or acquired, and other groups of persons with severe illness. The treatment covered by necessary dental care is determined for each individual on the basis of general health, dental health, and the benefits of the treatment. Essential dental health care must contribute to a better ability to assimilate nutrition; failing that, the goal is to reduce pain and discomfort.

The purpose of this prospective study was to provide a report of implant treatment in patients with neurologic disabilities.

Materials and Methods

The patients recruited for this prospective study had been referred to the National Orofacial Resource Centre (Mun-H-Center) with different disabilities, specifically neurologic disorders causing various orofacial dysfunction problems, and were suitable for prosthodontic treatment with implants. Enrolled patients were treated with single implant–supported crowns, fixed partial dentures, or complete implant-supported dentures. Implants were threaded titanium cylinders (Nobel Biocare). The inclusion criterion for the study population was patients with a neurologic disorder, either congenital or acquired, including mental retardation and different degrees of autistic behavior. Patients were excluded if they themselves or their legal guardian or personal caregiver was negative toward prosthodontic treatment with implants. Despite sometimes serious disabilities, all patients in this study lived in their own homes or in residential housing, but with the help of personal caregivers. The prospective study is planned for 30 patients, but this part of the study comprised 14 edentulous or partially edentulous patients referred to the clinic between 2000 and 2003.

The posthodontist first examined all patients and planned treatment. Before implant placement, the prosthodontist again examined all patients together with the oral surgeon and discussed the treatment concept. Because of behavior problems among some of these patients, panoramic and other relevant radiographs were not always available at the time of examination and had to be taken under general anesthesia at the time of implant placement.

The following variables were recorded: presence or absence of parafunction, implant failure, implant bone level, surgical and/or prosthetic complications, as well as the design of the prostheses and number of visits. The anatomic form, surface and color, and fit of the fixed prostheses were recorded according to a scale: excellent, acceptable, or not acceptable. Oral hygiene in general and visible plaque on the abutments were also documented. Soft tissue pathology, such as perimucositis or peri-implantitis and fistulas, was recorded. The definition of perimucositis is an inflammatory process involving the peri-implant soft tissue; peri-implantitis is an inflammatory reaction involving the deeper regions of the peri-implant mucosa, including the peri-implant bone tissue.[34]

Implant success was determined using the criteria established by Albrektsson and Zarb.[35] Implant stability was checked relative to the actual implant and superstructure, in combination with inspection of the peri-implant mucosa and radiographs of the implants.[35] However, the prosthesis was not removed at the evaluation of implant stability. The bone quality and shape of the alveolar crest were classified according to Lekholm and Zarb.[36] Parafunctions such as daytime bruxism were recorded according to a scale with five degrees: none, little, sometimes strong, strong, and continuous bruxism. The data were obtained through questioning the patients' caregivers and through the author's observations. Each implant placed was given a prognostic score from 1 to 4 (1 = uncertain; 4 = very good). The criteria evaluated for each implant were: implant

Table 1 Details of Study Population and Treatments

Patient No.	Gender	Age (y)	Diagnosis	Prosthodontic treatment	Implant location*
1	M	48	Down syndrome, epilepsy	Tooth-supported fixed prosthesis in maxilla; implant-supported fixed prosthesis in partially edentulous mandible	46, 44, 43
2	F	41	Mental retardation	Single-tooth implant	11
3	F	51	Mental retardation, epilepsy	Single-tooth implants	11, 21
4	F	55	Mental retardation	Implant-supported fixed prosthesis in completely edentulous mandible	44, 43, 31, 33, 34
5	M	53	Fragile X syndrome	Implant-supported fixed prosthesis in partially edentulous maxilla	16, 14, 13
6	M	24	Autism, epilepsy	Single-tooth implant	21
7	F	46	Down syndrome	Single-tooth implant	21
8	F	55	Mental retardation, epilepsy, schizophrenia	Implant-supported fixed prosthesis in completely edentulous maxilla	15, 13, 11, 21, 23, 25
9	F	36	Rett syndrome, epilepsy	Single-tooth implant	21
10	F	53	Mental retardation, epilepsy	Implant-supported fixed prosthesis in partially edentulous maxilla	13, 11, 23
11	F	19	Mental retardation, multiple disabilities	Implant-supported fixed prosthesis in partially edentulous maxilla	12, 22
12	F	53	Mental retardation, epilepsy	Single-tooth implant	24
13	M	50	Mental retardation	Single-tooth implant	24
14	M	33	Mental retardation	Single-tooth implant	21

*Fédération Dentaire Internationale tooth-numbering system.

placed in bone of good quality; implant shows good initial stability and is anchored in at least marginal or basal cortical bone; no exposed threads; and placement was done according to the standard protocol. The implant was given a score of 4 if all four criteria were fulfilled.

All patients and their caregivers were given an individual prophylactic program by an oral hygienist, including a chart of photos presenting suitable toothbrushes for optimal cleaning of the prostheses. Patients were usually recalled every 3 months for an oral hygiene checkup. The observation time for the implants after prosthesis insertion was 6 to 28 months. Cumulative survival rates for the implants were calculated through life table analysis.[37]

Results

All patients participating in this study had some degree of mental retardation from neurologic impairment, congenital defect, trauma, or genetic syndromes such as Down syndrome. Often, the patients had other medical disorders, such as thyroid dysfunction or epilepsy, often in combination with different degrees of autistic behavior (Table 1). Many of the patients had a list of medications that included substances such as thyroid hormone, antiepileptics, antidepressives, megaloblastics, neuroleptics, and tranquilizers.

No bruxism was observed in two persons, nine persons were categorized as having little bruxism, and three persons had sometimes strong bruxism. No reliable data could be obtained about nighttime bruxism, but most of the patients reported sleeping without nocturnal bruxism. The bone quality and shape of the alveolar crest were recorded and classified according to Lekholm and Zarb[36] as bone scores B2, B3, and C3 in three, four, and seven patients, respectively.

Implant treatment was performed according to the standard (two-stage) protocol of the Brånemark system (Nobel Biocare). Implants placed and lost are shown in Table 2. Oral surgeons placed all implants, but the author did most of the abutment operations and all prosthodontic treatment. The implants were placed under general anesthesia in 11 patients and with local anesthesia in 3 patients. Mandibular implant failures and other complications were observed in two patients. Three implants were lost before or at second-stage surgery, and two implants were lost after loading. No major complications have been observed for the other 12 patients treated.

The implant-supported fixed prostheses in edentulous jaws were fabricated as Procera Implant Bridges (Nobel Biocare; titanium framework + acrylic resin teeth). All fixed partial prostheses were made of metal-ceramic with a framework of gold. The single-tooth restorations were made as all-ceramic crowns using the CeraOne System (Nobel Biocare).

For many reasons, the number of patient visits according to the standard protocol for prosthetic treatment of implant-supported fixed prostheses had to be reduced. In many cases, the patients were unable to do without sedation when single-tooth restorations were tried in and cemented. The following technique was used. For single-tooth restorations, an impression was made and the occlusal and vertical dimensions were

Table 2 Distribution of Implants Placed and Lost*

Length (mm)	Machined Regular Platform	Machined Narrow Platform	TiUnite Regular Platform	Lost before loading	Lost after loading
7.0	0	0	2	1	1
10.0	1	0	0	0	0
11.5	0	0	1	0	0
13.0	4	0	1	0	0
15.0	5	1	14	2 (machined)	1 (machined)
18.0	2	0	4	0	0
Total	12	1	22	3	2

*All implants were Brånemark Mk III (Nobel Biocare).

Table 3 Abnormal Incidents Noted in Surgical Records (No. of Implants) in Relation to Prognostic Score and Implant Loss*

Score	No. of implants	Abnormal swelling	Exposed cover screw	Dehiscence of mucoperiosteal flap	Infection	Lost before loading	Lost after loading
4	20	0	0	2	2	1	1
3	13	0	2	2	0	2	0
2	2	0	0	1	0	0	1
1	0	0	0	0	0	0	0

*Range of 4 (very good) to 1 (uncertain) for prognosis score.

recorded at the same appointment as the implant placement, while the crown was cemented at the abutment operation. The same procedure was used for short-span fixed prostheses in the anterior region in two patients. In two other patients, the impression was made and the occlusal and vertical dimensions recorded at the abutment operation, and prosthesis insertion was done in the dental chair. In patient 4, all prosthetic treatment with a complete-arch implant-supported fixed prosthesis had to be performed under general anesthesia. Three appointments for general anesthesia were planned, but because of multiple implant failures, a provisional acrylic resin prosthesis had to be inserted, and the number of appointments increased to five before the permanent implant-supported fixed prosthesis was inserted.

The prognostic scores of the implants at placement are given in Table 3. The most common criterion not fulfilled was exposed implant threads, reported for nine implants. The criterion "implant placed in bone of good quality" was not fulfilled in seven implants, and one implant did not show good initial stability. Table 3 also presents notes about abnormal incidents in surgical records in relation to both prognostic score and implants lost. Two implants with prognostic scores of 3 and 4, respectively, failed. Patient 1, who had Down syndrome (Figs 1 and 2), lost a 7-mm implant because of rapid bone loss approximately 17 months after loading, and one implant lost half of its bone support because of a sequestration, probably because of a postoperative dehiscence of the mucoperiosteal flap.

Six of these patients have been followed for 1 year or more. In all patients, intraoral radiographs were taken at the abutment operation and prosthesis insertion. However, it was not always possible to take radiographs of good quality at the follow-up appointments in the dental chair in these patients. The cumulative survival rate for placed implants was 88.6% after 1 year and 80.5% after 2 years (Table 4).

Discussion

In spite of all these patients having different disabilities, including mental retardation and different degrees of autistic behavior, it was possible to carry out the treatment with relatively good results and contribute to improved esthetics and oral function. It was decided to present both clinical and radiographic data on peri-implant oral hygiene, soft tissue pathology, bone loss, and evaluation of the fixed prostheses in a forthcoming separate 1-year follow-up study of all 30 included patients.

In two of the patients, implant failures occurred, but the number of implants placed and lost in this prospective study to date is probably too low to be able to relate implant loss to the prognostic score given for that implant. However, in a 5-year follow-up study it might be valuable.

One of the most important factors responsible for implant failures is probably the local anatomic structure regarding bone quality and quantity.[38] Etiologic factors caused by surgical failures, such as bone overheating

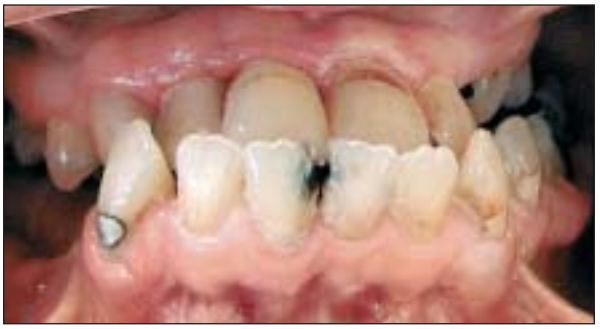

Fig 1 Before treatment: Patient 1 has prenormal jaw relation, periodontitis, caries, and need for better tooth support in mandibular right premolar and molar region.

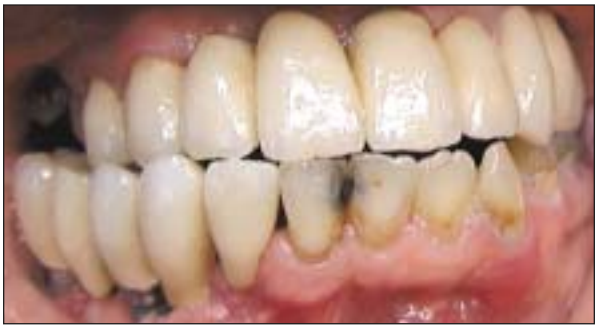

Fig 2 After treatment with maxillary fixed partial prostheses made in edge-to-edge jaw relation. Fixed implant-supported partial prostheses placed in mandible. Note exposed threads at region of mandibular right first premolar implant, which lost half of its bone support because of sequestration caused by postoperative dehiscence of mucoperiosteal flap.

Table 4 Cumulative Survival Rate of Placed Implants

Time period	No. followed	No. failed	Survival rate within group (%)	Cumulative survival rate (%)
Placement–loading	35	3	91.4	91.4
Loading–1 y	32	1	96.9	88.6
1–2 y	11	1	90.9	80.5
2–3 y	9	0	100.0	80.5

or infections, could be reasons for early implant failures.[39] Other host-related factors, such as patients' general health conditions, might play an important role in early implant failure. Examples of these health conditions are diabetes, osteoporosis, and ongoing medication.[33]

This mechanism has not been observed in these patients, except in patient 1, who had Down syndrome with possibly reduced resistance to infections; the author had the impression that the healing process was delayed. White blood cells in people with Down syndrome have a decreased response to infection and a decreased ability to kill microorganisms. This may be one reason for the decreased immunity to infection seen in children with Down syndrome.[40,41] This patient was also affected by macroglossia and oral habits, which were probably responsible for the dehiscence of the mucoperiosteal flap. In this patient, a late implant failure also occurred through rapid bone loss, probably because of overloading. There were radiologic signs of peri-implantitis at that implant. Periodontitis and loss of periodontal bone support around natural teeth had been observed earlier in this patient. The suitability of patients with Down syndrome for implant placement has been questioned because of macroglossia, osteoporotic alveolar bone, and a tendency toward poor cooperation.[19]

In patient 4, the probable reason for implant failure was the local anatomic structure with reduced bone quantity and quality, in combination with oral habits resulting in a dehiscence of the mucoperiosteal flap. However, almost all published studies show one or two patients with multiple implant failures who experience a so-called "cluster phenomenon."[39,42]

Daily bruxism has been found to be common in children with brain damage.[43,44] However, separate studies indicate that bruxism and high occlusal loads are risk factors for technical complications or implant failure.[38,45] This was especially observed in a study where implants were immediately loaded; in that study, 41% of the implants were lost in patients with parafunction, compared to 12% in the control group.[46] This indicates that a two-stage standard protocol for implant placement should be used, especially in the present group of patients.

Good oral hygiene is important to maintain healthy conditions around teeth and implants. The risk of soft tissue complications is probably higher among patients with physical or mental impairments, who cannot maintain good oral care on their own. However, one study observed a group of patients treated earlier with implant-supported prostheses and now unable to maintain good oral care because of advanced age or a generally impaired state of health and dependence on others for their activities of daily life (patients covered by "necessary dental care" in Sweden).[47] In these

patients, no difference was observed in the degree of soft tissue inflammation, despite more plaque on the abutments, compared to another group of patients with implant-supported prostheses who were able to provide their own oral care.[47]

Oral health is an integral part of general health. Improving the oral health of people with disabilities calls for the involvement of all the specialties of dentistry to ensure that those who have the greatest need also receive the best oral treatment. Strict adherence to a surgical protocol is needed for the management of patients with neurologic disabilities. Frequent checkups were also found to be valuable, as was using a soft splint to cover the surgical area postoperatively. It is important to inform the patient's caregiver about maintenance of good oral hygiene and the increased risk of complications caused by finger or oral habits.

Acknowledgments

The author wishes to thank the team of oral surgeons: Drs Göran Widmark, Carl Johan Ivanoff, Cecilia Larsson, and Lucy Kartous, and dental hygienist Mia Zellmer. Special thanks to Dr Björn Adielsson of Nobel Biocare, Sweden, for the idea of a prognostic ranking of the placed implants, and to Camilla Billström, MSc, Nobel Biocare, for help with statistics.

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Literature Abstract

Comparison of the dimensional accuracy of injection-molded denture base materials to that of conventional pressure-pack acrylic resin

Polymethylmethacrylate (PMMA) has become the most commonly used material for denture bases because of its excellent properties. However, the inherent inaccuracy in the use of PMMA as a denture base material includes dimensional change during processing, frequently due to polymerization shrinkage. The purpose of this study was to compare the linear dimensional accuracy of three chemically different injection-molded denture base materials to that of conventional pressure-pack acrylic resin. Conventional pressure-packed PMMA was compared to injection-molded base materials, including PMMA, nylon, and styrene. An aluminum master cast simulating a maxillary edentulous area was used. A silicone mold of the master cast was fabricated and used to make 40 duplicate master casts in type III gypsum, on which the complete maxillary dentures could be waxed and processed. The reference points for the linear measurements consisted of ERA attachments cast in the base metal alloy. Forty maxillary wax dentures with teeth were fabricated on the previously prepared and indexed casts. Three dimensions were measured on the denture base for the evaluation of linear dimensional change. Measurements were made at the wax stage immediately before investing, after processing on the master cast (24 hours after breakout), and after decasting and storage in water at 37°C for 1 week. The measurements at the wax stage were used as the baseline readings. The effect of the material on dimensional change was assessed using Wilks lambda and the associated F test statistic derived from Wilks lambda. With conventionally processed PMMA, injection-molded PMMA, and nylon, the greatest distortion occurred when the processed denture was removed from the master cast, whereas, for styrene the greatest distortion occurred during processing. When removed from the master cast, nylon had the greatest anteroposterior and cross-arch distortions, and styrene had the least. The greatest overall distortion occurred with nylon, and the least with styrene.

Parvisi A, Lindquist T, Schneider R, Williamson D, Boyer D, Dawson D. *J Prosthodont* 2004;13:83–89. **References:** 18. **Reprints:** Dr Terry Lindquist, S 422, Dental Science Building, University of Iowa, Iowa City, IA 52242—*Khaldoun Alajlouni, UNMC College of Dentistry, Lincoln, NE*