CLINICAL RESEARCH

Survival of dental implants in patients with Down syndrome: A case series

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Down syndrome (DS) is the most common cause of intellectual disability of genetic origin, with a prevalence of approximately 1 in 700 live births.1 Individuals with DS are at increased risk of comorbid conditions,2 but treatment in recent decades has led to a significant increase in life expectancy, with survival up to the seventh decade in many individuals.3

Oral and perioral alterations in DS give rise not only to the characteristic phenotype but also to major changes in masticatory function, swallowing, and language.4,5 Results of a recent meta-analysis suggested that the prevalence of caries was lower in individuals with DS than in the general population,6 confirming the results of previous studies7 and

ABSTRACT

Statement of problem. The need for tooth replacement in individuals with Down syndrome (DS) is explained by the high prevalence of dental agenesis and by the premature loss of teeth through severe periodontal disease. Dental implants may be the dental procedure of choice in some of these patients.

Purpose. The purpose of this clinical study was to analyze dental implant survival in a series of patients with DS.

Material and methods. This was a multicenter, retrospective, observational study. Information on patients was gathered using a standardized questionnaire designed specifically for this study, including personal details, oral health status, information on the surgical and prosthetic phases, and follow-up visits. The questionnaire was sent to centers registered with the research network of the Spanish Society of Special Needs Dentistry (SEOENE). Patients with DS aged 18 years or older were included in the study if they had at least 1 dental implant and the corresponding prosthesis and had been followed up for at least a year.

Results. The study population was formed of 25 adult patients (13 men and 12 women) aged between 19 and 60 years. The interventions were performed by 5 different dental surgeons, usually under general anesthesia or deep sedation (n=17 patients). A total of 73 implants were inserted, 30 in the maxilla and 43 in the mandible, most commonly in the anterior region (n=51). The mean time to loading the implants was 4.1 ±1.3 months after surgery (range, 1 to 7 months). All patients completed prosthetic rehabilitation; the most frequent design used was the single fixed prosthesis (n=13 patients). A total of 17 (23.2%) implants failed in 8 (32%) patients; the majority (n=14 implants) failed in the postsurgical period before implant loading. The distribution by patients was 1 implant failure in 6 patients, 3 failures in 1 patient, and 8 failures in 1 patient.

Conclusions. Dental implant survival is lower in individuals with DS than in the general population. The reasons for early implant failure in these patients have still not been clearly identified. (J Prosthet Dent 2016;116:880-884)
Clinical Implications
The success rate for dental implants in individuals with Down syndrome seems to be lower than that observed in the general population. Specific risk factors for dental implant failure in these patients remain unknown.

indicating that caries would not appear to be a primary cause of tooth loss in these individuals. However, at least 2 explanations for the need for tooth replacement in this group are tooth agenesis, with a frequency 10 times higher than that observed in the general population,8 and premature tooth loss secondary to severe early onset periodontal disease.9

Improvements in quality of life and life expectancy, together with the progressive social integration of individuals with DS, have led to an increase in their demand for dental care. Dental implants are a first-order resource, in that the mean success rate at 10 years in the general population has been shown to be around 95%.10

To date, few studies have been published on dental implants in patients with DS, and only a few case reports11-13 or small numbers of individuals included in a heterogeneous series of patients with various degrees of intellectual or physical disability14-17 are to be found in the literature. The objective of the present study was to analyze dental implant survival in a series of patients with DS.

MATERIAL AND METHODS

This was a multicenter retrospective observational study approved by the Ethics Committee of the Santiago de Compostela University, Spain. Information on patients was gathered using a standardized questionnaire specifically designed for this study. The questionnaire was first piloted by a group of qualified dentists who were members of the research network of the Spanish Society of Special Needs Dentistry (SEOENE). Those dentists reviewed the questionnaire and gave feedback on the different items. Subsequently it was presented and discussed at the SEOENE biannual meeting in Cadiz, Spain, in 2015, and, after additional changes, its current form was approved by consensus.

The questionnaire gathered information in the following areas: demographic details (age, sex, dental clinic of origin), oral health status (oral hygiene, DMF [decayed, missing, filled] index, reason for tooth loss), surgical phase (date, behavior control technique, type of anesthesia, number, position and type of implants used, intraoperative findings, bone regeneration material used, primary stability, fenestration, dehiscence), prosthetic phase (interval between surgery and implant loading), type of prosthesis, type of anchorage, follow-up (peri-implant probing, presence of bleeding and/or suppuration, mobility, radiologic bone loss, mechanical complications), and survival of the implants and of the prosthesis.

The inclusion criteria for the series of patients with DS were age 18 years or older, insertion of at least 1 dental implant and, when applicable, the corresponding prosthesis, and at least 1 year of follow-up after implant loading (except when implant failure occurred earlier). Patients satisfying these criteria were identified in 7 dental centers registered with the SEOENE, but the information was only accepted from centers that provided at least 3 patients each and filled in the questionnaires with the minimum information required (5 centers in total).

The results were analyzed with statistical software (R statistical software; The R Foundation). To determine variables that could explain implant failure (response variable), we considered each patient and each implant as a clinical study unit. The variable “patient” was analyzed using a binomial logistic regression model (patients in whom no implant had failed versus patients in whom at least 1 implant had failed) and a Poisson regression model (absolute number of failed implants per patient). The analysis of “implant” as an independent clinical unit was conducted using logistic generalized linear mixed models (GLMM),18,19 including a random effect for “patient,” in the form of a random intercept model. In both analyses, only those variables for which values had been recorded for all patients in the series were studied as explanatory variables; these included the individual patient, patient age and sex, dental surgeon, number of implants inserted, time between implant insertion and loading, and type of prosthetic rehabilitation. To compare implant survival rates in the DS and general population, a 1-tailed exact test of proportions was conducted, with the null hypothesis $H_0: P<.94$. For this comparison, the most optimistic survival rate for DS and the most pessimistic rate for the general population (from the interval .94 to .97) were used.20

RESULTS

The study population was formed of 25 patients, 13 (52%) men and 12 (48%) women, with a mean age of 34.0 ±10.5 years (range, 19 to 60 years). Oral hygiene was considered “poor” in the majority of individuals (recorded in 13 of the 18 patients), and the mean DMF index was 14.7 ±5.8 (recorded in 17 patients). The most common reason for tooth loss was periodontal disease (recorded in 9 of the 17 patients), followed by caries (recorded in 5 of the 17 patients).

The interventions were usually performed under general anesthesia (n=17 patients) by 5 different dental...
Table 1. Characteristics of surgical phase (n = 25 patients with 73 implants)

<table>
<thead>
<tr>
<th>Behavior Control Technique</th>
<th>Implant Site</th>
<th>Anatomic Distribution of Implants</th>
<th>Bone Regeneration Techniques</th>
<th>Primary Implant Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maxilla</td>
<td>Anterior region</td>
<td>Yes</td>
</tr>
<tr>
<td>By patients</td>
<td></td>
<td>Maxilla; mandible</td>
<td>Yes</td>
<td>Good</td>
</tr>
<tr>
<td>General anesthesia=17 (68%)</td>
<td>Maxilla=10 (40%)</td>
<td>Anterior region=51 (69.9%)</td>
<td>Yes</td>
<td>Good=35 (47.9%)</td>
</tr>
<tr>
<td>Deep sedation=4 (16%)</td>
<td>Mandible=10 (40%)</td>
<td>Posterior region=8 (10.9%)</td>
<td>No</td>
<td>Poor=3 (4.2%)</td>
</tr>
<tr>
<td>Nonpharmacologic=4 (16%)</td>
<td>Maxilla and mandible=5 (10%)</td>
<td>ND=14 (19.1%)</td>
<td>ND=31 (42.3%)</td>
<td>ND=35 (47.9%)</td>
</tr>
</tbody>
</table>

Table 2. Time between implant insertion and loading (n = 25 patients with 73 implants)

<table>
<thead>
<tr>
<th>Time to implant loading (mo)</th>
<th>Patients, n (%)</th>
<th>Implants, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>14 (19.2)</td>
</tr>
<tr>
<td>1</td>
<td>1 (4.0)</td>
<td>1 (1.4)</td>
</tr>
<tr>
<td>2</td>
<td>1 (4.0)</td>
<td>2 (2.7)</td>
</tr>
<tr>
<td>3</td>
<td>2 (8.0)</td>
<td>3 (4.1)</td>
</tr>
<tr>
<td>4</td>
<td>9 (36.0)</td>
<td>20 (27.4)</td>
</tr>
<tr>
<td>5</td>
<td>3 (12.0)</td>
<td>8 (11.0)</td>
</tr>
<tr>
<td>6</td>
<td>2 (8.0)</td>
<td>3 (4.1)</td>
</tr>
<tr>
<td>7</td>
<td>1 (4.0)</td>
<td>2 (2.7)</td>
</tr>
<tr>
<td>Unknown</td>
<td>6 (24.0)</td>
<td>20 (27.4)</td>
</tr>
</tbody>
</table>

NA, not applicable because implants failed before loading.

Table 3. Prosthetic rehabilitation in study population (n = 25 patients with 73 implants)

<table>
<thead>
<tr>
<th>Prosthetic Rehabilitation Type</th>
<th>Patients, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single fixed prosthesis</td>
<td>13 (52.0)*</td>
</tr>
<tr>
<td>Partial fixed prosthesis</td>
<td>5 (20.0)</td>
</tr>
<tr>
<td>Complete removable prosthesis</td>
<td>1 (4.0)</td>
</tr>
<tr>
<td>Fixed complete lower prosthesis</td>
<td>3 (12.0)</td>
</tr>
<tr>
<td>Complete removable prosthesis</td>
<td>1 (4.0)</td>
</tr>
<tr>
<td>Single fixed prosthesis + Partial fixed prosthesis</td>
<td>2 (8)</td>
</tr>
</tbody>
</table>

*In 10 patients, crowns were independent and in 3 were splinted.

Surgeons. A total of 73 implants were inserted, 30 (41.1%) in men and 43 (58.9%) in women, with a range of 1 to 12 implants per patient. The mean length of the implants was 12.2 ±1.8mm (range, 8.5 to 15 mm) and the mean diameter was 3.6 ±0.2 mm (range, 3.3 to 4.5 mm). The diameter was only recorded for 42 of the implants in the series. Implants were inserted into the maxilla in 15 patients, into the mandible in 15 patients, and into both jaws in 5 patients. A larger number of implants were inserted into the mandible (n=43; 58.9%) than into the maxilla (n=30; 41.1%). The majority of implants were inserted into the anterior region (n=51; 69.9%). Bone regeneration techniques were required for 11 implants (this datum was not recorded for 31 implants). Primary stability was evaluated clinically and was considered good in 35 (47.9%) implants (datum not recorded for 35 implants). The results relating to the surgical phase are summarized in Table 1.

The time to implant loading varied between 1 and 7 months after surgery, with a mean of 4.1 ±1.3 months. This parameter was not available for the 14 (19.1%) implants that failed before loading (Table 2). Prosthetic rehabilitation was performed in all patients despite the failure of some implants; the most common design was the single fixed prosthesis (n=13 patients; 53%) (Table 3).

Because of behavioral problems, perimplant probing could only be performed in 19 implants at the follow-up visits. The mean probing depth was 2.2 ±0.8 mm (range, 1 to 4 mm). For the same reason, radiologic evaluation of the bone level could only be performed on 17 (23.2%) implants; mean bone loss was 1.8 ±0.6 mm (range, 0 to 4 mm). Suppuration was not observed around any implant and bleeding was observed in only 1. The survival period of the implants, defined as the time between implant loading and the final follow-up visit, varied between 12 and 120 months (mean, 43.2 ±29.5 months).

At least 1 implant failed in 8 (32%) patients (4 men and 4 women). The total number of implant failures was 17 (23.2%), 6 in men and 11 in women, corresponding to failure rates of 20% in men and 25.5% in women. The distribution by patients was 1 implant failure in 6 patients, 3 failures in 1 patient, and 8 failures in 1 patient. The estimated proportion for implant survival rate in DS was significantly lower than the proportion observed in the general population (P <.01).

Considering the patient as the “clinical unit,” binomial analysis of implant failure showed that the only variable that affected the success or failure of the implants was the individual patient (P=.043). When failure was analyzed as a discrete variable, the variables that affected implant failure were the patient (P<.001), the dental surgeon (P<.001), and the number of implants inserted in each patient (P<.001).

GLMM analysis of implant failure using each implant as the “clinical unit” showed that the variables that affected the success or failure of the implants were the dental surgeon (P<.010; β estimate = −3.239; standard error = −1.055), the type of prosthetic rehabilitation (P<.001; β estimate = −27.010; standard error = 7.769),
DISCUSSION

In this study, a retrospective analysis was performed of a series of patients with DS treated with dental implants. Almost 1 in every 3 patients lost at least 1 implant, indicating an implant survival rate considerably lower than that observed in the general population.20,21 Many case reports of patients with DS have described implant loss.11-13 To our knowledge, this is the first series of these characteristics published, although previous series of patients with neurologic disabilities rehabilitated with implant-supported prostheses have suggested that implant loss may be more common among patients with DS.14,15 The study by Van de Velde et al17 was particularly interesting; those authors selected a series of 18 individuals with an edentate mandible to study the efficacy of immediate implant loading. The study population included a patient with DS who presented no other medical contraindications and in whom dental treatment was possible under local anesthesia. A total of 91 implants were inserted in that study; 3 implants were lost, 2 of which occurred in the patient with DS.

The results of the present study must be interpreted with caution because of methodologic limitations. The multicenter retrospective design means that clinically relevant information may have been lost, that the dental surgeons themselves may constitute an explanatory variable, that distinct patient selection criteria may have been applied, and that a number of different types of implant and surgical/prosthetic techniques may have been used. In addition, the behavioral characteristics of the patients made it impossible to carry out certain oral examinations in the follow-up visits. Although the causes of the high implant failure rate in this population remain to be defined, failure may be related to factors such as osteoporotic alveolar bone, reduced resistance to infections, the presence of macroglossia and parafunctions, and poor patient cooperation.16

The majority of implant failures in the present series occurred during the osseointegration phase. This requires us to exclude certain variables that may be implicated, including the time between implant insertion and loading, the type of prosthetic rehabilitation, the pressure of the tongue on the implants,25 and other factors that have been described in patients with intellectual disability, including poor oral hygiene and parafunctions such as bruxism.25

The DS population has an elevated risk of osteoporosis.24 In addition, in these patients it is not uncommon to detect reduced bone mineral density secondary to reduced osteoblast activity with no associated alteration of the reabsorption process.24 Long-term dental implant failure may be higher in patients with osteoporosis,25 although scientific evidence to date is insufficient to support the hypothesis that osteoporosis can have negative effects on the osseointegration process.26

Immune system dysfunction characterized by lymphopenia, impaired mitogen-induced T-cell proliferation, reduced antibody responses to immunizations, and defects of polymorphonuclear leukocyte chemotaxis and phagocytosis has been described in patients with DS.27 This is another factor that could affect the success of dental implants because it may interfere with the osseointegration process or favor the onset of aggressive perimplantitis in patients with previously untreated periodontitis. In this context, a reduced expression of cytokines such as interleukin-10 (IL-10), an increase of signal transducer and activator of transcription 3 (STAT-3), and impaired activation of interferon signaling have been described in patients with DS and periodontal disease. This could indicate an attenuation of antiinflammatory mediators and an increase of proinflammatory mediators.28,29

In the present series, implant surgery was performed under general anesthesia or deep sedation in 68% of the patients with DS, indicating the poor level of cooperation. The prevalence of finger and oral habits, such as excessive tongue movements, which could favor dehiscence of the mucoperiosteal flap, infection, and early loss of the dental implants, is higher among patients with more conspicuous behavioral disturbances.15

CONCLUSIONS

The present case series shows that the success rate for dental implants in individuals with DS is lower than that observed in the general population. In view of the methodologic limitations of this study, it is essential to design prospective studies with sufficiently large study groups to confirm the risk of early implant loss in this population and enable us to establish specific selection criteria for these patients.

REFERENCES


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