Clinical Guidelines for Implant Treatment in Patients with Down Syndrome

Hugo De Bruyn, DDS, MSc, PhD1*
Maarten Glibert, DDS, MSc1*
Liesbet Matthijs, DDS, MSc1/Martens Filip, DDS, MSc1
Véronique Christiaens, DDS, MSc1
Luc Marks, DDS, MSc, PhD2

This study evaluated implant outcome in patients with Down syndrome (DSPs) and provides clinical guidelines to maximize treatment outcome. A total of 57 implants were placed in eight DSPs. During follow-up, implant survival was recorded and crestal bone level was evaluated when possible. After a mean follow-up time of 5 years, six patients with 45 implants were evaluated and an implant survival rate of 84.4% was recorded. A mean crestal bone loss of 1.7 mm (SD 0.9) was measured in three patients around 20 implants. Down syndrome is not a contraindication to dental implant placement, but multiple complicating factors yield reduced implant survival. Int J Periodontics Restorative Dent 2019;39:361–368. doi: 10.11607/prd.3284

Down syndrome (DS) is the most frequent livable chromosome deviation and characterized by congenital malformations, speech problems, intellectual disability, generalized muscle hypotonia,1 and higher risk of systemic diseases, such as cardiovascular problems,2 diabetes,3,4 gastrointestinal problems,5 osteoporosis,1,6 connective tissue disorders,7 and reduced immunity.8 Multiple tooth agenesis and tooth malformations are common.9 Due to impaired immunity in combination with ineffective plaque control, patients with Down syndrome (DSPs) have a higher prevalence of gingivitis and periodontitis compared to the general population.10 Consequently, DSPs are often partially or fully edentulous at a young age and conventional removable dentures yield limited comfort due to the increased tongue pressure, muscle hypotonia, xerostomia, bruxism, and flat palate characteristic of DS.1,6,7,9,11 DSPs might be more comfortable with an implant-supported fixed rehabilitation, although multiple risk factors for higher implant failure are present in DSPs compared to the general population.12 Impaired immunity, delayed wound healing, lack of oral hygiene, cognitive disability, excessive tongue pressure, bruxism, diabetes, and history of periodontitis could all lead to early
or late implant failure.13,14 Needless to say, implant treatment in DSPs is not described in prospective trials and is limited to case reports and case series. A literature search in PubMed with “Dental Implant” AND “Down Syndrome” as search string yielded only 10 clinically relevant articles (summarized in Table 1) with survival rates from 50% to 100% after a short follow-up of 2 to 7 years.15–24 The most extensive case series described 73 implants in 25 DSPs16 and yielded a 76.7% implant survival rate, confirming that implant therapy is less predictable. The majority of failures occurred in the early preloading stage, suggesting impaired osseointegration or delayed healing. The current prospective study assesses early and delayed implant survival in DSPs, describes factors affecting implant failure, and proposes clinical guidelines.

### Materials and Methods

Study subjects were selected among DSPs consecutively treated at the Centre of Special Dental Care at Ghent University Hospital from 2009 to 2011. Selection criteria were as follows: (1) unable to function with a removable denture; (2) having at least 8.5 mm bone height; (3) having no contraindications for general anesthesia; (4) able to undergo noninvasive treatment procedures without sedation; (5) sufficient mouth opening; and (6) signed informed consent provided by the patient, parent, or legally appointed caregiver. The study was approved by the ethical committee of the Ghent University Hospital (2009/138).

Antibiotics were administered prior to implant placement (amoxicillin 500 mg 3 times/day for 7 days), which was performed under general anesthesia using open-flap surgery with the protocol proposed by the manufacturer (Biomet 3i). Under-preparation of the implant bed was allowed to increase initial implant stability whenever the surgeon considered the bone quality soft. A two-stage protocol was preferentially chosen to avoid excessive tongue pressure on the implants. Impressions and wax bite registrations were taken during surgery to have the fixed restorations ready at the time of implant exposure under general anesthesia, after 4 to 6 months. Single restorations could all be placed at the time of second surgery, but in case of multi-implant constructions only the metal frame was fitted. The fixed screw-retained restorations were placed a few weeks thereafter, with or without general anesthesia depending on the cooperation of the patient. Oral hygiene instructions were given to the patients, parents, or caregivers, and recall sessions

### Table 1 Overview of Clinical Studies with Information on Number of Patients with Down Syndrome (DSPs) Treated, Number of Placed and Failed Implants, and Average Follow-up Time

<table>
<thead>
<tr>
<th>Study</th>
<th>DSPs treated (n)</th>
<th>DSPs with failed implants (n)</th>
<th>Failed/placed implants (n [%])</th>
<th>Follow-up time (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corcuera-Flores et al15</td>
<td>6</td>
<td>2</td>
<td>9/31 (29)</td>
<td>4</td>
</tr>
<tr>
<td>Limeres Posse et al16</td>
<td>25</td>
<td>8</td>
<td>17/73 (23)</td>
<td>1–10</td>
</tr>
<tr>
<td>Saponaro et al17</td>
<td>1</td>
<td>0</td>
<td>0/3 (0)</td>
<td>2</td>
</tr>
<tr>
<td>Ribeiro et al18</td>
<td>1</td>
<td>0</td>
<td>0/13 (0)</td>
<td>2.5</td>
</tr>
<tr>
<td>Soares et al19</td>
<td>1</td>
<td>0</td>
<td>0/1 (0)</td>
<td>4</td>
</tr>
<tr>
<td>Van de Velde et al20</td>
<td>1</td>
<td>1</td>
<td>2/5 (40)</td>
<td>3</td>
</tr>
<tr>
<td>Oczakir et al21</td>
<td>3</td>
<td>0</td>
<td>0/8 (0)</td>
<td>7</td>
</tr>
<tr>
<td>Ekfeldt22</td>
<td>2</td>
<td>1</td>
<td>2/4 (50)</td>
<td>5</td>
</tr>
<tr>
<td>López-Jiménez et al23</td>
<td>4</td>
<td>2</td>
<td>3/unknown</td>
<td>5.5</td>
</tr>
<tr>
<td>Lustig et al24</td>
<td>1</td>
<td>1</td>
<td>1/4 (25)</td>
<td>2.5</td>
</tr>
<tr>
<td>Absolute summative failure rate</td>
<td>45</td>
<td>15 (33%)</td>
<td>31/142 (22)</td>
<td></td>
</tr>
</tbody>
</table>

Absolute implant failure rate is calculated based on the total number of all available cases in the literature.
were planned for 1 week after placement and at 3, 6, and 12 months. Thereafter, recall frequencies were set on an individual basis. Given the experience within the Centre for Special Dental Care, it was deemed impossible to assess the peri-implant health-related parameters as suggested in consensus reports. A more pragmatic approach was used based on visual clinical inspection of soft tissue and plaque by an experienced calibrated periodontal specialist (M.G.) using the four-scale index suggested by De Bruyn et al. This index rates the oral hygiene as perfect, acceptable, to be corrected for prevention, or unacceptable. Chairside radiographic evaluation by means of periapical radiographs (preferred) or orthopantomograms was performed whenever possible. The bone level around the implants was compared to the baseline situation at the time of prosthetic loading. Due to the small sample size, only descriptive statistics were performed.

Results

A total of 57 implants were placed in eight DSPs (two women and six men) with a mean age of 45 years (SD 10.3; range 23 to 54 years). After a mean follow-up of 5 years (SD 1.5; range 3.6 to 8.2 years), six patients with 45 implants could be evaluated. One patient moved, and one patient suffered from early dementia and was moved to a different healthcare facility and hence unable to attend. Seven implant failures were recorded in two patients, yielding a survival rate of 84.4% on the implant level and 66.7% on the patient level. All failures occurred within 3 three months of implant placement. Of the failures, 5 occurred in the maxilla and 2 in the mandible. Oral hygiene was rated to be corrected for prevention in one patient and unacceptable in five patients, meaning that none showed an acceptable level of oral hygiene. Bone level evaluations were only attainable in three patients because many blurry images could not be evaluated reliably. It was possible to take perfectly readable periapical radiographs in only one patient with 2 implants and panoramic radiographs in two patients with a total of 18 implants. After a mean follow-up of 5 years (SD: 0.3; range 4.8 to 5.6) the mean crestal bone loss for 20 implants was 1.7 mm (SD 0.9; range 0.3 to 4.7 mm).

Case Discussions

Case 1

A 23-year-old man presented with agenesis of the mandibular left central incisor and right second premolar (Fig 1a); the left central incisor was replaced by a tapered implant 3.25 mm in diameter and 13 mm in length. Due to the narrow ridge, a buccal dehiscence of 3 mm was present (Fig 1b). At the position of the right second premolar, a tapered 4 × 8.5-mm implant with a 3-mm healing abutment was placed using a one-stage protocol. A periapical radiograph confirmed the correct position of the impression coping and was considered as baseline for further bone level measurements (Fig 1c). The sutures were removed after 1 week in an ambulatory setting. Follow-up was performed every 4 to 6 months. As shown in Figs 1g to 1j, the implant at the position of the right second premolar shows stable bone levels even after 5 years in function. Yet the implant at the position of the left central incisor shows progressive bone loss over time (Figs 1d to 1f).

Case 2

A 24-year-old man was fully edentulous in the mandible and partially edentulous in the maxilla due to decay. Implants were placed at the positions of the maxillary right lateral incisor and canine (3.25 × 13 mm), mandibular right second premolar (3.25 × 10 mm), mandibular right central incisor (3.25 × 13 mm), and mandibular left lateral incisor and canine (3.25 × 11.5 mm) (Fig 2a). Impressions and bite registration were performed at the time of implant placement. During second-stage surgery, the metal framework of the shortened fixed screw-retained prosthesis was fitted but the implant at the position of the mandibular right second premolar was mobile due to nonintegration and removed. The metal framework was shortened, and an implant-supported bridge of six teeth supported by three implants was placed under general anesthesia 6 months after implant placement (Fig 2b). During placement of the fixed partial prosthesis in the maxilla, the implant at the position of the maxillary right lateral incisor


appeared not to have integrated and was consequently removed. After curettage of the osteotomy, a new wider-diameter implant of 4 × 13 mm was immediately placed and immediately loaded to avoid an additional narcosis. After 2 months of loading, both maxillary implants failed again. After discussion with the patient and his parents, it was decided not to replace them. Oral hygiene measures by the parents and professional maintenance every 3 months by the dentist were performed. Compliance was good for 3 years, but during years 4 to 8 the recall frequency dropped to once a year. At 5 years post–implant placement, the implant-supported restoration was still in function (Fig 2c) but excessive calculus was found at the prosthetic restoration (Fig 2d).

Case 3

A 41-year-old man presented with multiple missing teeth due to chronic periodontitis (Figs 3a and 3b). Initial treatment, including scaling and root-planing and extraction of the maxillary right canine, maxillary left second molar, mandibular left lateral incisor and canine, and mandibular right canine, second premolar, and first molar were performed under local anesthesia. The patient was cooperative and could maintain good oral hygiene. Implant treatment was planned for 3 months postextraction. Four implants were placed in the maxilla to support a fixed partial denture, and five implants were placed in the mandible to support a complete fixed denture. Implants at the sites of the maxillary left central and lateral incisors were 3.25 mm in diameter, with a length of 11.5 or 8.5 mm. At the sites of the maxillary right lateral incisor and first premolar, the bone width allowed 4-mm-diameter implants with lengths of 13 and 8.5 mm. In the mandible, implants were 4 × 11.5 mm at the sites of the left central incisor and right
canine and first premolar, and 4 × 13 mm at the sites of the left lateral incisor and canine. After 4 months, second-stage surgery was performed. The prosthetic restorations were placed under local anaesthesia (Fig 3c). Although oral hygiene was limited at the implant-supported restoration, stable bone levels were evident after a follow-up of 5 years (Figs 3d and 3e).

Case 4

A 51-year-old DSP had multiple diastemas and multiple endodontic and restorative problems (Fig 4a). Total extraction was performed under general anaesthesia followed 4 months later by implant treatment. Tapered implants 4 × 11.5 mm were placed at the locations of the maxillary right lateral incisor and first premolar, maxillary left central incisor, mandibular right canine and second premolar, and mandibular left second premolar; 4 × 13-mm implants were placed at the location of the maxillary right first molar, maxillary left canine and first molar, and mandibular right central incisor. At the mandibular left central incisor position, an implant of 3.25 × 13 mm was placed. At the location of the

Fig 2 A 24-year-old patient received 2 implants in the maxilla and 4 in the mandible (a). Within the first year, the 2 implants in the maxilla and 1 implant in the mandible failed. The remaining implants and restoration were still in function after 1 (b) and 5 years (c, d).

Fig 3 A 41-year-old patient presented with multiple edentulous spaces and general chronic periodontitis (a, b). The radiograph made at placement of the fixed restoration is presented (c). After 5 years, the restoration was still in function and minimal crestal bone loss was evident (d, e).
mandibular left canine, the implant was 4 × 10 mm. The implants at the locations of the maxillary right first premolar, maxillary left central incisor, and mandibular left canine were not integrated and were removed. A complete fixed denture supported by four implants in the maxilla and five implants in the mandible was fabricated, avoiding another general anesthesia session (Fig 4b). The patient was not compliant with oral hygiene measures, and therefore a recall interval of 2 to 3 months was planned. After 2 years of strict recall, the patient missed multiple recall visits thereafter. Despite inadequate plaque control, stable bone levels were recorded after nearly 5 years. (Figs 4c and 4d).

Discussion

This paper describes a clinical case series in which implants were evaluated in DSPs and provides clinical guidelines to maximize treatment outcomes. The implant survival rate of 84.5% is comparable with a previous case series yet significantly lower than implant survival rates in the general population. Survival rates of similar implants in patients without Down syndrome at Ghent University are 96.3% and 99.1%, respectively, after 5 to 7 years. A higher number of early failures accounts for the lower implant survival rates in DSPs. Once integrated, implant outcomes seem comparable to those of the general population. In a clinical study at Ghent University in patients without Down syndrome, a mean crestal bone loss of 1.6 mm (SD 0.77) was reported, comparable with the mean crestal bone loss measured in this study. A comparable mean crestal bone loss (1.8 mm; SD 0.6) was also reported in a previously published case series. However, the suggestion of stable crestal bone levels in DSPs should be interpreted with care due to the limited number of cases that could be evaluated.

A major drawback of the study is that the parameters for peri-implant health evaluation and the incidence of peri-implantitis could not be assessed. On the other hand, from the clinical assessment it is clear that the oral hygiene level of the study population was unacceptable and should be improved. Since DSPs are often dependent on caregivers, compliance was irregular. Although oral hygiene instructions were given at the start of the treatment and during maintenance visits, the outcome was ineffective and the result rather poor and insufficient, as shown in Case 4. There are many levels of developmental delay among DSPs. Only patients who were prosthetically treatable without sedation were selected for this study. Therefore, the conclusions of this study pertain to the least-compromised DSPs. Regardless of this selection, oral hygiene was still problematic and requires more attention. However, this inadequate oral hygiene did not always affect the bone levels. This finding was also described in a study of 134 implants in 61 patients with severe epilepsy and multiple disabilities followed for 16 years.
years, Stable bone levels and a high implant survival rate (97.6%) were recorded despite poor oral hygiene. While plaque control should not be neglected, these findings question the predictive value of oral hygiene alone in long-term implant treatment outcomes. The planned radiographic assessment was incomplete due to limited patient cooperation during chairside examination, but it was deemed unethical to bring patients under sedation for this merely scientific requirement. Hence, reporting implant success was impossible and is an additional shortcoming of the study.

DSPs are high-risk patients due to systemic factors and impaired immunity and wound healing, which may interfere with osseointegration. Furthermore, complicating local factors such as limited bone volume, impaired bone quality, and excessive tongue pressure may lead to early implant failure. Immediate loading should be avoided, as demonstrated in Case 2 and in accordance with the literature. Complicating factors may impair initial osseointegration and may affect crestal bone loss. Although implants survived in Case 1, the anterior implant showed progressive bone loss possibly related to excessive tongue pressure and initial bone dehiscence (Fig 1c). These complicating factors were not present at the implant at the location of the mandibular right second premolar, where minimal bone level changes were seen after 5 years.

It could be argued that implant treatment in DSPs is inappropriate, due to the higher risk of peri-implantitis associated with low oral hygiene levels. This decision should be balanced with respect to the advantage it brings to the patient in terms of oral health–related quality of life. For liability reasons, proper information must be given to the caregiver and professional maintenance must be organized on an individual basis. Based on the observations, considerations, and issues experienced during the treatment and follow-up of this case series, clinical yet pragmatic guidelines are proposed. These are summarized in Table 2 and relate to patient selection, surgical site selection, and surgical and prosthetic protocol.

Conclusions

This descriptive case series suggests that Down syndrome is not a contraindication to placement of dental implants, but multiple complicating factors yield reduced implant survival. Sufficient bone volume, a fully embedded implant, and delayed loading may lower the initial failure rate and ensure long-term bone stability, provided oral hygiene and compliance are high.

Acknowledgments

This study was supported by a research grant providing material support by Biomet3i (Palm Beach, FL, USA), and Prof De Bruyn disclosed on behalf of Ghent University a research and education grant from Biomet3i during the period of patient inclusion. The authors reported no conflicts of interest related to this study.

Table 2 Clinical Guidelines for Implant Therapy in Down Syndrome Patients

| Patient selection:  | Select highly motivated patients and caregivers. Noninvasive treatments should be possible chairside. |
| Surgical site selection and protocol: | Place the implant in bone with sufficient volume (Case 2). Do not allow a buccal dehiscence (Case 1). Select a fully imbedded smaller-diameter implant when limited crestal bone volume is present. Avoid immediate placement (Case 2). Avoid bone regenerative procedures. Place a sufficient number of implants in extensive prosthetic rehabilitation to counter for initial implant failures (Case 4). |
| Prosthetic protocol: | Avoid immediate loading (Case 2). Use screw-retained constructions to facilitate repair and maintenance. |
References


