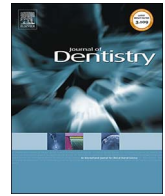




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## Long-term implant performance and patients' satisfaction in oligodontia

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### ABSTRACT

**Objectives:** To assess long-term ( $\geq 10$  years) implant survival, peri-implant health, patients' satisfaction and oral health related quality of life (OHQoL) in oligodontia patients rehabilitated with implant-based fixed prosthodontics.

**Methods:** All oligodontia patients treated  $\geq 10$  years previously with implant-based fixed prosthodontics at the University Medical Center Groningen, The Netherlands, were approached to participate. Clinical (plaque index, bleeding index, pocket probing depth) and radiographic (marginal bone level) data were collected between February and May 2016. Surgical implant details (e.g., bone augmentation) and implant loss were recalled from the medical records. Patients completed a satisfaction questionnaire (maximum score 10, high score favourable satisfaction) and the Oral Health Impact Profile (OHIP-NL49, maximum score 196, low score favourable satisfaction) to rate OHQoL. Implant survival was expressed according to Kaplan Meier. The Mann-Whitney U Test was used for the other analyses.

**Results:** Forty-one patients had been treated with implant-based fixed prosthodontics ( $n = 258$ )  $\geq 10$  years previously. Cumulative 10-year implant survival of these 41 patients was 89.1% (95%CI 85.2–93.0%). Twenty-eight of them ( $n = 163$  implants) were willing to visit us for additional clinical and radiographic assessments. In these 28 patients, highest peri-implant bone loss was observed for implants placed in augmented bone ( $p < 0.001$ ). Peri-implant mucositis (65.4%) and peri-implantitis (16.1%) were rather common. Patients' satisfaction ( $8.3 \pm 1.5$ ) and OHIP-NL49 scores ( $32.6 \pm 30.1$ ) were favourable and not associated with number of agenetic teeth ( $\leq 10$  versus  $> 10$ ).

**Conclusions:** Long-term survival, satisfaction and OHQoL results reveal that implant treatment is a predictable and satisfactory treatment modality for oligodontia, although peri-implant mucositis and peri-implantitis are common.

**Clinical significance:** This study showed unique long-term ( $\geq 10$  years) results about implant survival, peri-implant health, patients' satisfaction and OHQoL in oligodontia patients rehabilitated with implant-based fixed prosthodontics.

### 1. Introduction

Oligodontia is the congenital absence of six or more permanent teeth, excluding third molars [1]. Oligodontia patients commonly suffer from functional and aesthetic problems due to the high number of missing teeth and usually need rather complex oral rehabilitation.

It has been reported that implant treatment is a favourable option to functionally and aesthetically rehabilitate oligodontia patients [2], but the long-term performance of implant-based rehabilitations in such patients is not known yet. Knowledge concerning the long-term implant performance for oligodontia patients is eagerly needed as, in

comparison to non-compromised patients, bone augmentation is more often required as the native bone is vertically and horizontally underdeveloped in areas with the missing teeth. It is well known that implant survival is lower in areas needing bone augmentation. Therefore, it is presumed, but not yet proven, that the bone quality differs between oligodontia patients and non-compromised patients, which could be an additional factor affecting implant-survival. The lack of native bone, the high need for bone augmentation and a possible different bone quality may also compromise peri-implant health with potentially a higher risk on the onset and/or progression of peri-implant mucositis and peri-implantitis. Peri-implant mucositis and peri-implantitis are common

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late phenomena in non-compromised patients with dental implants that may jeopardize long-term function and have an impact on long-term cost-effectiveness [3–5]. The lack of external validity due to the complex nature of the dental state prohibits translation of these findings in non-compromised patients to a population of oligodontia patients. Such data are eagerly awaited because oligodontia patients often need dental implants. Moreover, the congenitally absence of teeth negatively impacts oral health related quality of life (OHQoL) [6,7]. It has been shown that absence of several teeth negatively affects well-being, oral function and aesthetics of oligodontia patients [6]. It is presumed that implant-based fixed prosthodontics will result in better oral function and aesthetics in these patients.

To adequately advise oligodontia patients and dental professionals about the expectations of implant-based fixed prosthodontic rehabilitation in oligodontia, insight is needed into long-term implant performance in these patients. This includes the condition of the peri-implant tissues as well as the factors that may potentially affect the treatment outcome, e.g., the need for bone augmentation surgery. Such data are lacking in literature. Therefore, we performed a study to assess the long-term ( $\geq 10$  years) implant survival, peri-implant health, patients' satisfaction and OHQoL in oligodontia patients rehabilitated with implant-based fixed prosthodontics.

## 2. Materials & methods

### 2.1. Treatment schedule

#### 2.1.1. Surgical procedure

Implants were placed after growth was finished. In the early days, when treatment need was high and the patient was younger than 18 years of age, a radiograph of the carpal and tarsal bones of the hands was made. When the cartilaginous zones of the epiphyses became obliterated, it was presumed that no further lengthening of the bones would occur. Later on, no implants were placed before the age of 18. All implants were placed according to the manufacturer's protocol by the same surgeon (GMR). Bone augmentation was performed, as and when required, during the same surgical procedure, unless the patients needed extensive bone augmentation. In those cases, augmentation surgery was performed prior to implant placement and the implants were placed four months after augmentation (see Table 1).

#### 2.1.2. Prosthetic procedure

After an osseointegration period of 3 months, the implants were uncovered and implant-based fixed suprastructures were provided (single crown or fixed dental prostheses, see Table 1).

### 2.2. Patient selection

All oligodontia patients treated  $\geq 10$  years previously with dental implants (Nobel Biocare implants, Gothenborg, Sweden) and fixed prosthodontics at the department Oral and Maxillofacial Surgery of the University Medical Center Groningen (UMCG), Groningen, The Netherlands, were identified and contacted by mail. Patients who did not respond were contacted by telephone. Those who could not be reached by any means were excluded. Routinely, three years after providing the patients with the fixed prosthodontics, the general practitioners of the patients were asked to take over routine dental care and follow-up.

The responding patients came to the hospital and were asked if they had any complaints regarding their implants over the period since their last hospital visit. Subsequently, with permission of the patient, a thorough clinical and radiographic implant examination was performed. All clinical and radiographic data were collected between February and May 2016. The need for bone augmentation, implant loss and its presumed cause were recalled from the medical records. As this research was an evaluation of routine dental care, the medical ethical

**Table 1**  
Patient, surgical and suprastructure information.

Patient information	
Number of patients	28
Current median age, years (IQR)	33 [31,39]
Gender (male/female)	12/16
Median number of agenetic teeth (third molars excluded) (IQR)	10 [8,14]
Surgical information	
Total number of placed implants $\geq 10$ years ago	184
Median age at implant placement, years (IQR)	20 [19,21]
Number of implants placed in regions where bone augmentation was performed (% of 184), with the following donor regions:	96 (52%) (in 23 patients)
intra-oral bone (%)	31 (32%)
extra-oral bone (%)	65 (68%)
Number of implants placed in regions where bone augmentation was performed as a pre-implant procedure	61 (64%)
Number of implants placed simultaneously with bone augmentation	35 (36%)
Suprastructures	
Number of implants with single crowns (%)	118 (64%)
Number of implants with fixed prostheses (%)	61 (33%)
Number of implants which never received a suprastructure due early implant loss (%)	5 (3%)

committee of the University Medical Center Groningen granted this study an exemption (M16.188270).

#### 2.2.1. Implant survival

The cumulative survival was calculated for all implants placed  $\geq 10$  years previously, i.e., from the time of placement of the implants until the date of implant loss or patients' last visit to the UMCG or general practitioner.

#### 2.2.2. Clinical assessments

The following clinical parameters were scored during the clinical examination:

– *Plaque according to the modified plaque index* [8]: 0 = No visible plaque; 1 = Plaque only recognized by running a periodontal probe across the smooth marginal surface of the implant; 2 = Plaque can be seen by the naked eye; 3 = Abundance of soft matter.

– *Bleeding on probing (bleeding index) according to the modified sulcus bleeding index* [8]: 0 = No bleeding when a periodontal probe is passed along the gingival margin; 1 = Isolated bleeding spots visible; 2 = Blood forms a confluent red line on the gingival margin; 3 = Heavy or profuse bleeding.

– *Probing pocket depth (PPD)*: Pocket probing depth was assessed at six sites per implant (distobuccal, buccal, mesiobuccal, distolingual, lingual, mesiolingual) using a manual standardized pressure periodontal probe (Click-Prober, Kerr, Bioggio, Switzerland), measured to the nearest mm.

#### 2.2.3. Marginal bone loss

Panoramic radiographs and standardized intra-oral radiographs (baseline, made shortly after completion of the prosthodontic rehabilitation and current situation) of each patient were uploaded in ImageJ [9].

#### 2.2.4. Peri-implant mucositis and peri-implantitis

Peri-implant mucositis was defined as bleeding upon probing with or without suppuration and  $< 2$  mm radiographic bone loss. Peri-implantitis was defined as bleeding upon probing with or without suppuration and  $\geq 2$  mm radiographic bone loss [10,11]. The translation

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