Implant-Surgical and Prosthetic Rehabilitation of Patients with Multiple Dental Aplasia: A Clinical Report

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The expanded experience with oral implants and supplementary augmentation techniques has opened new possibilities for treating patients with oligodontia or anodontia with fixed prostheses. A problem in treating such patients is the need to place implants in growing maxillae or mandibles, as many of these patients are children or adolescents. When implant treatment is postponed until the patient is full grown, dysfunctions become manifest, which necessitates extensive surgical measures to achieve a fixed prosthetic restoration. This report illustrates the problems associated with different concepts for the treatment of multiple aplasia with implants. The results are based on the findings of 22 patients with oligodontia who underwent surgical treatment and were followed over a period of 5 years. Two controversially treated cases are presented.
(Int J Oral Maxillofac Implants 1999;14:417–423)

Key words: bone atrophy, dental aplasia, growth, implants, timing of implant placement

Successful long-term treatment of patients with oligodontia or anodontia with fixed or partially removable dentures constitutes a challenge for dentists today. It is beneficial when treatment is started early for anatomic, functional, esthetic, and psychologic reasons. Most authors have recommended purely prosthetic solutions, such as bonded prostheses, metal framework prostheses, or resin dentures.[1–3] In some cases, the alignment of single teeth using orthodontic techniques or tooth transplantations can facilitate prosthetic treatment.[4–6]

According to a 1996 Consensus Conference on Oral Implants in Young Patients,[7] the following definitions are used: "hypodontia" is defined as the absence of 1 to 5 permanent teeth, while the term "oligodontia" refers to the absence of 6 or more permanent teeth and "anodontia" to the absence of all permanent teeth. The incidence rates among European populations given for the congenital absence of 1 or more teeth range between 0.3% and 13.6%, not taking third molars into account.[8,9] Oligodontia, the absence of 6 or more teeth, is a much rarer disorder; the incidence rate suggested by Schalk van der Weide[10] is 0.08% of the population. Anodontia is encountered in an even smaller percentage of patients.

Increased experience with oral implants and supplementary augmentation techniques has created new options for the prosthetic treatment of patients with oligodontia or anodontia. It has even become possible to treat many of these patients with a fixed prosthesis. Early implant treatment has an advantage in that it may help prevent bone atrophy or a lack of development of the alveolar process. However, a disadvantage is that, unlike teeth, implants cannot grow together with the growing jawbone.[11–14]

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Anatomic and Physiologic Fundamentals

Until age 4, the maxilla grows in a vertical direction, mainly through being displaced in a caudal-ventral direction in the course of craniofacial growth. Later, the growth pattern is characterized by sutural growth in the marginal regions and local bone apposition. The mandible develops in a V-form as a result of the growth of the ascending mandibular ramus and the mandibular condyle in a cranial and posterior direction as well as by bone apposition to and resorption of the body of the mandible in a buccolingual direction (remodeling).[15]

Development of the alveolar process via local apposition of bone requires the presence of local teeth.[16,17] As the dentition is essential to the formation of the maxillary and mandibular alveolar processes, the congenital absence of a larger number of teeth results in a decrease in growth stimuli to the jawbone.[1,18,19] This leads not only to a local bone deficit, but also inhibits the development of the entire bony masticatory apparatus, the most severely affected region being the maxilla, with severe hypoplasia and pseudoprognathism. Using lateral cephalograms, Korkhaus[20] and Kloeppel[21] demonstrated that the absence of a greater number of teeth results in growth inhibition as far as the middle face. Furthermore, they observed a certain correlation between the extent of growth inhibition and the number of congenitally missing teeth. The disharmonious appearance of such patients is further aggravated by a reduced lower facial height, compared with normal conditions. When oligodontia is left untreated, the juvenile jaws and the maxillomandibular relationship undergo early anatomic aging, resulting in an "optical senescence" of the lower facial half.

The most common clinical consequences resulting from this defective development are retained deciduous teeth, displacement of existing permanent teeth, false diastemas, impaired growth of the alveolar processes, pseudoprognathism, and a deep bite.[21]

Problem

There are basically 2 different ways to use implants in the treatment of oligodontia and anodontia to facilitate prosthetic treatment with a fixed or removable partial denture. When adolescent patients are treated with implants, a more or less severe malposition of the implants must be expected, depending on the implant host site and the age of the patient. However, implants can often be placed without supplementary surgical measures because the alveolar ridge formed during the eruption of the deciduous teeth can be used as a host site.

When implant treatment is postponed until the patient is full grown, the absence of an alveolar ridge or ridge resorption in the edentulous area and the occurrence of severe growth impairments and dysfunctions may necessitate surgical measures before prosthetic rehabilitation can begin. However, in most cases, it is not possible to achieve full rehabilitation of the patient.

The aim of this study was to establish a valid treatment concept by means of long-term examination of a group of patients.

Patients and Results

Twenty-two patients with oligodontia are being treated in the Department of Oral Surgery of the Dental School of the University of Vienna. Treatment planning was carried out in cooperation with the Department of Orthodontics and Prosthodontics. The patients, 11 female and 11 male, are between 9 and 33 years old and presented with 7 to 26 congenitally missing teeth each. The patients have been followed for a period of 5 years.

Thus so far, 72 implants have been placed in 13 patients; 69 implants osseointegrated without complication, and 3 implants in 1 female patient were removed because of a lack of osseointegration following sinus floor elevation in the posterior maxilla. Another 10 patients are scheduled to undergo implant surgery in the near future. In 9 patients, supplementary surgical measures, such as sinus floor elevation, mandibular bone augmentation, or splitting of the alveolar process, were necessary. Four patients are scheduled to undergo maxillary and/or mandibular augmentation in the near future (Tables 1 to 3).

Patient Reports

The following 2 representative clinical experiences will illustrate the problems involved in treating patients with multiple aplasia.

Patient 1. A 29-year-old female patient with oligodontia of the permanent teeth and partially retained deciduous teeth was treated. Only 13 permanent teeth were present (Fig 1). To achieve appropriate spacing and orientation for planned prosthetic abutment teeth, the patient first underwent treatment with a fixed orthodontic appliance.

The patient demonstrated considerable bone resorption in the maxillary posterior region, which made primary implant placement impossible.

Table 1 Data on Patients with Oligodontia Treated with Implants without Supplementary Surgical Measures

Patient	Sex	Age (y)	No. of congenitally missing teeth	No of placed (planned) implants	Received orthodontic treatment
C.F.	F	12	11	1	Yes
S.F.	F	15	20	4	Yes
N.P.	F	13	24	9	No
S.V.	M	18	14	4	Yes
K.M.	F	18	12	3	Yes

Table 2 Data on Patients with Oligodontia Treated with Implants and Supplementary Surgical Measures

Patient	Sex	Age (y)	No. of congenitally missing teeth	No. of placed (planned) implants	Supplementary surgical treatment	Received orthodontic treatment
E.B.	M	19	26	(14)	Bilateral maxillary sinus lift	No
B.E.	F	15	15	9	Mandibular augmentation	Yes
E.G.	F	25	16	6	Bilateral maxillary sinus lift	Yes
C.T.	F	20	9	3	Mandibular augmentation	Yes
A.Z.	F	33	13	13	Bilateral maxillary sinus lift, mandibular splitting, Gore-Tex	Yes
J.D.	M	22	8	2	Bilateral maxillary sinus lift	Yes
R.B.	M	23	24	8	Bilateral maxillary sinus lift	No
D.St.	M	22	10	6	Mandibular augmentation	No
M.K.	M	10	20	4 (8)	Bilateral maxillary sinus lift	Yes

Table 3 Data on Patients with Oligodontia Scheduled for Treatment

Patient	Sex	Age (y)	No. of congenitally missing teeth	Received orthodontic treatment	Planned implants	Planned supplementary surgical measures
H.L.	M	26	7	Yes	6	Maxillary external augmentation, mandibular external augmentation
B.Sch.	F	27	13	Yes	6	Bilateral maxillary sinus lift
E.K.	F	14	16	Yes	7	None
G.Sch	M	17	11	Yes	4	Mandibular augmentation, bilateral maxillary sinus lift
F.Sch.	M	9	11	Yes	4	None
D.R.	M	17	8	Yes	6	Mandibular augmentation
M.K.	M	12	9	Yes	5	None
K.Sch.	F	11	7	Yes	3	None

Therefore, internal augmentation of the maxillary sinus (sinus lift) was carried out initially. Bovine material (Bio-Oss, Geistlich, Wolhusen, Switzerland) was used as a bone substitute. One year after the sinus lift procedure, a total of 8 cylindric titanium implants (IMZ, Friatec, Mannheim, Germany; 11 mm and 13 mm long and 3.3 mm and 4 mm in diameter) were placed in the maxilla. The deciduous molars were removed 5 weeks before this procedure.

The patient also showed extensive mandibular atrophy, especially in a buccolingual direction. Therefore, combined splitting of the alveolar process and placement of polyethylene membranes (Gore-Tex, W. L. Gore, Flagstaff, AZ) was carried out to allow placement of cylindric titanium implants (IMZ; 10 mm long and 3.3 mm in diameter) in the regions of mandibular second premolars, first molars, and right second molar. The implants were uncovered after 4 months and used as anchorage units for orthodontic uprighting of the mandibular second molars. Six months after complication-free healing and uncovering of the implants, definitive prostheses were fabricated. As a first step, an occlusal splint was fabricated to increase the severely reduced facial height by 6 mm.

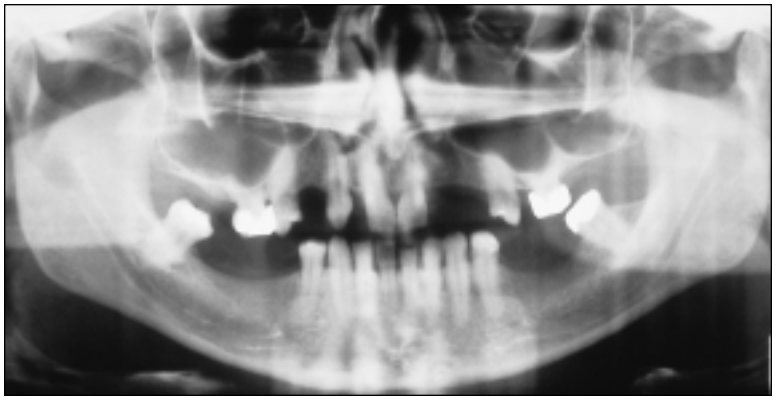


Fig 1 Orthopantomogram of a 29-year-old female with oligodontia of the permanent dentition and retained deciduous maxillary second molars.

Fig 2 Orthopantomogram of the same patient as in Fig 1, following a bilateral maxillary sinus lift, mandibular splitting, placement of IMZ implants in the maxilla and the mandible, and prosthetic treatment utilizing fixed restorations.

Then, a definitive fixed partial prosthesis was fabricated (Fig 2). The patient has been wearing the fixed partial denture for 3 years and is seen at regular recall examinations.

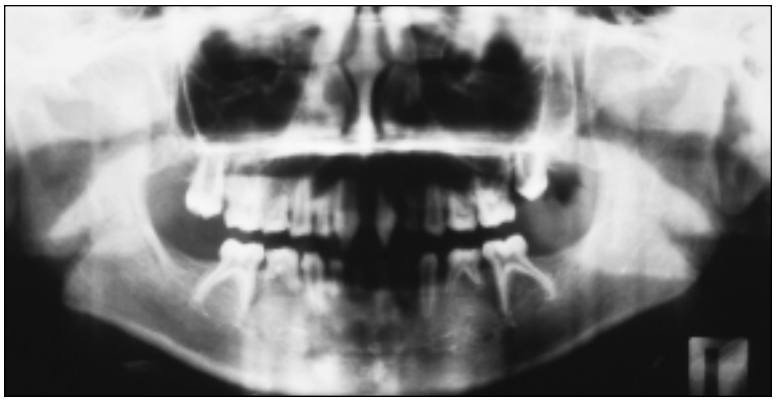
Patient 2. The second patient was a 10-year-old female (Fig 3) who suffered from oligodontia with retained deciduous teeth and an absence of all permanent teeth except for the mandibular central incisors and molars (Fig 4). Following diagnostic examinations and treatment planning, screw-shaped titanium implants (Brånemark, Nobel Biocare, Göteborg, Sweden) were placed, in spite of the patient's age, to achieve prosthetic rehabilitation with a fixed prosthesis. In the first procedure, several deciduous teeth were extracted and implants were placed in regions of the maxillary lateral incisors and first premolars and mandibular first premolars (Fig 5). Postoperatively, the patient was supplied with interim metal-based overdentures in the maxilla and the mandible. One year later, the remaining deciduous teeth in the mandible were extracted, and Brånemark implants were placed in the regions of the mandibular canines. The interim overdentures were extended accordingly. After another year, implants were to be placed in the regions of the mandibular central incisors. However, since this region had undergone extensive buccolingual bone resorption, only 1 implant could be placed in the region of the mandibular left central incisor without any supplementary surgical measures (Fig 6). After uncovering the implants in the mandible, a bar-supported fixed partial denture was placed. Deciduous mandibular second molars were supplied with single crowns. When implants in the regions of the maxillary lateral incisors and first premolars were uncovered, it was found that they had been considerably displaced in a cranial direction as a result of the onset of growth. This made it much more difficult to achieve an esthetically pleasing prosthetic result. Implants replacing the missing permanent teeth were restored with 2 implant-supported fixed partial dentures. Furthermore, single crowns were attached to the maxillary central incisors and to deciduous maxillary second molars (Fig 7).

Now 15 years of age, the patient is very satisfied with her current prosthetic restorations esthetically, functionally, and psychologically (Fig 8).

The patient is scheduled to undergo an osteotomy of the maxillary alveolar process with coronal repositioning of the segment when growth has been completed.

Fig 3 *(Left)* Photograph of a 10-year-old female with marked oligodontia, reduced lower facial height, and typical lip rhagades (optical "senescence").

Fig 4 *(Below)* Orthopantomogram showing oligodontia and partially retained deciduous teeth.



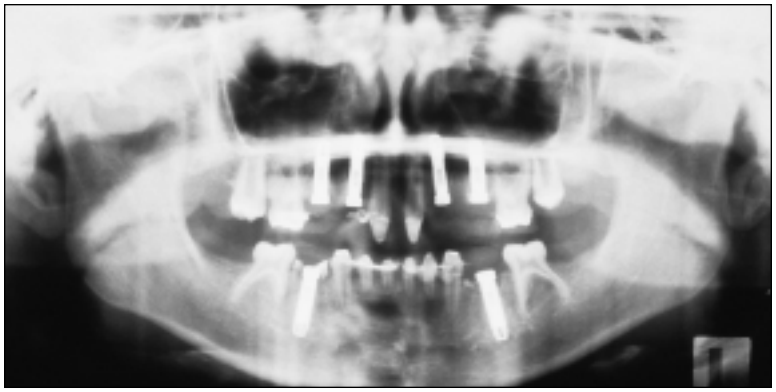


Fig 5 Orthopantomogram following placement of implants in the maxilla and the mandible.

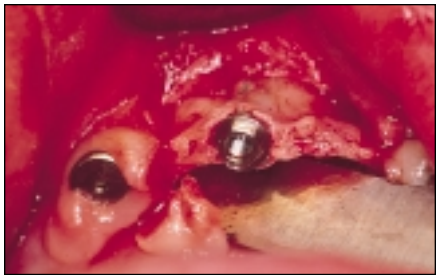


Fig 6 Intraoperative condition following extraction of deciduous mandibular left central incisor and placement of an implant in the region of mandibular left central incisor.

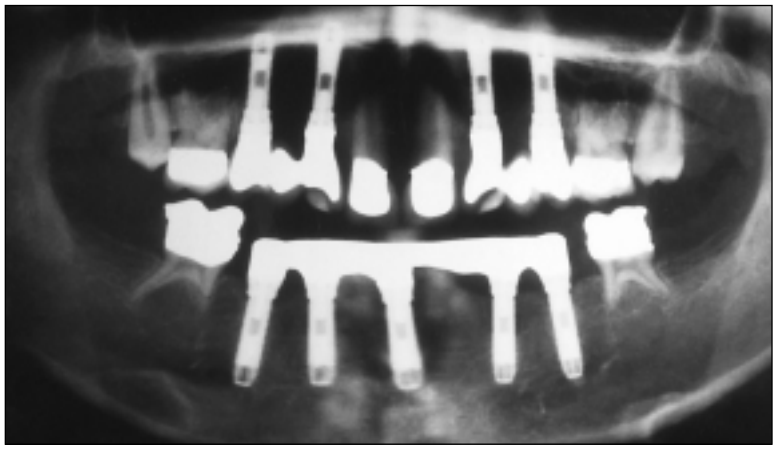


Fig 7 Orthopantomogram showing the current interim fixed prosthesis.

Fig 8 *(Right)* Photograph of the patient currently, at age 15.

Discussion

These 2 patient reports demonstrate the problem of treatment timing. In the 29-year-old patient, long-term edentulism led to a considerable bone deficit. As a result, implant treatment was possible only in combination with extensive adjunctive surgery. In contrast, the 10-year-old girl displayed a sufficient amount of local bone after timely removal of the deciduous teeth so that primary implant placement was possible. While the implants placed in the anterior mandible showed perfectly normal positioning, those in the maxilla had been considerably displaced in a cranial direction as a result of continuing growth.

There is no doubt that, in patients with only a few congenitally missing teeth, the placement of implants could generally be postponed until maxillomandibular growth has been completed to avoid functional impairment or maldevelopment. In patients with oligodontia or anodontia, implants should be placed at an earlier age, before puberty or even earlier if possible, to avoid possible functional disturbances and to support orthodontic treatment. In this case, the growth potential of the respective arch region has to be taken into account during surgical planning to avoid malposition of the implants as a result of ongoing growth. Because of its rapid growth, the anterior mandible constitutes a special situation from the implant-surgical point of view, as local growth is advanced at a relatively early age, around age 6.[22,23]

In contrast, marked growth episodes must be expected in the mandibular posterior region and, to an even greater degree, in the entire maxilla. When implants are placed in these regions either for orthodontic or for prosthetic reasons, there is a chance that they will need to be removed later or that an osteotomy will need to be carried out after the completion of growth to reposition the bone segment housing the implant.[24] A possible drifting of the implants, as with natural teeth, is not to be expected under any circumstances.[11–14] Possible further bone growth can be compensated by selecting an adequate implant position. However, this is possible only to a limited degree and only in a horizontal direction. Thus, implants should be placed as far buccally and mesially as possible during this phase of growth to ensure that their position permits prosthetic rehabilitation after the completion of growth. It is impossible to predict further vertical growth of the jawbones.

Implant treatment alone, without any functional use of the implants in the context of prosthetic treatment, cannot prevent resorption or maldevelopment of the alveolar process. However, under no circumstances must the prosthetic restoration inhibit further growth. Therefore, minimal prosthetic restorations that do not extend beyond the midline are indicated in the maxilla.[25–27] It is still unclear what advantages may result from the functional load of implants on bone.

In principle, this type of treatment requires close cooperation among orthodontists, prosthodontists, and oral surgeons, with coordination of the treatment phases in all or any of these disciplines, taking into account the degree of edentulism and associated maxillomandibular deformation.[28] When there is associated illness, such as ectodermal dysplasia, all treatment schemes should be coordinated with other specialists or psychologists involved. No definitive treatment concept that can be applied to all cases of oligodontia or anodontia can be currently recommended. The treatment options suggested here should be seen as an attempt to define and discuss increasingly acknowledged treatment guidelines.

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