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Short Communication

Implant-supported provisional prosthesis facilitated the minor revision of occlusion and incisor exposure after orthognathic surgery of extended oligodontia in maxilla

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Abstract *Background:* The congenital oligodontia in maxilla could result in a significant skeletal jaw malformation such as atrophic maxilla and severe skeletal class III malocclusion. Since there is no referable dentition in anterior maxilla, the orthognathic surgery and oral rehabilitation for those patients becomes more challenging and less predictable.
Materials and methods: We hereby present a new sequencing of interdisciplinary treatments, including calvarial bone grafting, installation of implant-supported provisional prosthesis, bimaxillary orthognathic surgery, and the final installation of dental implants and the fixed prosthesis.
Results: The facial esthetics and function of the permanent prosthesis were satisfactory, with a remarkable improvement in the maxillomandibular relation, adequate horizontal and vertical repositioning of the maxilla, and appropriate incisor exposure.
Conclusion: Although more surgeries and longer treatment period may be required due to the interdisciplinary treatment plan, better aesthetic and functional outcomes may be acquired by this reported procedure in the long-term for young patients.

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Introduction

The congenital absence of large numbers of teeth, which is called oligodontia, can seriously disable a young person both physically and emotionally.[1] The missing of the teeth could result in a reduced alveolar bone growth in the adolescent patients. Thus, patients with extended oligodontia in maxilla often present with significant skeletal jaw malformations such as atrophic maxilla, severe class III malocclusion with disproportionate facial structures and unfavorable maxillomandibular relationship.[2] These maxillomandibular discrepancies can often make the fixed implant-supported rehabilitation challenging and less predictable.

To achieve a good balance between the function and esthetics in patients with oligodontia in maxilla and the severe class III malocclusion, an interdisciplinary treatment planning is essential. It should include preprosthetic surgical procedures such as bone grafting, orthodontics, orthognathic surgery, and implant placement, then followed by final prosthetic rehabilitation. Since the repositioning of the jaws is determined by the pre-fabricated occlusal splint during the orthognathic surgery, a fixed full dentition is needed before surgery. However, with the presence of the implants in the maxilla, the post-surgical orthodontics in the maxilla is almost impossible. In this circumstance, a slight relapse after the orthognathic surgery could lead to a new malocclusion and worse incisor exposure.

On the basis of several approaches which were reported in such cases,[3] here we present a new sequencing of interdisciplinary treatments to meet the patient's functional and esthetic expectations, which involved calvarial bone grafting, installation of two implants, fabrication of implant-supported provisional prosthesis, pre-surgical orthodontics, bimaxillary orthognathic surgery, and the final restoration of dental implants and the fixed prosthesis.

Materials and methods

Three cases of congenital oligodontia in maxilla who were referred to the department of oral and craniofacial surgery, Shanghai ninth people's hospital with the chief complaint of upper removable denture instability were collected and reviewed by authors. These cases presented with multiple maxillary missing teeth due to the congenital oligodontia, which may be related to the ectodermal dysplasia, and the discrepancy of the jaws. The anteroposterior, vertical, and transverse deficiencies of the maxilla were confirmed by clinical and radiographic examinations. A typical patient was a 24-year-old female, who presented with maxillary missing teeth from the right first molar to the left first molar. In order to restore the appropriate prosthesis to an ideal position in the maxilla of the patient, a multi-discipline treatment plan was established. Informed written consent was obtained from the patients for publication of this case series and accompanying images.

Initially, grafting procedures were performed in the maxilla using the autogenous calvarial mono-cortical bone block under the general anesthesia. The calvarial bone was harvested using a standard technique, to remove 4—6 outer table calvarial bone blocks measuring approximately $1.5 \times 1.0 \times 0.3$ cm (length $\times$ width $\times$ height) each. Intraorally, after reflection of the mucoperiosteum, the calvarial bone blocks were fixed buccally onto the alveolar process with 1.3 mm diameter microscrews. After periosteal release, the mucosa was closed tensionless. During the graft healing phase, a lower orthodontic appliance was applied for alignment, leveling, and decompensation of the lower teeth. After a graft incorporation period of 3 months, two maxillary dental implants were placed on the bilateral canine zone for the support of a provisional dental prosthesis without compensation to maintain a maxillomandibular Class III malocclusion relationship (Fig. 1). After completion of lower orthodontics, the orthodontic brackets were applied to the maxillary prosthesis for intermaxillary fixation during surgery and postoperative elastic therapy.

Preoperative radiographs for planning orthognathic surgery were obtained. The orthognathic surgery planning with facial analysis was performed. Bimaxillary orthognathic surgery was performed uneventfully with advancement of the maxilla to create an appropriate facial profile and occlusal relationship, and surgical splints were used during surgery. The intraoperative intermaxillary fixation (IMF) was carried out. The orthodontic appliances were maintained postoperatively for elastic therapy and lower orthodontic finalization.

Six months after surgery, the upper provisional prosthesis was removed and three extra dental implants were installed on the anterior and bilateral maxillary region. After a 6-month healing period, the orthodontic appliance was removed, and an upper permanent prosthesis was fabricated with a metal framework and esthetic porcelain, which was adjusted for the optimal occlusion (Fig. 2).

Results

After the restoration of the maxillary dental arch, the patients were satisfied with the esthetics and function of the permanent prosthesis. A remarkable improvement in the maxillomandibular relation was achieved, which allowed for the preparation of an upper prosthesis without prosthetic compensation. Improvement in facial esthetics also was noted, with adequate horizontal and vertical repositioning of the maxilla. Postoperative radiographs at 36 months showed proper positioning of the mandible and

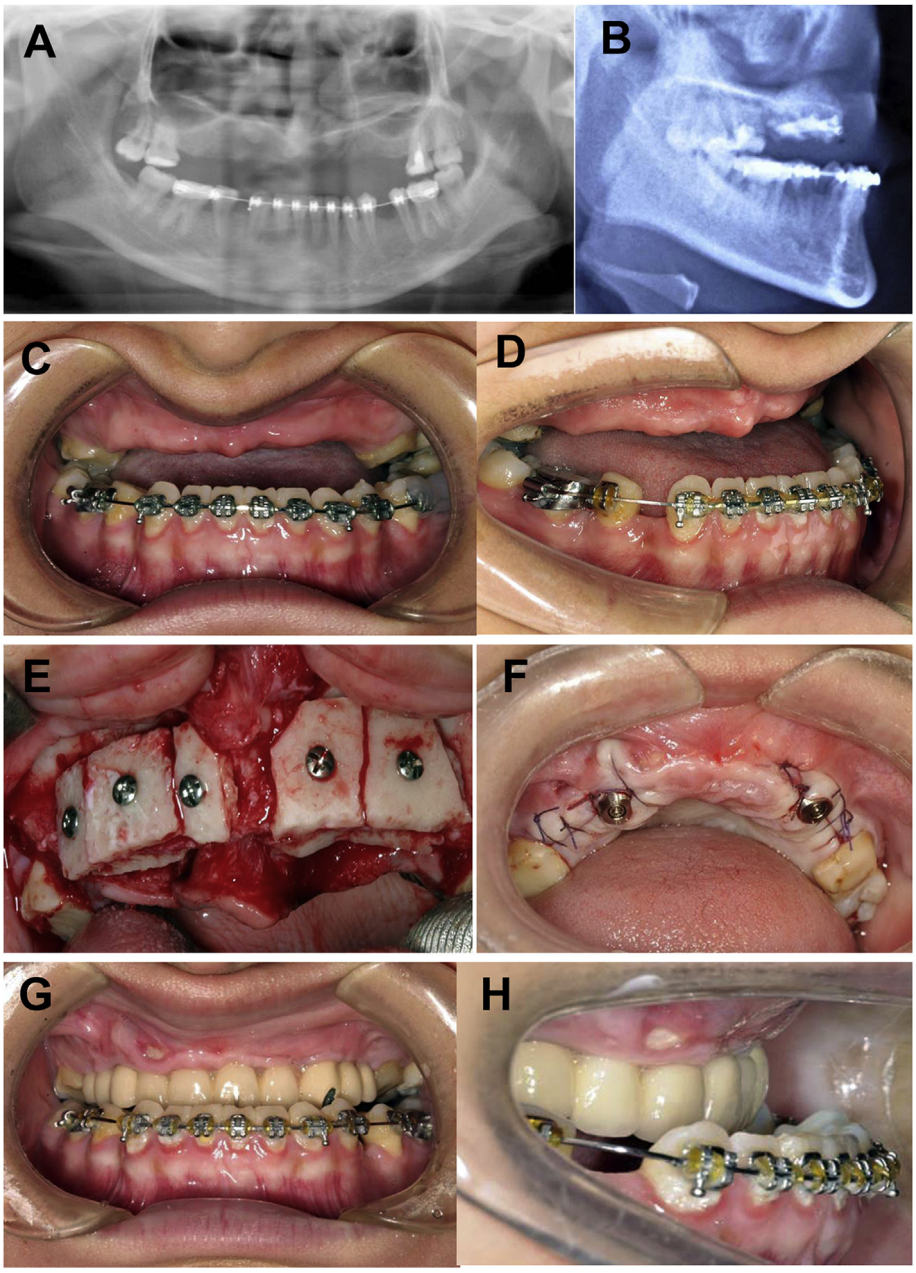

Figure 1 (A) Patient's initial panoramic radiograph displayed maxillary missing teeth from the right first molar to the left first molar. (B) The lateral cephalometric radiographs before surgery showed the severely atrophic alveolar in maxilla. (C and D) The Intraoral pictures of the patient before treatment showed a large maxillomandibular discrepancy. (E) The calvarial bone blocks were harvested and fixed buccally onto the alveolar process with micro-screws. (F) Two maxillary dental implants were placed on the bilateral canine zone for the support of a provisional dental prosthesis. (G and H) The provisional dental prosthesis was made without compensation to maintain a crossbite occlusion, similar with a patient with Class III malocclusion.

maxilla, with no signs of relapse, and all dental implants were clinically and functionally successful.

Discussion

Management of patients with skeletal malocclusion and extended missing teeth resulting from ectodermal dysplasia has been a challenge for years. Such patients often have inappropriate maxillomandibular relationship, severely resorbed alveolar and unfavorable profile, which requires interdisciplinary treatment including orthognathic and prosthetic care.[1] Many studies have discussed the sequences of implant placement and orthognathic surgery. The first approach is to perform bimaxillary orthognathic surgery, maxillary interpositional bone grafting and implantation at the same time. However, this approach was reported to have a relatively high implant failure rate.[4] In addition, the relapse after the surgery could be obvious due to the occlusal instability post-operatively. Thus, the prosthetic compensation is needed to obtain a satisfactory occlusion.

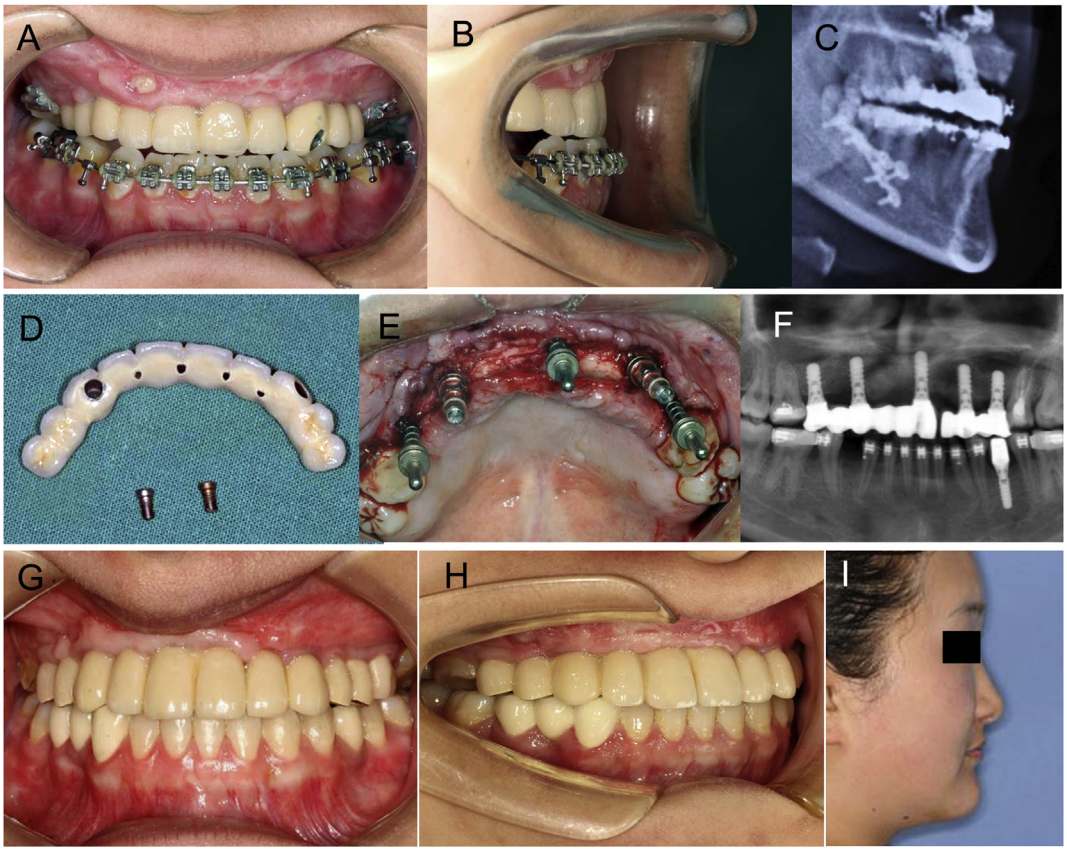

Figure 2 (A and B) The occlusal relationship with the provisional prothesis six months after bimaxillary orthognathic surgery. (C) The lateral cephalometric radiographs six months after surgery. (D) The provisional prosthesis was removed. (E) Three extra dental implants were installed on the maxilla. (F) The permanent prosthesis was fabricated with a metal framework and esthetic porcelain. (G and H) The optimal occlusion was acquired after the permanent prothesis fixation. (I) Facial profile after treatment.

The second approach is a two-stage procedure, in which the Le Fort I osteotomy followed by interpositional bone grafting was performed in the first surgery. After 3—6 months, the dental implants were placed and then the fixed prosthesis was fabricated.[5] However, since the Le Fort I osteotomy was performed without the guidance of the accurate dental splint, it is difficult to acquire the best position for the edentulous maxilla. Furthermore, the inappropriate position of the maxilla could lead to an unfavorable incisor exposure and nasal-labial angle after the treatment.

The third approach for the rehabilitation of the severely atrophic maxilla is to put the implants before the orthognathic surgery.[6] In this situation, the implant-supported fixed prosthesis can be fabricated without compensation, similar with the pre-surgical orthodontics. However, optimal 3-dimensional positioning of implants is crucial, and even a slight postoperative relapse can result in an inappropriate occlusion.[7] In the present case, our plan was to place 2 implants in the bilateral canine zone and fabricate a provisional restoration before the orthognathic surgery. Once the provisional bridge was placed, we identified the relationship between the upper lip and the maxillary incisors, which greatly facilitated the orthognathic surgery treatment planning, improved the patient profile and resulted in a better occlusion. When the provisional prosthesis was in place, the midline, anteroposterior and vertical corrections are more accurate and similar with conventional treatment. In addition, it is possible to perform regular surgical maneuvers such as the use of surgical splints and IMF. Thus, planning and stability of orthognathic surgery seem to be more predictable using this approach, because the pre-, peri-, and postoperative management of these patients is similar with a patient with regular Class III malocclusion.

After the orthognathic surgery, the maxillary relapse must be taken into account, even with the use of interpositional grafts.[8] Therefore, the second implant placement and the final restoration should be performed at least half year after surgery. In this case series, the patients' esthetics, facial profile, and oral function were significantly improved after the treatment.

The manipulation of maxillary alveolar bone resorption in the esthetic zone is another major difficulty in this case. Autogenous block bone graft has been applied widely and showed a satisfying result for the alveolar augmentation. Intra-oral donor sites such as ramus and chin can only provide a limited graft volume of the cortical bone, while the iliac crest can provide more than 10 cm^3 of the bone. Nevertheless, the grafted iliac was mainly consist of cancellous bone and has a pronounced resorption over time. It was reported that there is a 24.16% resorption in the mandible after 6 months,[9] and an 87% resorption in the mandible after 6 years of the surgery.[10] On the other hand,

grafted calvarial bone, which has the same pattern of intramembranous ossification with maxilla and mandible, is highly stable and has less resorption rate (8.44%) after a 6-month of healing.[9] The main reason preventing the widely use of the calvarial bone graft is the patient acceptance, rather than the technique itself.

In conclusion, oral rehabilitation in patients with maxillary oligodontia, alveolar bone loss and skeletal Class III malocclusion requires well-planned, interdisciplinary treatment to ensure better aesthetic and functional outcomes. Although more surgeries and longer treatment period may be required, this reported procedure may be more conservative in the long-term for young patients.

Declaration of Competing Interest

The authors declare no conflicts of interest.

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