Case Report

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Correction of Severe Orofacial Malformation with a Combination of Orthodontics and Orthognathic Surgery

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Abstract

This case report presents the multidisciplinary treatment of severe orofacial malformation in a female Caucasian patient aged 24 years and 10 months. Clinical examination showed mandibular deficiency, severe skeletal Class II and skeletal open bite with backward chin posture. The patient displayed noticeable facial asymmetry, a narrow upper jaw with unilateral crossbite, shifted midlines, incompetent lips up to 7 mm and hypertonic muscles mentalis when trying to put lips together. The Orthodontic phase of the treatment aimed at a) correction of the transversal discrepancy through Surgically Assisted Rapid Maxillary Expansion (SARME) using bonded acrylic Hyrax appliance, b) midline correction and c) creation of sufficient space for the alignment of all teeth and for insertion of implants to teeth 14 and 27. Surgical correction in the upper jaw was performed by Le Fort I corticotomy, Bilateral Sagittal Split Osteotomy (BSSO) in the lower jaw and chin genioplasty. The total time taken to accomplishing the treatment goals and to meet patient’s expectations was three years and five months. The patient was very satisfied with her new appearance due to corrected open bite, new position of the teeth and mandibular deficiency reduction, resulting in better face appearance, and her self-confidence increased tremendously. Follow-up checks have taken place over a period of six years since completion of treatment in order to maintain the stability of the results and it is anticipated that long-term cooperation with the patient will continue.

Keywords: Skeletal Open Bite; Orthodontic Treatment; SARME; Orthognathic Surgery

Abbreviations


Introduction

In recent years people have become increasingly interested in improving their physical appearance. Physical attractiveness, including facial esthetics, is regarded as an important asset, whether when looking for a job or seeking a life partner. Therefore many adults visit orthodontists or surgeons to seek help for what they perceive to be a social problem.

Contemporary orthodontics routinely uses Rapid Maxillary Expansion (RME) for the management of transverse arch deficiencies. In combination with surgery it can help in adult patients with unilateral crossbite, significant gingival recession or facial dysplasia. SARME is well documented in the orthodontic literature and has some supporters - in the USA: Farrar 1888, Godbard 1893, Black 1893, Monson 1898, Landsberger 1910; in Europe: Babcock 1911, Huet 1926, Derichsweiler 1953, Korkhaus 1953 - and adversaries like Case 1893, Ketchham 1912, Dewey 1913. Surgical approaches, from a subtotal Le Fort I to more limited osteotomies of the lateral maxilla and palate (Alpern and Yurosko, 1987), when combined with fixed palatal expanders, have been successful in allowing the palatine suture to split and the maxilla to widen [1].

In severe cases of orofacial malformations a surgical component to treatment is obviously necessary. Orthognathic surgery may precede or follow the orthodontic phase of treatment depending on the diagnosis. The mandibular prognathism surgery was introduced in the 20th century and beginning of the modern era in orthognathic surgery was marked in 1957 by the introduction of sagittal split ramus osteotomy [2]. Rapid progress in maxillary surgery techniques culminated in the development of the Le Fort I down fracture technique which allowed repositioning of the maxilla in all three spatial planes [3,4].

Today, combined surgical-orthodontic treatment allows us to help patients fulfill their dreams and to satisfy their demands for better facial appearance and social acceptance by correcting the position of their teeth and jaw, and improving oral functions such as chewing and speaking.

Case Report

Clinical and radiographic examination

A female Caucasian patient, aged 24 years 10 months was seeking to improve her esthetic appearance as well as to achieve “better chewing” in her own words.

Extraoral status (Figure 1) showed a long, narrow dolichocephalic face with a prolonged lower third. The face was asymmetrical with a slightly more prominent right facial half and a nose with deviated nasal septum and tip curving to the right. The chin was also deviated to the right and a highly visible asymmetric diastema made smiling embarrassing for the patient. Her profile was retrognathic with a backward chin position and incompetent lips up to 7 mm at rest, which were impossible to close even with help of musculus mentalis. These birth face appearance was one of the main reasons why the patient consulted the orthodontist.

Muscular status: The orofacial muscles were flabby with hypertonus of musculus mentalis, when the patient tried to close her mouth by putting her lips together. The temporomandibular functions did not induce any inconvenience, sound phenomenon or pain.

Intraoral status (Figure 1 and 2): Due to missing second right molar and first right premolar in the upper jaw, the midline was shifted to the right. The right half of the upper jaw narrowed...
asymmetrically by comparison with the left. Multiple fillings were present: 16, 15, 23, 24, 25, 26, 27.

The lower right jaw quadrant displayed crowding. Due to the missing second left premolar, the lower midline was shifted to the left. Substantial amalgam fillings were present at 36, 46, 47.

Due to the missing teeth it was not possible to assign an Angle Class. The midline in the upper jaw was shifted by 4 mm to the right, in the lower by 1 mm to the left. Measurements revealed an overjet of 8 mm and an overbite of 2.5 mm and lateral crossbite was present in 26, 27 with 36. The intraoral status described above led to skeletal maxillary constriction with a transversal deficiency of 5.5 mm in the intermolar region.

Dental hygiene was found to be poor. The periodontal status matched this finding, showing atrophic periodontitis and gingival recession in the lower incisors.

Personal anamnesis: The patient did not report any infectious diseases, allergies, bad habits or current illnesses. She reported mixed breathing through nose and mouth. The patient had undergone an upper jaw frenectomy in childhood. She had also worn removable orthodontic appliances in both jaws for about two years as a child. The family anamnesis was not substantive.

Orthopantomogram (OPT) evaluation (Figure 3): Upper jaw missing 17, 14, and 28. Due to the missing right first premolar the neighboring frontal teeth were distally inclined. Visible fillings were at
17, 14, 24, 25, 26 and 27. Lower jaw was missing 38, 37, 35 and 48. Crowding was in the lower right quadrant. Fillings were at 36, 46 and 47. The bone showed periodontal changes in the form of interdental wedge-shaped bone resorption in all intermolar regions. On the left mandibular side bone height was reduced due to missing 37 and 38. The radiographic and clinical examinations of the temporomandibular joint showed no symptoms or destructive changes, as far as could be determined from the quality of the X-ray, which was on plastic film.

Cephalometric analysis (Table 1, Figure 3): The patient was diagnosed with severe skeletal open bite and Class II occlusion. A Wits appraisal gave a value of 4.6 mm and an ANB angle of 9.5°. The angle of the upper and lower jaw planes was wide open with a value of 48.9° as was the gonion angle, which measured 141.8°. The upper incisors showed retrusion with an angle of 96.7° and the lower incisors protruded by 7.1 mm. The lower jaw and chin were retruded with values of SNB (sella-nasion-B point) = 71.4° and SNPg (sella-nasion-pogonion) = 70.6° respectively. A large overjet of 6.7 mm was measured. Cephalometric measurements clearly indicated that orthodontic treatment would need to be combined with surgical jaw correction.

Treatment Plan

1. SARME - Insertion of Hyrax appliance followed by surgery to resolve upper jaw transversal deficiency and crossbite. Also a focus on correction of midline, to be moved to the left, and on opening of space for an implant at 14.

2. Insertion of full upper fixed appliance after removal of the Hyrax, using a Transpalatal Arch (TPA) or bihelix to maintain the result achieved by the expander.

3. Extraction of 44. Use of segmental technique to distalize 43, then full lower fixed appliance insertion and lower jawmidline correction.

4. Bimaxillary surgical correction of the jaw position with genioplasty, if needed.

5. Retention by means of fixed retainer in the upper and lower jaw from 13 to 23 and 33 to 43, and removable functional Monobloc appliance.


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Table 1: Cephalometric values.

Figure 3: Pretreatment cephalogram, photographs superimposition and initial panoramic radiograph.
Treatment progress

Orthodontic phase (Figure 4 and 5): An acrylic tooth borne Hyrax with a 9 mm Dentaurum screw was manufactured and inserted in the upper jaw to correct the maxillary deficiency and the crossbite. Follow-up surgical intervention was based on Le Fort I corticotomy aligned with the zygomatic buttress, as well as the loosening of the midline palatal suture. Immediately after surgery the screw was opened 0.8 mm by the surgeon. All together SARME achieved a widening of 5.6 mm in the upper jaw. Two months after completion of the Hyrax active expansion phase tooth 44 was extracted, bands were inserted on 36 and 46 and a brace was inserted at 43. The distalization of tooth 43 was achieved with a T loop segmental 17 × 25 Titanium molybdenum arch wire (TMA). The Hyrax was removed five months after its insertion, at which point a full upper fixed appliance was inserted with initial co-axial wire. The use of a TPA was necessary in order to maintain the results of the expansion. Orthodontic treatment in the upper and lower jaw was accomplished with Gemini braces by 3M Unitek, Roth prescription with 0.18 inch slot. In order to prohibit bite opening, 0.16 TMA multi loop wire, manufactured in the dental practice, was initially placed on the lower jaw. During subsequent visits, the wire was upgraded from round soft Nickel-titanium (NiTi) wire into stiff Stainless Steel (SS) wire. The space for the insertion of an upper right premolar implant was created with a push coil spring.

Whilst the patient was being prepared for surgical correction, presurgical records were made; these consisted of panoramic and lateral cephalogram X-rays and dental casts. She visited the orthognathic consultation room so that an evaluation of orthodontic phase could be undertaken and information about the surgical procedure provided. At this point the surgeon suggested the need not only for bimaxillary surgery, but also for genioplasty to solve the problem of musculus mentalis hyper function and to achieve better facial appearance. Surgical splints were manufactured using model surgery casts.

The patient was prepared for the surgical phase one year and 10 months after insertion of the upper jaw fixed appliance. Before the
operation, surgical 18 × 25 Stainless steel wires with prefabricated thorns were attached to the patient’s jaw.

**Orthognathic surgery phase:** The operation was focused on the esthetic and functional goals of the reconstruction with the aim of meeting patient expectations. In the upper jaw a Le Fort I osteotomy with backward movement and intrusion was carried out. Also a minor correction on the nasal base structures was undertaken and four titan mini plates were inserted to ensure stability and healing of the upper jaw bone structure. In the lower jaw BSSO was used to advance the mandible, and two titan plates were inserted on each side. Chin genioplasty was undertaken, resulting in the upward and forward movement of the chin, which was retained by a modified titan plate. For better intercuspidation and occlusal stability the surgeon inserted a skeletal anchorage in the upper and lower jaw (Figure 5). Intermaxillary II Class elastics were applied for the establishment of a more stable and functional Class I occlusion in the canine region. Because of the extent of the operation the patient was advised to open and close her mouth gently during the first three weeks.

**Finishing phase and retention:** The finishing period took one year and three months. After the appliance was removed, fixed retainers were inserted and bonded from canine to canine in the upper and lower jaws. Soft 16.8 braided lingual retainer wire (Bond•a•Braid™, Forestadent) bonded with a light cure resin Retensin MT and Opticor flow (Spofa Dental) were used. The patient was shown how to maintain good oral hygiene with floss, and familiarized with correct methods for brushing teeth.

Two simple removable appliances were manufactured, one for each jaw. At that point due to financial restrictions the patient did not proceed with the insertion of any planned implant, at 14 and 37.

The completion of this treatment of severe orofacial malformation took three years and 5 months in total.

**Treatment Results**

**Extraoral status (Figure 6 and 7):** A more symmetrical facial appearance was attained by the end of the treatment process in line with the patient’s expectations. Nasal septum deviation remained as the patient did not proceed with its correction. The tip of the nose was corrected during surgery with a view to attaining better facial appearance. Hypertonus of the musculus mentalis was eliminated thanks to maxilla impaction and chin correction. Lip competence was recovered. On the other hand there was a certain level of deficiency in upper teeth display when smiling, due to upper jaw impaction.

**Intraoral status (Figure 6, 7 and 8):** In the upper jaw sufficient transversal width was achieved with enough space for midline correction and implant insertion at 14. In the lower jaw, the extraction of 44 allowed alignment of the lower teeth.

A Class I Angle relationship was achieved after surgery in the canines, and Class III in the molar region.

**Periodontal status:** Dental hygiene of the patient was inadequate from the beginning of treatment. Therefore she paid several visits to the dental hygienist and periodontologist. Nevertheless gingival recession was observed on the lower incisors before and after treatment.

**Muscular status:** The patient had no temporomandibular joint (TMJ) dysfunctions either before or after treatment. An OPT taken three years after treatment showed no significant bone loss or root resorption (Figure 9). The implant insertion in the position of the upper right first premolar and lower left second molar was clearly

![Figure 6: Post treatment facial and intraoral photographs.](image-url)
visible three years after treatment. Good bone consolidation had been achieved and the miniplates had the expected appearance. Fixed retainers were in place, one in the upper jaw from canine to canine, and two in the lower jaw, the first more incisal from canine to canine and the second bonded marginal on incisors.

Cephalometric evaluation (Table 1, Figure 9): The post treatment cephalometric analysis undertaken three years after treatment showed a significant improvement in the skeletal relationships (Figure 8). The retrusive lower jaw and chin displayed normal values of 79.1° and 81.4° respectively. Open bite was reduced by 9.6° and the gonion angle by 4.9°. The upper incisor position was normalized to 104.3° and the lower incisors no longer protruded (1-APg from 7.1 mm to 2.4 mm). Wits appraisal actually showed a negative value of -2.2 mm. Profile convexity of ANPg 10.2° before treatment, showed values of a straight profile at ANPg 4.5°. Overall, skeletal changes in the patient’s face were satisfactory and led to a pleasant appearance with competent lips and balanced proportions.

Long Term Follow Up

We have been conducting regular follow-up tests on the patient during the six years since completion of her treatment. Due to periodontal atrophic problems in the lower jaw and tooth mobility one year after treatment the patient’s lower retainer broke and was subsequently replaced with a new one. Advice from a periodontologist was sought, but no gingival curettage or augmentation was recommended. After 6 months the retainer was found to be loose at 41, and that tooth showed out of row
movement and gum dehiscence on its vestibular side. The retainer was removed and dental hygiene performed. The patient was given 3D lingual braces for correction of the tooth position and with for the aim of achieving better gum appearance (Figure 9, 10). She used the lingual fixed appliance for about one year and three months. During that period several consultations with the periodontologist took place and finally deep curettage was performed. Six months after the lingual braces were removed, the new fixed retainer became loose in the region of 31, 41. At that point we inserted two fixed retentions - one more incisal from canine to canine and the other in the middle of the tooth surfaces at the incisors. Gold plated 6-stranded 0195 coaxial retainer wires were bonded into place (Pelz & Companion).

The upper jaw fixed retainer had to be replaced due to cracking two years and seven months after its initial insertion. Two years later it had to be changed again due to the development of a crack between 12 and 13, and a cavity was fined mesial at 13, which required a new filling.

Meanwhile the patient had the implants inserted by an implantologist, firstly at 14 and subsequently at 37. The patient reported to us high sensitivity in the area of miniplates during cold winters with below-zero temperatures. She consulted this issue with the surgeon. They discussed removing mini plates and it is still under consideration.

In discussion with the patient, her subjective feelings are that she has developed higher self-confidence following the orthodontic and surgical correction of her facial appearance. New occlusal development has improved her ability to chew. She attends our surgery for a check-up once a year.
Discussion

The main treatment goals were the correction of skeletal open bite, the improvement of skeletal II Class jaw relationships and the freeing up of sufficient space for implant insertion of the upper right first premolar and lower left second molar. Solving unilateral crossbite, opening space for an implant at 14 and producing symmetry in the upper jaw required the use of SARME. The original idea of surgically assisted expansion was that cuts in the lateral buttress of the maxilla would decrease resistance to the point where the mid-palatal suture could be forced open. This procedure as shown in studies by Haas in 1980; Betts, et al. in 1995; Singh, et al. in 1999 avoids the painful opening of a mid-palatal suture and prevents rotations and vestibular inclinations of teeth to which appliance is attached [5]. It also leads to more stable results.

The main goal of the orthodontic phase was to ensure symmetry in the upper and lower jaw arches and thereby to prepare the patient for orthognathic surgery.

In recent years, a trend toward implementing treatment plans that achieve immediate facial change has arisen. In "Surgery First" patients appreciate the immediate improvement in facial appearance while the orthodontist can utilize the increased bone turnover to achieve accelerated tooth movement [6]. In our patient the implementation of this method was not recommended due to the complexity and severity of the orthodontic problem.

Three operation sites were needed to eliminate skeletal problems, achieve facial esthetics and stabilize the occlusion. In the upper jaw moving the maxilla up, so that the mandible can rotate up and forward, is the most stable orthodontic procedure [78]. Proffit et al advise decreasing face height through maxillary ostotomies, in combination with mandibular ramus osteotomy if further mandibular advancement is required. Since it is effective in patients in their 20s it was decided to use this method in our patient. A ramus osteotomy in combination with maxillary osteotomy does not stretch the muscles and is acceptably stable. Proffit, et al [9], affirm the chin moved anteriorly, upward, or laterally to produce highly favorable esthetic results.

Our patient did not seek rhinoplasty, despite the fact that it might lead to even better facial appearance. In her own words she wanted to keep a part of her previous personality.

For cephalometric analysis the Williams method was used [10]. This method is sufficient to determine the skeletal and dental relationships and to serve our evaluation and diagnostic needs. The poor copy quality of the initial profile X-ray made on plastic film did not permit cephalometric superimposition.

After treatment was completed, there were some complications with the retainer. In a recent study Kucera and Marek have reported that facial divergence and pretreatment ventral incisor position increase the likelihood of complications with mandibular fixed retainers [11]. This is borne out in our patient, who had a pretreatment cephalometric value of SNB 71.4° showing a posterior divergent face and a ventral incisor position of 1-APg 7.1 mm.

According to Timothy et al., the regular observation of patients wearing fixed retainers is necessary and should be carried out in the short term by the orthodontist and in the long term by family dentists [12]. Taking into consideration the periodontal status of the lower incisors in our patient, there are multiple reasons for complications with her mandibular fixed retainer. It seems that long term cooperation will be necessary.

Conclusion

The treatment of severe orofacial malformation with skeletal open bite and Class II malocclusion required close multidisciplinary cooperation by Orthodontist, Surgeon and Implantologist. To obtain the desired treatment result and meet patient expectations, it was necessary to make a correct diagnosis and to follow the necessary steps of the treatment programme. The treatment goals were fulfilled and the patient's expectations of better functional and esthetical appearance met.

References


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