Orthodontic surgery and aesthetics

Orthodontic treatment generally follows aesthetic, functional, and prophylactic objectives, where individual aspects of isolated cases are accorded varying importance as they arise. Increasing aesthetic expectations and awareness of modern dental treatment options disseminated by the media have resulted in increased interest and greater willingness of adults to consider orthodontic treatment. Aesthetic orthodontics is thus primarily adult orthodontics.

A peculiarity of orthodontic treatment in adults compared with paediatric or adolescent orthodontics is the age-associated involution of the connective tissues that leads to a reduction in cell density, thickening of the fibre bundles, delayed fibroblast proliferation, and reduced vascularisation. These are the causes of slower dental movement and delayed tissue and bone reactions. Absent sutural growth, the age of the periodontium, specific periodontal diagnoses, and tissue atrophy also make treatment in adults particularly challenging.

As a rule, aesthetically oriented adult orthodontics therefore has an interdisciplinary inclination. Occlusion, function and aesthetics are considered to be equivalent parameters in modern orthodontics and particularly here in combined orthodontic-maxillofacial surgical treatment. This was achieved through optimisation of diagnostic tools and further development and increasing experience in orthopaedic surgery.

Nowadays, treatment of adult patients with dental malposition and mastication impairment is one of the standard tasks of the orthodontist. If the discrepancies in spatial allocations of the upper and lower dentition are particularly pronounced and where the cause is primarily skeletal and not only dentoalveolar, conventional orthodontic therapy is limited and combined orthodontic-surgical therapy is indicated for remodelling of the jaw bases.

Treatment for a skeletal dysgnathia (Class III) using combined orthodontic-maxillofacial surgical correction is discussed in this article.

Chronological development of maxillofacial surgery of the mandible

The first orthodontic-maxillofacial surgical procedure on the mandible described in the literature was that of the American surgeon Hullihen in 1848. This procedure was a segmental osteotomy of the anterior
mandible (a posterior shift [retrusion] of a protruding mandibular alveolar process, following a burn injury). Towards the end of the 19th century, the method of orthodontic-maxillofacial surgical correction of dysgnathias by surgical retrusion or protrusion of the mandible was revisited. Jaboulay14 described resection of the Processus condylaris and Blair4, osteotomy on the Corpus mandibulae. The continuity resection in the horizontal branch by Blair was the first surgical prognathism procedure. The patient first visited the dentist Whipple in St. Louis in 1891 and was then referred to the then most renowned orthodontist Dr Edward Hartley Angle5, who ultimately recommended the surgical procedure mentioned above.

Six years later, the procedure in this osteotomy on the Corpus mandibulae was also published by the Hamburg surgeon Floris.11 Parallel with this development in the US, Von Auffenberg3 in Europe conceived a step-by-step osteotomy for correcting a mandibular retrusion, which was performed by Von Eiselberg in 1901.
The era of orthodontic surgery in Europe began only after World War I. The experience gained there led to a substantial extension of the indications for orthodontic-maxillofacial surgical procedures, as well as to the transferral of this surgical technique to the area of elective procedures. 

In the early 1920s, Bruhn and Lindemann set transversal osteotomy of the Ramus mandibulae as the standard method at the time for the surgical correction of mandibular prognathism. This method, which continued to have many adherents well into the 1960s, is today known as the Bruhn–Lindemann procedure.

In 1935, Wassmund, who saw its drawbacks in a possible dislocation of the proximal segment by the muscles inserted there, described a modification of the Bruhn–Lindemann surgical technique. In the early 1950s, a new era in orthodontic surgery of the mandible was begun with Kazanjian’s resumption of transverse, oblique severing of the ascending ramus, first performed by Perthes in 1922. Shuchard modified this method in 1954 by enlarging the bony insertion surface, and in 1955 Obwegeser introduced sagittal splitting at the horizontal ramus of the mandible. He shifted the buccal osteotomy line...
obliquely from the last molar to the posterior margin of the jaw angle. In 1959, Dal Pont moved this buccal osteotomy line from the last molar to the inferior margin of the mandible. Since then, this method of sagittal split at the mandible has been called sagittal split according to Obwegeser–Dal Pont (Fig. 1). Epker developed the incomplete sagittal split into a routine method.

Clinical case presentation

History and diagnosis
A 25-year-old patient presented on his own initiative. He complained of functional (impairment of mastication and jaw joint pain) and aesthetic impairment (sunken face with facial asymmetry). He had undergone orthodontic treatment between the ages of 8 and 15 and reported pain in the area of the anterior mandible.

The lateral image showed a retrusive lower face inclined forward with mid-facial hypoplasia—regio infraorbitale—a flat upper lip and an elongated lower face compared with the mid-face—47%:53% instead of 50%:50% (Table I; Fig. 2a). Owing to the negative sagittal overjet, there was a positive lower lip step. The frontal image shows mandibular deviation (laterognathia) to the right, which can be traced to growth asymmetry in the jaw (Fig. 2b). In addition, there was a Class III dysgnathia angle with conspicuous mandibular midline deviation to the right, frontal and right lateral crossbite, anterior mandibular labial tilt, and a steep anterior mandible. Tooth 26 had been missing for some time (Figs. 3a–e). FRS analysis (Table I & II) clearly shows the strongly sagittal and relatively weak vertical dysgnathia both in the soft-tissue profile and in the skeletal region. The parameters indicated a mesiobasal jaw relationship and a growth pattern with an anterior course: the vertical grouping of the soft-tissue profile showed a disharmony between the mid-face and the lower face (G′-Sn : Sn-Me′; 47%:53%). This was relatively weakly expressed in the bony structures (N-Sna:Sna-Me; 44%:56%). In the region of the lower face there was also mild disharmony (Sn-Stm : Stm-Me′; 31%:69%). Complementary assessment of the mandible showed that the area from the subnasal-labial inferior to the soft-tissue chin (Li-Me′), which should have been 1:0.9, was shifted in favour of the Li-Me′ part (0.9 : 1; Fig. 4). The panoramic image showed a lucency of teeth 31 and 41. A root canal procedure followed by root apex resection was thus performed (Fig. 5).

Therapeutic objectives and treatment planning
The objectives of this combined orthodontic-maxillofacial surgical treatment were:

1. the establishment of neutral, stable, and functional occlusion with physiological condylar positioning;
2. the optimisation of the facial aesthetics;
3. the optimisation of the dental aesthetics, considering the periodontal situation;
4. the assurance of the stability of the results achieved;
5. meeting the patient’s expectations.

The improvement of the facial aesthetics not only in the sagittal axis in the region of the lower face (the mandibular region), but also in the region of the mid-face (hypoplasia) and in the transverse axis should be noted as specific treatment objectives. The change in the region of the mid-face was intended to affect the upper lip and the upper-lip vermillion. These treatment objectives were achieved by two procedures:

1. a dorsal extension of the mandible with lateral sweep to the left for correction of the sagittal and transverse defects, as well as occlusion and the soft-tissue profile;
2. bone augmentation in the mid-face for harmonisation of the face. It would not have been possible to achieve
the desired treatment objectives with respect to function and aesthetics using orthodontic procedures alone.\textsuperscript{27}

**Therapeutic procedure**

Correction of the pronounced dysgnathia was done in six phases: 27,30–33

1. Splint therapy: a flat bite guard splint was installed for six weeks in order to determine the physiological condylar position or centrics before the final treatment planning. By doing this, the forced bite could be demonstrated to its full extent.

2. Orthodontics for forming and adjusting the dental arches relative to each other and decompensation of the skeletal dysgnathia (Figs. 6a–c).

3. Splint therapy for determining the condylar position. This was performed in the 4 to 6 weeks prior to the surgical procedure. The objective was registration of the jaw joint in a physiological position (centrics).

4. Oral surgery for correction of the skeletal dysgnathia: after model operation, determination of the transposition path and production of the splint in the target occlusion, the surgical mandibular translocation using sagittal split according to Obwegeser–Dal Pont was done. Augmentation in the mid-facial region was done using autologous bone.

5. Orthodontics for fine adjustment of occlusion.

6. Retention: 3-3 retainers were cemented in the mandible.

Mandibular and maxillary plates were used as the retention appliance. Prosthetic care was provided after six months.

**Results**

Figures 7a–e show the situation after the conclusion of treatment and after extraction of tooth 31 and subsequent prosthetic treatment, neutral occlusion, and correct midline with physiological sagittal and vertical bite. The extra-oral images show a harmonious profile in the vertical as well as in the sagittal axis (Figs. 8a & b). The oral profile is harmonious. The upper-lip vermilion is distinctly visible in comparison to the original situation (Figs. 8c & d).

The FRS shows the changes in the parameters that arose as the result of the displacement of the mandible. There is harmonisation in the vertical arrangement of the bony and soft-tissue profile. The disharmony in the lower third of the face has been corrected (Figs. 8c & d).

The OPG shows the positioning screws in both jaw angles and the fixation screws of the augmented bone in the mid-face (Fig. 10). \textbf{...}

Editorial note: A complete list of references is available from the publisher.