

## **Harmonisation of the Dento-Facial Complex A Result Of Combination A Orthodontic and Orthognathic Surgical Therapy**

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**Abstract:** *Studies of motivation, expectation and satisfaction show that patients seek orthognathic surgery not for functional but rather for esthetic reasons wherby the weighing of the reasons for the individual depends e.g. on the extraoral extent of the skeletal deformity. Independent from that, the orthodontist has to set the treatment goals so that the esthetic and function for the individual is optimal. For example the solely occlusion orientated therapy might not be related to a satisfying facialesthetic result.*

**Keywords:** *Cephalometrics, lower face height, skeletal deep bite, short face syndrome, mandibular advancement, splint therapy, lateral open bite*

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### **I. Introduction**

One of the main objectives of orthodontics, in addition to the diagnosis of dysgnathy, is to determine the status of indication for orthodontic treatment, for which treatment necessity and prognosis are evaluated.

Occlusion, function and esthetics are considered equivalent parameters in modern orthodontics, particularly in combined orthodontic and orthognathic surgical treatment. This was achieved through the optimisation of diagnostic tools and advancements and increasing experience in orthopaedic surgery.

The objectives of orthodontic and orthognathic surgical treatments are:

- the establishment of a neutral, stable and functional occlusion with physiological condylar positioning;
- the optimization of facial esthetics;
- the optimization of dental esthetics, considering the periodontal situation;
- the assurance of the stability of the results achieved; and
- the fulfillment of the patient's expectations.

The following factors are to be considered in assessing the prospects of success of orthodontic therapy:

- the degree of the dysgnathy;
- the growth configuration and potential;
- the individual reaction of the periodontal and skeletal structures;
- the general condition of the teeth;
- the patient's age;
- the patient's compliance;
- the patient's wishes and expectations; and
- the dentist's the ability and experience.

In many cases, the objectives of dentoalveolar treatment measures — the achievement of the functional and esthetic optimum for the patient — can be achieved using modern treatment methods.

While minor dysgnathies can be treated using dentoalveolar measures only, successful treatment of prominent sagittal discrepancies, such as Class II dysgnathies, is far more difficult.

Correction can be achieved through dental movement, if the jaw proportion is correct and if the dysgnathy is purely dentoalveolar. However, dental movements are possible only up to a certain degree and are thus limited.

A correction or stable dental compensation of a skeletal dysgnathy (for example, the correction of a frontal cross-bite in a Class III or the correction of an extremely enlarged sagittal overjet in a Class II) is doubtful in some cases and, in general, shows a compromise in esthetics and/or function.

In order to determine the options available for the therapy of a Class II dysgnathy, the remaining growth of the patient must be assessed 35. Functional orthodontic treatment is a therapy form that can influence growth

and is considered a causal therapy in adolescents [8,51,57,67,70,71, 78, 79, 80]. If the growth is completed, orthognathic surgery to correct the position discrepancy between both jaws is a causal therapy form (Fig. 1).

A premise for the successful realization of a combined therapy is that less invasive treatment options (for example, growth influence, as mentioned above) can no longer be used or do not achieve the treatment objectives or even worsen the situation (for example, extraction in a flat profile) [33, 34, 77]

The second option for the causal therapy of a skeletal dysgnathia (Class II) using combined orthodontic and orthognathic surgical correction is discussed in this article, with a special focus on Class II dysgnathias with skeletal deep occlusion [ 1, 2, 3, 6, 7, 44, 45, 55].

### **clinical implementation of the treatment concept**

A 21-year-old female patient presented at our Clinic, complaining of temporomandibular joint pain when chewing and poor esthetics, due to the malpositioning of her maxillary incisors.

The lateral image shows a short face, a deepened supramentale and, in comparison to the mid-face, a short lower face — 53% : 47% instead of 50% : 50% (Table I; Figs. 2a, b) [4, 5, 14, 15, 43, 63] (Fig 2a-c, Fig 3a-c) Owing to the enlarged overjet (13 mm), there was a dysfunctioning of the lower lips in occlusion, owing to which lip closure was not possible without habitual, ventral positioning of the mandible.

Furthermore, the frontal image shows a Class II/1-, a deep bite (6 mm) with a bite into the palatal mucosa. The upper dental arch shows a deficit in the transversal dimension relative to the lower arch. The curve of Spee in the lower arch is more distinct (Figs. 4a-e).

The Cephalometric analysis (Tables I, II) clearly shows sagittal and vertical dysgnathy in the soft-tissue profile and the skeletal profile.

The parameters indicated a skeletal deep bite with the typical extra-oral symptoms of the short face syndrome: disto-basal jaw relationship, decreased Gonion angle, decreased interbase angle due to the anterior rotation of the mandible, increased ratio between anterior and posterior facial height.

The vertical arrangement of the soft-tissue profile showed a disharmony between the mid-face and the lower face ( $G^{\prime}$ -Sn:Sn-Me'; 53% : 47%), which was expressed in the bony structures (N-Sna:Sna-Me; 48% : 52%). Disharmony in the region of the lower face was also evident (Sn-Stm:Stm-Me'; 30% : 70%).

These discrepancies in the ratio are the result of the deficient lower face, rather than the length of the upper lip. An additional assessment of the lower face indicated that the ratio between the subnasal-labral inferius (Sn-Li) and the soft-tissue menton (Li-Me'), which should have been 1:0.9, was shifted in the favor of Sn-Li (1:0.7). This larger ratio was primarily caused by the short mandible (Fig. 5a-c, Fig. 6).

### **Therapeutic objectives and treatment planning**

An improvement of the facial esthetics, not only in the sagittal but also in the vertical dimation, was a specific treatment objective [ 21, 25]. This was to be achieved through the lengthening of the lower face without extreme amplifying the prominence of the chin.

Lengthening of the lower face as causal therapy and the subsequent effect on the facial esthetics could be achieved in those cases using orthognathic surgical treatment. It would not have been possible to achieve the treatment objectives with respect to esthetics using orthodontic procedures alone.

The decisive step for the desired functional and esthetic results was taken during surgery. The surgical enlargement of the mandibular angle (Gonion angle) was decisive for the improvement of the extraoral appearance through a posterior

rotation of the dentigerous segment.

The three-point support on the incisors and molars was a prerequisite for a stable enlargement of the jaw angle and thus a posterior rotation of the horizontal mandibular ramus.

Through the rotation, the menton was shifted caudally, so that the skeletal situation and the soft-tissue profile of the lower face were improved in the vertical Dimension. Accordingly, the interbase angle was enlarged, while the ratio between the posterior and anterior facial height was reduced (Fig. 7a).

A translation of the dentigerous segment led to the correction of the sagittal dysgnathy without the improvement of the vertical Dimension. In addition, the translation resulted in an enhancement of the prominent chin, which led to a flattened mouth profile and thus to a maturation of the patients appearance (Fig. 7b).

These above-established treatment goals are reached decisively with surgery. The necessary lengthening of the lower face is achieved by rotation of the tooth-bearing segment of the mandible during surgery. The orthodontist plans and controls the extent of these movements [72, 73, 74]. Prerequisite for the stability of the enlarged gonial angle by this move, is a three-point support at the incisors and molars at the time of the surgery. Mandible can be rotated posteriorly only when the lower front teeth are in contact with the palatal surfaces of the maxillary incisors. Once the incisors are occluded, the skeletal correction is accomplished by a clockwise rotation of the mandible. This maneuver increases the lower face height and enlarges the gonial angle (Fig.7a-c). Although the mandible is displaced anteriorly, the chin prominence is

accentuated only a little because the posterior rotation compensates for the ventral movement, which in these patients is an advantage. The flattening of the sublabial sulcus can also be observed.

A straightforward advancement of the mandible when the curve of Spee is leveled, might correct the sagittal discrepancy, but not the vertical; chin will become prominent, and the face concave. It will then be necessary to perform genioplasty (Fig. 7b).

### **Therapeutic procedure**

The correction of the dysgnathia was done in six phases:

**1. Splint therapy:** An occlusal splint was inserted in the lower arch for six weeks, to determine the physiological condylar position or centric position before the final treatment planning. The forced bite could thus be demonstrated to its full extent [75, 76].

**2. Orthodontic therapy:** The aim of the orthodontic preparation is to align the dental arches, harmonize in three dimensions of space and to eliminate the dental compensations. Special care must be taken for the transversal dimension at the canines to prevent premature contacts during surgery - it forces the mandible distally. The upper dental arch in Class II deformities usually shows a deficit in the transversal dimension relative to the lower arch. The correction of this discrepancy by widening the upper arch can be impeded or even made impossible when there is a stable occlusion. In the short-face syndrome patients the lower arch is not leveled prior to surgery so that the curve of Spee and the deep bite is left uncorrected. For this purpose arch wires with corresponding bends are inserted (Fig. 8a-e). Leveling of the lower arch by incisor intrusion increases the overjet. In turn, mandible requires greater advancement at the expense of rotational movement. In the event teeth have compensated for the skeletal deformity, and the curve of Spee nonexistent, extrusion of the lower anteriors might be necessary [71, 72, 73].

**3. Splint therapy:** Four to six weeks prior to surgery, splint therapy was performed to determine the condylar centric and thus register the temporomandibular joint in a physiological position (centric).

**4. Orthognathic surgery:** Orthognathic surgery was performed in order to correct skeletal dysgnathia. After a model operation, determination of the translocation path and production of the splint in the target occlusion, the preliminary surgical mandibular translocation was carried out by means of sagittal split according to Obwegeser-Dal Pont [9, 10, 12, 13, 23, 24, 36-38, 52-54, 56, 58, 61, 62, 69], after the positioning of the TMJ, the jaw segments were fixed with positioning screws [ 22, 46-50, 59, 65]

**5. Orthodontic therapy:** As a consequence of the posterior rotation of the segment with 3-point contact, a laterally open bite results after surgery which requires the earliest possible correction (Fig. 9). Therefore, the post-surgical orthodontic treatment starts only a few days after surgery:

- Its objectives are the correction of the laterally open bite without any loss of skeletal height and
- Finishing of occlusion

According to our concept, the open bite should be corrected only by extrusion of the upper posterior teeth and not by intrusion of the anteriors. In the later case, an anterior rotation of the mandible would result, and consequently a reduced height of the lower face, which in turn would partly cancel out the surgical gain of lower face height.

### **The closure of the lateral open bite is done in two phases:**

1. The maxillary steel archwire is replaced by 0.018 x 0.025 NiTi. Extrusive bends for the premolars and the first molar are incorporated in this archwire and vertical elastics are used to augment the extrusive effect while minimizing the intrusive reaction to the remaining teeth. The elastics are placed in such a manner that one tooth in the upper jaw and two teeth in the lower jaw are loaded. Some days later, the extrusive step in the open bite area – mostly the first or second premolar – is increased, and the elastic use continued (Fig 10a).

2. After the NiTi-wire is passive in the upper jaw a NiTi wire replaces the lower steel archwire. Again, up-and-down elastics are used to close the residual open bite by extrusion of the premolars, and as little as possible by intrusion of the anterior teeth. Now one tooth in the lower is loaded against two teeth in the upper jaw (Fig. 10b).

**6. Retention:** Following surgery reorientation of skeletal parts by the muscle pull could be a significant problem for the soft tissues balance [ 40]. This strain on the muscles is reduced significantly by rotation of the mandible as described above. To allow the muscles to adapt to the new situation, we suggest a bimaxillary appliance for retention e.g., a bionator. The construction bite must be taken with teeth only slightly disoccluded. If the mandibular advancement was significant, especially in patients with tense or short muscles of the suprahyoid

complex, a physiotherapeutic treatment is prescribed to rehabilitate and reorient the muscles to their new positions [ 17, 26, 27, 28, 60]. Furthermore, a bonded canine to canine retainer might be recommended, especially in patients with severely malposed teeth prior to treatment.

## II. Results

Figures 11a to e show the situation in occlusion and after closure of the lateral open bite, a neutral occlusion and correct midline with physiological overjet. and overbite. The extra-oral photos show a harmonic face in the vertical Dimention which was achieved through the surgical lengthening of the lower face, and a harmonic profile in the sagittal Dimention. The mouth profile is harmonious, with relaxed lip closure and a relaxed supramental sulcus (Fig. 12a-c). The Cephalometric X-ray shows the changes in the parameters that arose as a result of the enlargement of the Gonion Angle. The Gonion angle was increased surgically by 5 degrees. Accordingly, the mandibular inclination was increased, which led to an enlargement of the interbase angle (around 5 degrees).

Due to the enlargement of the anterior facial height by the posterior rotation of the mandible, there was a reduction of the ratio PFH / AFH (around 5%) (Table II).

The vertical analysis of the bony and soft tissue profile shows a harmonization. The disharmony in the lower third of the face is improved (Figure 13 a-c, Table I.).

**Table I:**

Parameter	Mean	Before treatment	After treatment
G'-Sn/G'-Me'	50%	53%	51%
Sn-Me'/G'-Me'	50%	47%	49%
Sn-Stm/Stm-Me'	1:2 (33%:67%)	(30%:70%)	(31%:69%)
Sn-Li/Li-Me'	1:0.9	1:0.7	1:9

**Table II:**

Parameter	Mean	Before treatment	After treatment
SNA	82°	76,5°	76,5°
SNB	80°	72°	75,5°
ANB	2°	4,5° (incl. 1°)	1,5° (incl. 1,5°)
WITS-Wert	± 1mm	3.5mm	1,3 mm
ML-SNL	32°	27,5°	32,5°
NL-SNL	9°	7,5°	7,5°
ML-NL	23°	20°	25°
Gonion-<	130°	121°	126°
SN-Pg	81°	76,5°	79°
PFH/AFH	63%	69%	64%
N-Sna/N-Me	45%	48%	45%
Sna-Me/N-Me	55%	52%	55%

## III. Discussion

Skeletal facial deformations, beside posing functional risks, jeopardize psycho-social well-being due to impaired aesthetics. Negative social experiences often arise from personality stereotypes often attributed to the jaw profile. Little astounding, therefore, that psycho-aesthetic motives play a crucial role in the patient's decision to undergo orthognathic surgery and his subjective evaluation of treatment outcome [ 11, 29, 30, 31, 32, 39, 41, 42, 64].

It is often necessary to insert an initial splint in these patients either for the treatment of temporomandibular joint problems or for diagnostics [66, 68, 75, 76]. Celenza [18, 19, 20] and Calagna et al. [16] have showed that by tiring the muscles with a splint, the mandible could be retruded more than the hinge-axis position. In Class II div.1 patients a ventral positioning of the mandible is normally observed. Habitually, these patients protrude the mandible to make lip-closure possible. If there is a discrepancy of centric occlusion and centric position of the condyles (centric relation) after splint therapy, all diagnostic records (cephalograms, facial photographs, study casts and articulated casts) need to be re-taken in centric relation to be able to set up the final treatment plan [71, 72, 73, 74]

We demonstrate in this report that patients with the short-face-syndrome are best treated by posterior rotation of the mandible. The clinician is cautioned that leveling of the lower dental arch prior to surgery reduces the effectiveness of the surgical move. The leveled dental arch will force a straightforward advancement. As discussed earlier, without the rotational component, the chin becomes undesirably prominent. It may even stretch the suprahyoid muscles beyond their natural tolerance and elicit relapse.

From a dental perspective it is important to realize that labial tipping of the lower anteriors promotes posterior rotation of the mandibular segment during surgery. Naturally, the surgical rotation as described gives rise to a lateral open bite. The three-point-contact (molars and anteriors) could potentially overload the anterior

teeth and can harm (root resorption) teeth. Thus, we advocate closure of the created lateral open bite as soon as possible following surgery. This can be done by extrusion of the buccal teeth and as little as possible by intrusion of the anterior teeth. A strategic plan for treatment based on the concepts outlined in this report, in our experience, ensures satisfactory facial esthetics and stability.

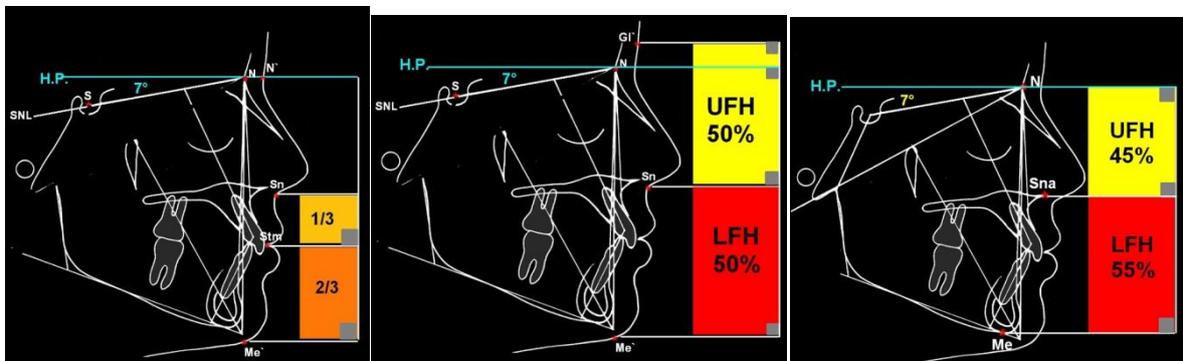
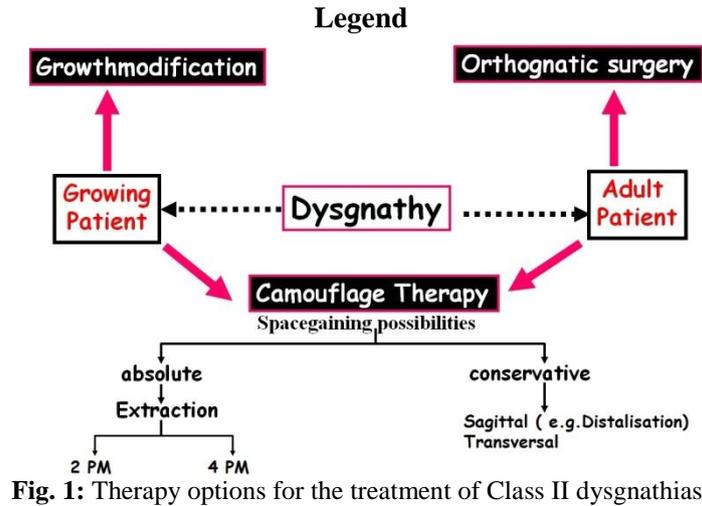
#### IV. Conclusion

The focus of this Article is on patients with a class II deformity and skeletal deep bite, i.e., Short Face Syndrome. Those patients who experience their shortened lower faces as a particular aesthetic shortcoming, pose a special challenge to a subtle and conclusive treatment concept. The expected harmonization of the soft tissue structures and proportions in both sagittal and vertical dimension was achieved after systematic application of the treatment concept including surgical posterior rotation of the mandible.

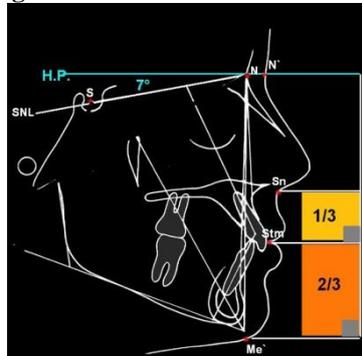
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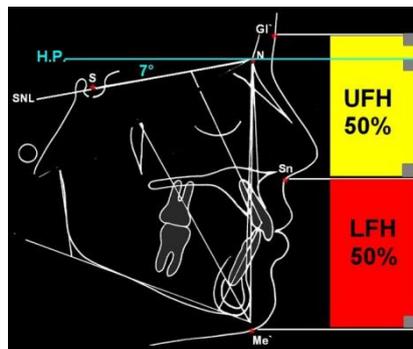
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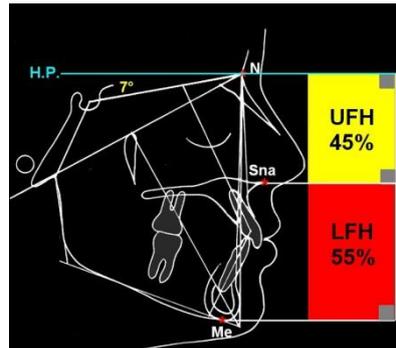
**Fig. 2a-c:** Ideal vertical face division



**Fig. 2a:** The vertical division of the face between  $G'$  and  $Me'$  in the cephalogram with respect to the horizontal plane (HP); the harmonic relation of upper face height (UFH,  $G'-Sn$ ) to lower face height (LFH,  $Sn-Me'$ ) is 1:1, 50%:50%.



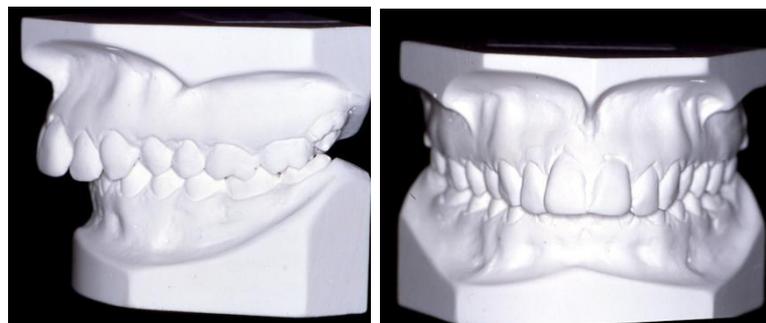
**Fig. 2b:** Vertical division of the lower face ( $Sn-Me'$ ). The ratio of upper lip ( $Sn-Stm$  or  $Stms$ ) to lower lip and the chin ( $Stm$  or  $Stms-Me'$ ) is 1:2, 33%:67% in rest position.



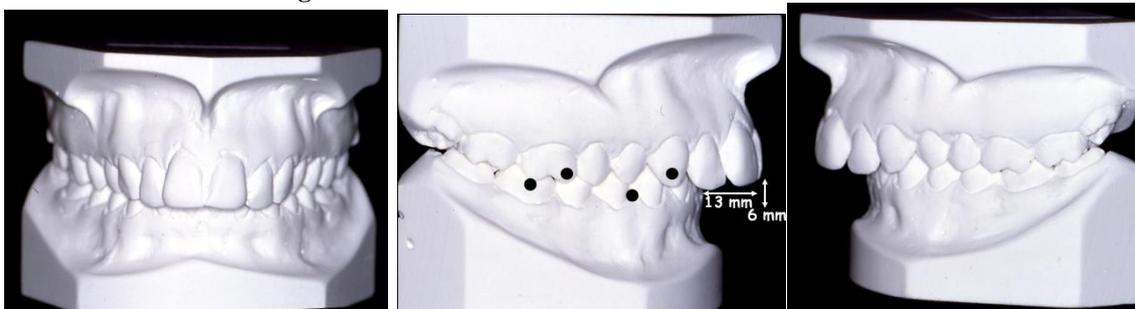
**Fig. 2c:** Skeletal division of the face in the vertical dimension, the relation of mid- to lower face with respect to Anterior nasal spine (N-Ans:Ans-Me) is 45% to 55%.



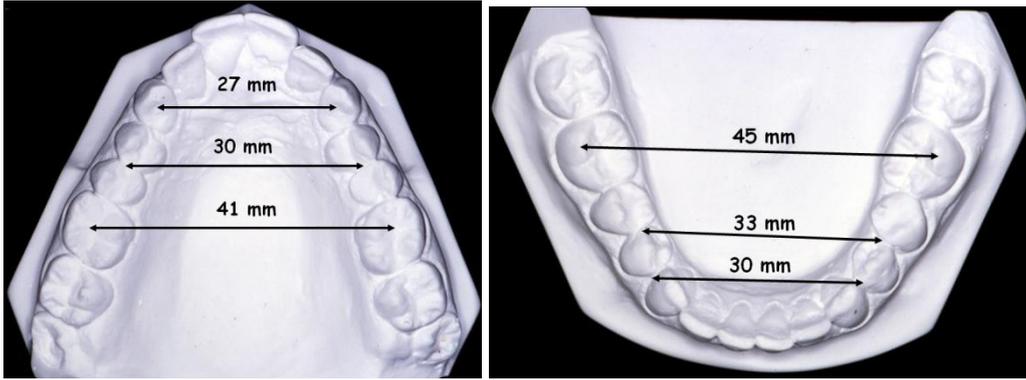
**Fig. 3a-c:** Lateral and frontal facial photograph picture of a Class II patient with short-face-syndrome, short lower face, deepened sublabial sulcus with prominent lower lip and chin.



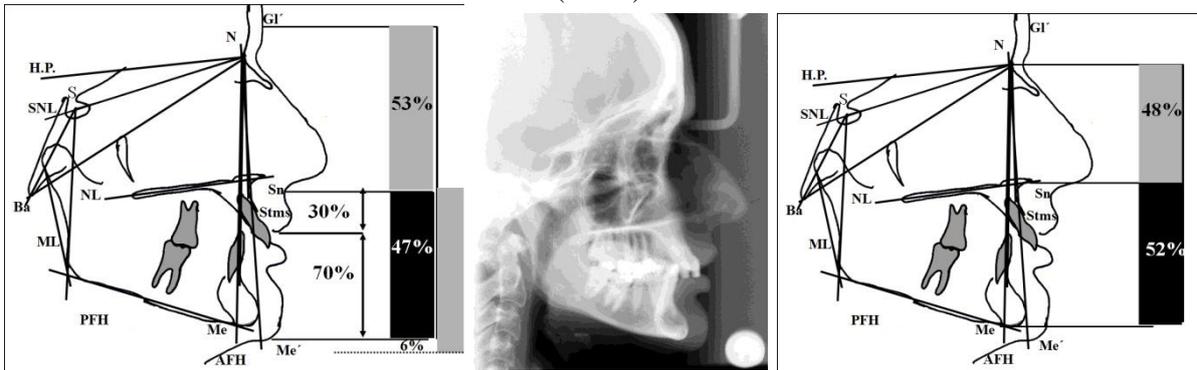
**Fig. 4a-e:** Clinical situation before the start of treatment



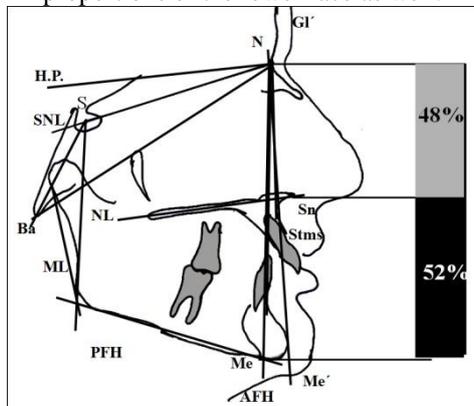
**Fig. 4a-c:** The Modells shows a distal occlusion, deep bite and malpositioned teeth.



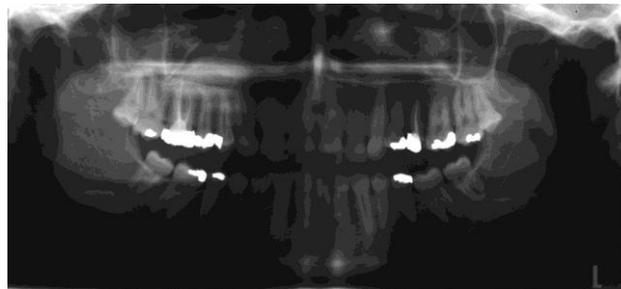
**Fig. 4d, e:** A The upper dental arch shows a deficit in the transversal dimension relative to the lower arch. Discrepancy of corresponding points of occlusion of the canines in the upper (27mm) and lower dental arch (30mm)



**Fig. 5a-c: Fig. 5a-b:** Disharmonic vertical proportions of the soft tissue profile of upper face (G'-Sn) to lower face (Sn-Me'). The lower face shows a deficit of 6% compared to the upper face. There is a disharmony of the proportions of the lower face as well.



**Fig. 5c:** The cephalometric image shows the disharmonious skeletal arrangement in the vertical axis. The lower face shows a deficit of 6percent in relation to the upper face. The mandibular angle and the interbase angle are small.



**Fig. 6:** Orthopantomogram before treatment

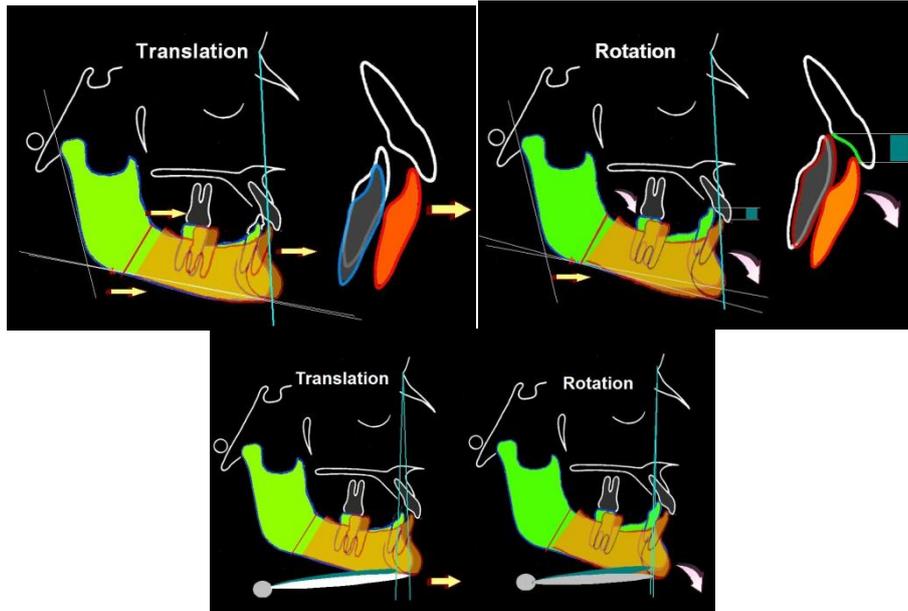


Fig 7a-c: Simulation of a preliminary surgical Rotaion and Translation

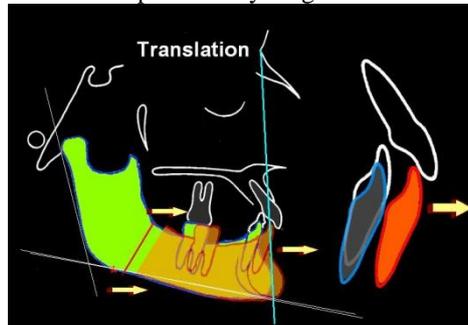


Fig. 7a: Simulation of the surgical advancement without leveling the lower dental arch. By surgical rotation of the mandibular segment there is an opening of the Gonial angle. The vertical plumb line touches Pogonion in the presurgical situation and shows a minor ventral advancement of the chin prominence.

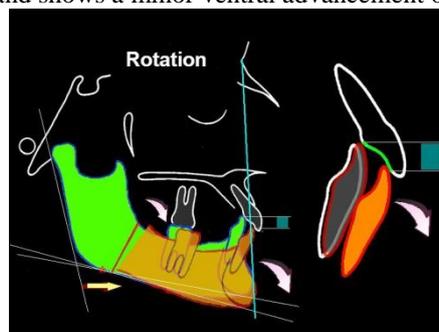
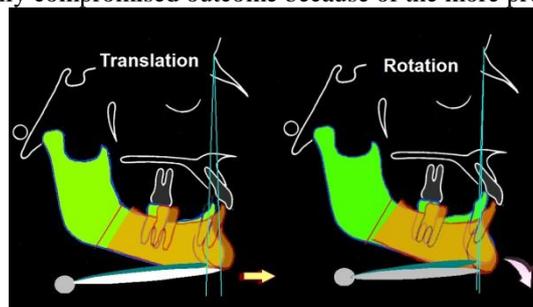


Fig. 7b: Simulation of a surgical advancement of the mandibular segment with leveling of the lower dental arch prior to surgery. It results in the correction of the sagittal disharmony without changing the vertical relation and an esthetically compromised outcome because of the more prominent chin.



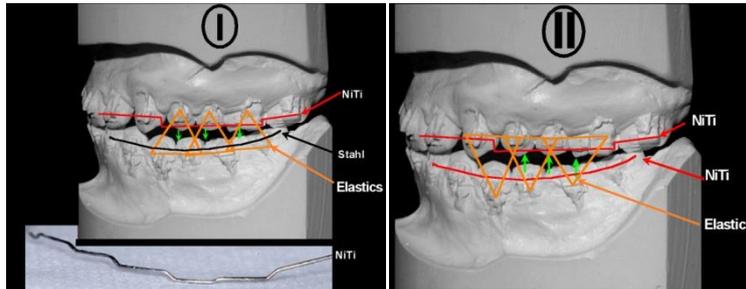
**Fig. 7c:** Demonstration of the effects of the different advancements: The rotation results in a minimal stretching of the digastric muscle (right) whereas, it is rather extensive with translation (left).



**Fig. 8a-e:** Clinical situation after orthodontic preparation. Deep bite and curve of Spee are almost unchanged.



**Fig. 9:** Cephalogram after surgical advancement of the mandibular segment and its rigid fixation with screws, consequence of the advancement with posterior rotation of the segment with three point contact is a lateral open bite.



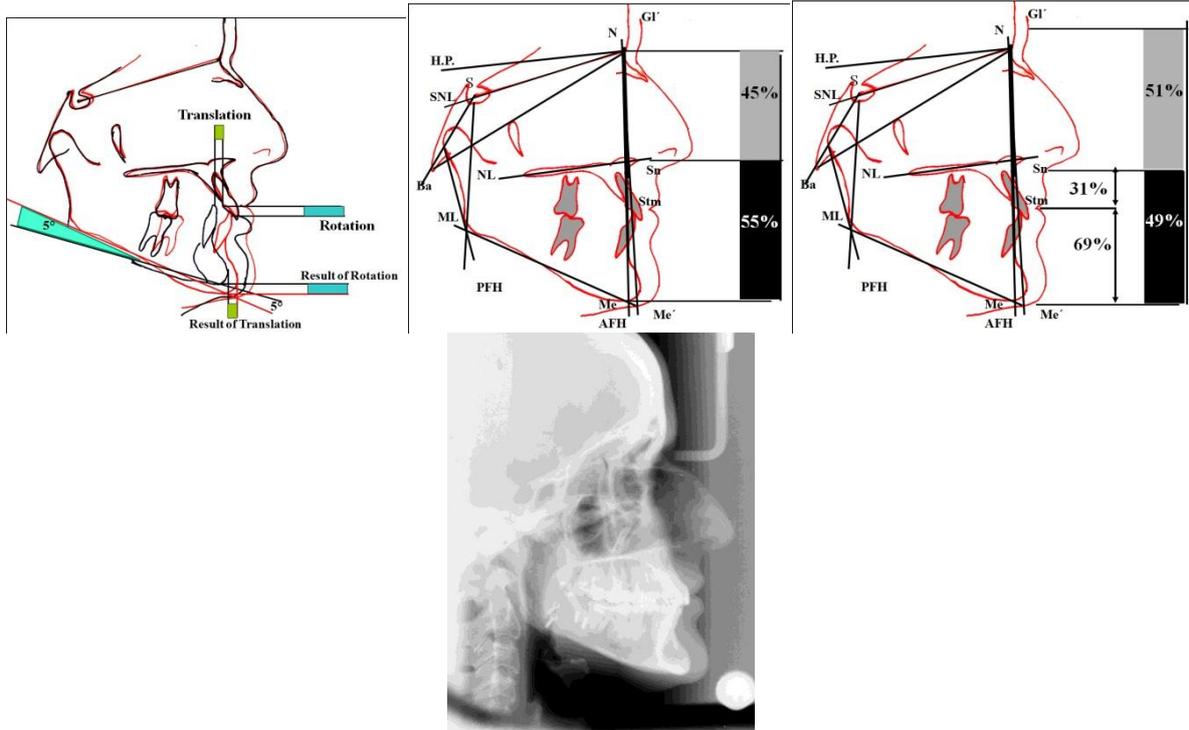
**Fig. 10a, b:** Phases and mechanics to close the lateral open bite.



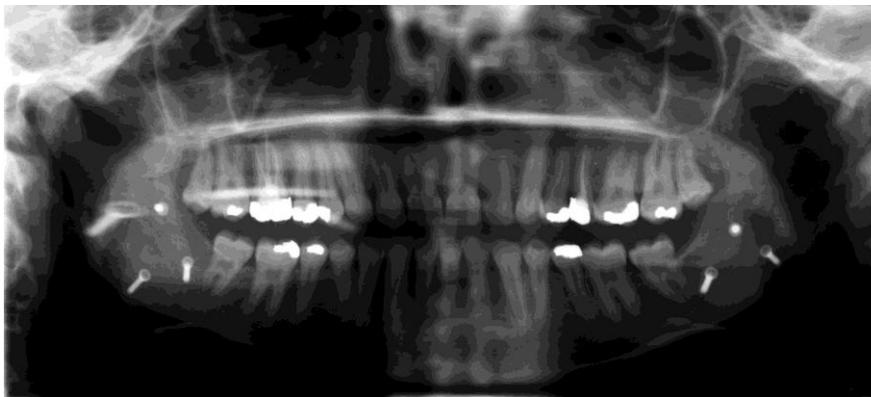
**Fig. 11a-e:** Clinical Situation at the End of the Treatment. Class I and stable occlusion with correct overjet and overbite.



**Fig. 12a-c:** Extraoral appearance of treatment results. The sagittal deficit was corrected without increasing the chin prominence. At the same time the vertical dimension was harmonized. The sublabial sulcus was flattened.



**Fig. 13 a-d:**The cephalogram after treatment shows a harmonic relation of the soft tissue profile of upper to lower face; the proportions within the lower face are harmonized as well. A harmonization of the skeletal structures in the horizontal and in the vertical dimensions was achieved. An increase of the interplane angle (ML-NL) by surgical opening of the Gonial angle resulted in an increase of the posterior incline of the mandibular plane (ML-NSL; variables in table III and IV).



**Fig. 14:** Orthopantomogram after treatment.