Treatment of mandibular retrusion by distraction osteogenesis: a new technique

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Summary We treated the mandibular retrusion of a 20-year-old man by distraction osteogenesis. Our aim was to avoid any visible discontinuities in the soft tissue profile that may result from conventional 'one-step' genioplasty. The result was excellent. In addition to a good aesthetic outcome, there was increased bone formation not only between the two surfaces of the osteotomy but also adjacent to the distraction zone, resulting in improved coverage of the roots of the lower incisors. Only a few patients have been treated so far, but the method seems to hold promise for the treatment of extreme retrognathism, as these patients often have insufficient buccal bone coverage.

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1. Introduction

Intraoral genioplasty for the aesthetic correction of the facial profile was introduced by Trauner and Obwegeser in 1957. It is usually done in one step, fixing the tip of the chin in a more prominent position after an osteotomy to separate a lower anterior segment from the remaining mandible. The extent of forward movement is limited because the osteotomy surfaces must overlap to fix the segment stably in the new advanced position, or a bone graft must be interposed. Also, the steps in the contour can compromise the soft tissue profile.

Other techniques such as the advancement of the mandible by sagittal split operations are also subject to the drawbacks of a one-stage operation. These procedures, particularly when longer distances were required, were replaced by distraction osteogenesis, which has the advantage that not only are the bones elongated, but also the soft tissues are slowly stretched as a result of the gradual advancement of the bone segments.

We have designed a simple device to correct mandibular retrusion, replacing traditional genioplasty. We used the advantages of distraction osteogenesis to obtain a better result in terms of final soft tissue profile and of movement achieved.

2. Material and method

2.1. The distractor

A special distractor (MDO-G, Orthognathics Ltd., Zurich, Switzerland) was developed. The device (Fig. 1) consists of a T-plate in which the main body connects to the segment to be distracted, while
the short arm holds a bone screw at right angles to the plane of the plate. This screw can rotate but cannot move axially. On the end of the short arm, a linear plate is connected by means of a hinge joint. The function of the device is shown in Fig. 2a–c. The T-plate is mounted upside-down. The rotatable bone screw that causes the distraction movement is screwed into a hole in the mid-sagittal area above the osteotomy. The vector of the drilled hole (and therefore the transport screw) is important, as it defines whether in addition to lengthening the chin there is a reduction or an augmentation of the height of the chin. After screwing-in the transport screw until the main body of the plate touches the bone surface, the segment to be distracted is fixed to the main body of the plate with bicortical 2 mm screws.

The distraction is achieved by turning the transport screw gradually out of its hole.

The linear plate attached by hinge joint serves simply as a guide to obtain access to the distraction screw. While the distraction screw is hidden in the soft tissues beneath the mucobuccal fold, the plate emerges through the mucobuccal fold and adapts to the changing relative position thanks to its hinge joint.

2.2. Surgical technique

The device is implanted under local anaesthesia. The distraction must be planned so that the movement to be reached can be achieved with the transport screw still remaining sufficiently inside the bone and therefore continuously guided until the end of active distraction.

A horizontal incision is made in the vestibulum 5 mm distant from the attached gingiva from canine to canine. Care is taken to spare the mental foramen and the mental nerve.

The periosteum is separated from the bone down to the horizontal osteotomy line and the mental nerve is displayed. The osteotomy is made at a safe distance from the inferior alveolar nerve. We use a thin burr-type bone cutter (Cutter E0540, Maillefer, Ballaigues/Switzerland), and we take care to protect the lingual periosteum and soft tissues while sufficiently weakening the lingual cortical bone.

The chin segment is then mobilised and the vector of the drill hole for the transport screw established. Usually the transport screw and therefore the distraction vector is positioned parallel to the occlusal plane but can be aimed slightly upward at an angle to the occlusal plane, for instance in case of insufficiency of a lip. The distractor is inserted by screwing the transport screw into the drill hole until the distractor touches the bone surface. The distractor is fixed to the segment to be distracted (Fig. 3) and the function and free mobility without interference is tested. To gain access to the transport screw for activation, a silicone drainage tube is put over the screw head and led along the guidance part of the distractor into the labial sulcus.
Figure 2 (a) Diagrammatic side view of the distractor at the start of the distraction. The transport screw is screwed into the mandible above the chin segment, then the transverse part of the T-plate is connected to the segment with bicortical screws. (b) Diagrammatic front view of the distractor in place. (c) Diagrammatic view of the distraction. When the transport screw is turned out of the mandible, the segment is moved forward. The advancement is not restricted by the need for an overlap of the osteotomy surfaces. The axis of the screw establishes whether an additional increase or reduction in the height of the chin is obtained together with the advancement.

Figure 3 The distractor installed. The wound is ready to be closed around the emerging part of the device which will allow access to the distraction screw.

The mucosa is tightly sutured around the emerging parts. The distraction is started 7 days after the operation at a distraction rate of 0.5–1 mm/day achieved in one activation. To get access to the distraction screw, the screwdriver is inserted through the drainage tube and the soft tissues are pressed down on to the screw head. As this may be painful,

Figure 4 Lateral cephalogram of a patient during active distraction genioplasty. Note the hinge joint and the position of the guide plate in the vestibulum.
Figure 5  The patient before genioplasty. Side view (a), front view (b), and oblique view (c) show incompetence of lip and a strongly retrognathic profile. (Published with permission of the patient.)
Figure 6  Preoperative lateral cephalogram.

Figure 8  Lateral cephalogram after the end of the consolidation phase and the removal of the distractor. Note how new bone was formed not only between the osteotomy surfaces but also on the old frontal bone surface adjacent to the osteotomy (arrow). The bone contour was therefore smoothed out substantially leading to an improved soft tissue contour including improved support of the sublabial sulcus.

for the first 1–3 days a local anaesthetic is applied around the emerging part of the distractor. Fig. 4 shows the lateral cephalogram of a patient during the active distraction phase.

After reaching the final position, the device is left in place for 10 weeks, to allow consolidation of the distracted tissues. The guidance part that emerges into the oral cavity may be clipped off, so that the device is completely submucosal during consolidation. It is then removed with similar but smaller access as at the time of implantation.

Figure 7  Lateral cephalogram at the end of active distraction. The linear guide plate for access to the screw was removed so that the distractor is now completely covered by mucosa for the consolidation phase.
Figure 9 The patient at the end of the treatment. Side view (a), front view (b), and oblique view (c) show improvement in lip competence and profile. The lower contour of the chin is harmonious without any apparent discontinuities. (Published with permission of the patient.)
3. Case report

A 20-year-old man was referred for genioplasty. Fig. 5a–c shows the facial profile, front view, and oblique view illustrating the lip incompetence and the retrognathism. The lateral cephalogram (Fig. 6) shows the slight protrusion of the lower incisors with their limited bone coverage on the buccal side.

In an operation lasting about 30 min, an osteotomy was made and a distractor inserted under local anaesthesia. The duration of active distraction was 15 days and resulted in an advancement of the chin by 10 mm. Fig. 7 shows a lateral cephalogram after reaching the final position. The guidance part of the distractor was removed to allow consolidation with the distractor completely submucosal. After 10 weeks, the distractor was removed. Fig. 8 shows the result 13 weeks after the end of distraction. New bone was formed not only in the area between the two former osteotomy surfaces but also on the frontal bone surfaces adjacent to the osteotomy (see arrow) up to a height of 1.6 cm above the osteotomy. This resulted not only in a smoothing out of the initial step created by the distraction but also an increased support of the sublabial sulcus.

Fig. 9a–c shows the facial profile, front view, and oblique view after removal of the distractor. The lip incompetence and the retrognathic appearance have been corrected. The lower soft tissue contour of the mandible is harmonious and there is no discontinuity as a result of a bony step, which may be found after a conventional genioplasty.

4. Discussion

The original motivation for the development of this new technique was to avoid steps in the soft tissue contours in the area of the canine or premolars. This goal was reached not only in the present patient but in all six patients treated so far.

The distraction led to bone formation not only in the area between the two osteotomy surfaces that were moved apart during distraction, but also on the bone surfaces around the osteotomy. The osteogenesis seems to occur in the area where the periosteum is stretched away from the bone surface during active distraction, where it forms a kind of a tent rounding off the step between the osteotomy surfaces. A similar pattern of bone formation was also described after conventional genioplasty.7

In the present case, the bone formation on the buccal side improved the support of the sublabial sulcus considerably. If the osteotomy is not too far below the roots (while maintaining a viable distance of at least 5 mm below the roots), it should be possible to increase their coverage with bone as indicated by Precious et al.7

At present, the process is under more precise scrutiny using computed tomography. If the effect is found consistently, it might be relevant for younger patients as an extreme mandibular retrusion is often coupled with insufficient buccal bone coverage of the lower incisors and it might therefore make sense to do the distraction genioplasty before orthodontic treatment, to achieve better conditions for orthodontic movements of the lower incisors.

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References