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Reinventing the wheel: a modern perspective on the bilateral inverted 'L' osteotomy

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Abstract. The bird-face deformity of a severe class II, high Frankfort–mandibular plane angle with significant retrogenia, often associated with diminutive condyles and reduced posterior face height, poses many challenges to the orthognathic surgeon. Of greatest concern in these patients is the degree of mandibular advancement required and the potential for relapse. The sagittal split osteotomy is the workhorse of mandibular surgery but does not allow significant lengthening of the ramus, which is desirable in this group of patients. An inverted 'L' osteotomy of the mandible to facilitate ramus lengthening is therefore indicated in the management of this group, but is a procedure that has largely fallen out of favour due to the need for an extraoral approach and intermaxillary fixation. The advent of distraction osteogenesis promised to be the answer for these cases, but with nearly 20 years of experience with these techniques, it is clear that it does not represent the panacea that was hoped for. We present a series of four cases of bimaxillary surgery consisting of maxillary osteotomy and bilateral inverted 'L' osteotomy of the mandible carried out via an intraoral approach (average advancement 10.5 mm), where internal semi-rigid fixation was employed to obviate the need for intermaxillary fixation. We highlight the indications for this procedure and why it is ideally suited to this group of patients and argue that the procedure should be re-introduced to the armamentarium of the orthognathic surgeon.

Key words: bird-face deformity; orthognathic; inverted L osteotomy; class II.

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The inverted 'L' osteotomy was first introduced by Caldwell et al. in 1968,[1] with a primary indication according to Henderson[2] of ''mandibular hypoplasia where the deficiency is both horizontal (antero-posterior) and vertical''. A particular group of patients presenting to our institution have the classic 'bird-face' deformity of a class II malocclusion on a significant class II skeletal base, an increased Frankfort–mandibular plane angle (FMPA), marked retrogenia with radiographically diminutive condyles, and a decreased lower posterior face height. The anticipated problems include the degree of advancement required, thus potentially lengthening already high FMPA faces, together with the propensity for relapse with such an unusual condylar anatomy.

Treatment options traditionally include the conventional bilateral sagittal split osteotomy (BSSO), distraction osteogenesis, and the inverted 'L' osteotomy with or without maxillary osteotomy to facilitate closure of an anterior open bite. The advantages of the BSSO are numerous

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and include high operator familiarity and one-stage surgery. However one must not overlook the risks to the inferior dental nerve; Westermark et al.[3] reported 40% of patients to have some residual nerve dysfunction at 2 years post-surgery. The ramus anatomy in all of the cases treated at our institution was highly abnormal, thus effectively rendering this option unsuitable. Distraction osteogenesis promises to decrease early relapse by slowly increasing the pull on the pterygomasseteric sling, thus allowing compensatory adjustment. However it requires surgery twice, to insert and then remove the distractor. Unsightly scars have also been documented following the use of extraoral distractors. High patient compliance both in follow-up attendance and daily perseverance turning the distractor is also necessary. Complications such as pressure sores and infection have also been reported in the literature.[4] The advantages and disadvantages of both surgery and distraction techniques were discussed with all of our patients prior to embarking on definitive treatment plans.

The inverted 'L' osteotomy has long fallen out of favour, mainly due to the use of an extraoral approach to the rami and wired intermaxillary fixation (IMF). We have developed a method using right-angled instruments that obviate the need for an extraoral incision and use semi-rigid fixation in the form of miniplates. This improves cosmesis as there is no visible scar, and it reduces the risk of damage to the facial nerve significantly. The procedure also greatly reduces the risk to the inferior dental nerves, as all cuts are made under direct vision, superoposterior to the lingula.

Technique

Access to the ramus is performed via standard intraoral incision along the external oblique ridge and a mucoperiosteal flap is raised. Once a suitable sub-periosteal dissection has been performed both buccally and lingually, Leverson–Merrell and Bauer retractors are inserted to provide good visualization of the ramus and angle. A combination of a Lindeman bur and right-angled saw is then used to perform the inverted 'L' osteotomy, as described previously by Caldwell. The Lindeman bur is first used to make a horizontal cut through the bone, extending to just beyond the lingula. A right-angled saw is then used to complete the vertical cut posterior to the lingula.

An acrylic wafer is used to hold the occlusion in its final position and secured with temporary IMF. The proximal and distal segments of the mandible are then plated into position using an 'L'-shaped plate inferiorly and a 'Y' plate superiorly.

Two blocks of harvested autogenous iliac crest bone are then slid into position, perpendicular to one another, to form an 'L' shape; these are subsequently secured via the remaining holes in the plates. For ease of insertion, we have found that the 'L' graft should be comprised of two separate rectangular bone blocks. Completion of the 'L' shape is by inserting the vertical limb to the full height of the defect first and then sliding the horizontal limb into place. Plating of the area is performed with a right-angled drill and screwdriver; however the plates could also be secured via a transbuccal trochar and conventional instruments. The wafer is then removed, occlusion checked, incisions closed with dissolvable suture material, and intermaxillary elastics applied in theatre. The degree of elastic traction is heavier than that required for conventional BSSO in favourable bone, and the elastics remain *in situ* for 3–6 weeks.

Case presentation

On presentation, patient A reported that she did not like her ''severe lack of chin''. Having been seen in our joint clinic, the option of combined orthognathic/orthodontic treatment in the form of distraction or bimaxillary surgery was discussed, which she was keen to pursue. Clinical examination was as discussed above, showing class II skeletal bases, significant retrogenia, a small mandible, decreased lower posterior face height, high FMPA, mild asymmetry, and an anterior open bite with radiographically small condyles. Medically she suffered with arthritis and had undergone a total hip replacement at age 37 years.

Having decided to undergo surgery, unremarkable pre-surgical orthodontics was followed by a Le Fort I maxillary osteotomy to correct the asymmetry and an inverted 'L' mandibular osteotomy via an entirely intraoral approach as per the technique described above.

Discussion

Seven inverted 'L' osteotomy procedures have now been performed at our institution by the same two consultants. The first three were performed with standard extraoral incisions until it was found that the procedure could be performed through the intraoral access sites alone. The four subsequent patients underwent intraoral surgery; all had sought treatment for a difficulty eating due to anterior open bite and/or a dislike of their diminutive chin. These four patients all underwent standard pre- and post-surgical orthodontics ± maxillary osteotomy. All patients had a class II division I malocclusion on a significant skeletal class II base, with grossly increased anterior vertical dimensions and decreased lower posterior face height (increased FMPA) (Fig. 1).

Postoperative imaging was requested for each of the four intraoral patients as routine follow-up, with the longest set of records covering 24 months post-surgery. One patient underwent imaging of a different modality for other reasons postoperatively and so did not undergo additional imaging for our assessment. A second case only had imaging immediately post-surgery and subsequently failed to attend for further review. The cephalometric images of the remaining two patients were analyzed and the results are shown in Table 1.

Mean mandibular advancement in our cohort measured 10.5 mm, with the smallest movement being 9 mm. Results showed the maxilla to be relatively stable, with minimal average backward (0.25 mm) and downward vertical (0.75 mm) change to the anterior nasal spine between surgery and 21–30 months. However, the mandible showed some signs of relapse, with an average 3.25 mm downward and 3.5 mm (33%) backward mandibular rotation when superimposed on the anterior cranial base. All patients showed significant remodelling of the angle of the mandible. These figures appear comparable to those reported by Proffit et al.[5] for class II skeletal cases treated with maxillary surgery and mandibular advancement, namely 25% of patients having 2–4 mm horizontal relapse, plus 7.5% having >4 mm horizontal relapse within 1 year following BSSO (Fig. 1).

Stability has always been a problem with larger movements in orthognathic surgery,[6] but the dawn of semi-rigid fixation has minimized the need for wired maxillary-mandibular fixation. Relapse has classically been divided into early and late relapse,[7] early being within 6–8 weeks and attributed to movement at the osteotomy site itself,[8] and late relapse, seen radiographically between 6 and 17 months,[9] attributed to condylar resorption. The majority of the relapse in the series presented appeared to be early (Table 1), with changes measured at <6 months postoperatively.