

Mandibular retrognathia and osteodistraction

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Paul studied dentistry and medicine before completing formal surgical training in maxillofacial surgery in 2002. He has broad hospital experience, with basic training in general medicine and paediatric/general dentistry, with advanced medical training in both psychiatry, and emergency/resuscitative medicine (including Advanced and Definitive level qualifications in general Severe Acute Trauma management). His post-Master's senior registrar training in OMS was conducted at both John Hunter (NSW) and Singapore General Hospitals. He is now in exclusive private consultant practice in Newcastle NSW, where his professional interests lie predominantly in reconstruction and augmentative facial surgery, although he practices in all aspects of the speciality.

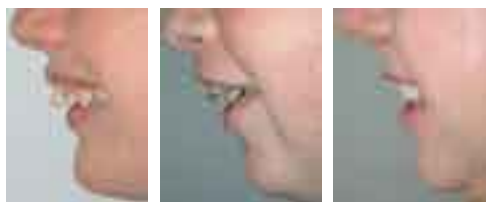
Orthognathic surgery is the art and science of creating proportion between the upper and lower jaws, in coördination with orthodontic alignment of teeth. Treatment is conducted conjointly by a specialist orthodontist and specialist oral and maxillofacial surgeon.

Jaw distraction is a relatively new technique in Oral and Maxillofacial surgery, and is set to revolutionise the management of mandibular retrognathia in adolescents. The under-growing lower jaw (which has been present throughout childhood), leads to a number of secondary dental and facial developmental problems; all of which have their major ramifications in the last few years of adolescent growth. Firstly, and most obviously, the shortened lower jaw cannot accommodate all the adult teeth, and severe crowding becomes a prominent orthodontic treatment issue.

By not coming into a normal biting relationship, some teeth over-erupt; and some never erupt at all. Front teeth may become "bucky" as the lower lip gets caught behind the upper incisors making them stick out (and more prone to injury). The lower front teeth over-erupt and can even cut into the palate (roof-of-mouth), grossly accentuating the curve of Spee.

As the chin is so short, there is a reduction in normal facial height. With this, there is a primary effect on lip continence, and many patients suffer from frank drooling. The inability for the teeth to meet makes eating and biting abnormal, and sometimes impossible. Many patients develop life-long jaw-joint clicking and later frank osteo-arthritis. Mild cases of short jaw are classically treated with premolar or molar extractions, so that the orthodontist can "pull-back" the prominent upper front teeth. This style of dental treatment does nothing to correct for the under-developed lower jaw and usually results in a compromised facial developmental profile. A sloping facial profile is created that worsens the lack of chin projection.

Special thanks are given to Dr Peter Powell Vaughan, MDSc Orthod. (Syd.), Specialist Orthodontist in Charlestown (Newcastle), NSW. Peter actively orthodontically managed all orthognathic surgical patients shown in this article.



Series showing moderate mandibular retrognathia in a male, with second photo showing premolar extractions, and "pull-back" of upper anteriors to mimic an Angle's Class I incisor relationship to correct for a Angle's Class II skeletal relationship caused by juvenile rheumatoid arthritis. The third photo showing an adult after treatment 20 years previously, who now has obstructive sleep apnoea, unstable incisor position, and complains of excessive chin role with excessive backward sloping and "gingival show" of the orthodontically "corrected" upper incisor teeth.



Series showing effect on incisor proclination with pull back of upper teeth to achieve a Class I incisor relationship, usually achieved with removal of upper premolar or molar teeth.

Traditional orthognathic surgery aims to prevent orthodontic tooth extractions, and to primarily correct for the shortened lower jaw after the completion of a formal orthodontic

treatment course. Classic corrective surgery follows orthodontic treatment, and occurs only once growth has ceased. Treatment times and complexity are usually greater with this form of treatment, but results are normally excellent, with normalisation of facial profiles and occlusion.



23 year old male... First photo showing Angle's Class II malocclusion with severe crowding, and backwards collapse of the upper incisor teeth. Second photo shows correction of occlusion with orthodontic intra-arch alignment and correction of the maxillary incisor collapse, with normalization of the mandibular position with classic bilateral para-sagittal ramus split advancement mandibular osteotomy.



23 year old male. First photo showing moderately retruded mandible, with second photo demonstrating correction of facial profile, and effect on lip posture, chin advancement and improved lower facial height, with correction through normal advancement osteotomy mandible. Classic combined orthognathic surgery with non-extraction orthodontics can produce excellent aesthetic and functional occlusal results, but can be completed only after the cessation of growth.

New jaw-distraction techniques are relatively less complex operations, with fewer side-effects and are quicker to perform. Importantly they can be done at a much younger age, whilst growth is still occurring. The

most important revolution of jaw distraction surgery is that surgery can precede braces, and prevent damaging compensatory dento-alveolar growth and over-eruption of teeth in the opposing normal jaw. Jaw distraction surgery (and surgery performed in-between teeth) pre-emptively creates spaces for later orthodontic alignment of crowded lower dental arches. Most operations only last a couple of hours, and overall treatment can be completed over six weeks.



13 year old male. First photo showing moderately retruded mandible, with second photo demonstrating correction of facial profile utilising distraction surgery (distractors are still in place, but are not visible). Time difference between photos is 3 weeks, and orthodontics will follow removal of distractor appliances.



Appearance of distractor appliances in place. Close up photos show before and after appearance of the distraction gap. Distraction is ~1mm day, and progresses over 7-10 days. The process of distraction is painless, but a preceding oral acetaminophen 500mg tablet is recommended. The distractors are held in place for ~4-6 weeks prior to removal. Normal osteoid forms in the distraction gap, which is almost fully mineralized by 6 weeks.

Orthodontic braces normally follow, and usually can occur without the traditional removal of premolar or molar teeth. The braces close the gaps that distraction can cause, and allows for general straightening of the teeth. The change in facial appearance can

be dramatic, even over the short 6-8 week treatment periods demonstrated here.

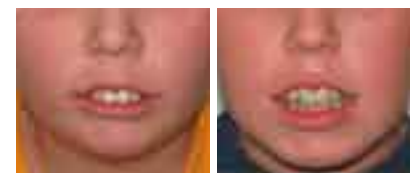
If you are considering jaw distraction surgery as suitable for your patient, it is important that the orthodontist is both familiar with this style of treatment, and with the surgeon performing the operation.

Treatment is carried out in a "team" atmosphere, with coordination of the activities of the patient, parent/carer, general dentist, orthodontist and surgeon. Two operations are usually required (one to place the distractors... 1.5 hours, and one to remove them... 0.5 hrs), and the actual distraction process is carried out at home with regular reviews by both the orthodontist and maxillofacial surgeon. Operations are usually day-stay only.

Surgery and anaesthesia is heavily Medicare subsidised, with surgical appliance and hospital costs provided by Medical/Hospital insurance. Patients with craniofacial abnormalities may be eligible for inclusion into the Cleft-Lip and Palate Scheme, with orthodontic treatment also subsidised by Medicare.

CASE 1. 12 year old male with severe mandibular retrognathia

This 12 year old boy had a family growth tendency of extremely short lower jaw. Because the jaw is so short, there is a prominence to the upper teeth, and a complete inability to chew as the back teeth do not meet.



Severe underset jaw characterised by prominence of upper teeth, and 'caught' lower lip. Correction over 8 weeks gives fullness to the lower face, and normalisation of lip posture as well as occlusion.



8 week treatment difference of occlusion. Severe underbite and complete inability to chew or bite as no teeth contact in normal occlusion. Correction creates a stable and inter-digitating occlusion, with the orthodontist able to place braces for a normal orthodontic treatment course.



The underset jaw is characterised by prominence of the upper teeth, partial to complete lip incompetence, and retruded profile and chin. Correction through distraction, allows for the lower jaw to 'catch up' and normal facial growth continues with normal jaw proportions.

Distraction of the jaw occurs between the 1st and 2nd molar teeth. The space created extends the lower jaw forward, as well as allowing for creation of an orthodontic space; this is later used later to 'unbuckle' the lower teeth into a normal arch form.



Treatment sequence shown is: 1. Pre-operative view, 2. Three months post-operative OPG, 3. Nine months post-operative view (with closure of the dental gap using orthodontic brackets). Full distraction was ~10mm. Surgery occurs between the back 1st and 2nd molars and literally "stretches" the jaw. Over 1 week the jaw assumes normal proportions and teeth inter-digitate normally.

CASE 2. 13 Year old male with moderate mandibular retrognathia

As the retrognathic lower jaw is so set back, the lower lip is unable to cover and protect the upper front teeth. Such prominence leads to increased rates of knocking and chipping. The moderately underset lower jaw is characterised by a short chin height, and "catching" of the lower lip behind the upper front teeth.



Lack of lip protection to the front upper teeth leads to increased rates of incisor dental injury and tooth chipping. After surgery photo (on right) shows natural lip continence, and longer lower chin height. Difference between photos is 8 weeks.



Separation of the lower 1st and 2nd molars occurs with distraction. Time difference seen here is 6 weeks. Normal bone consolidates in the distraction gap, with normal chewing forces achieved at 6-8 weeks from initiation of the distraction process.



Before and after photos showing effect of lower jaw distraction on the general relationship between the upper and lower teeth. Distraction distance is ~8mm, and results in normalisation of the bite into a skeletal Class I type occlusion. Braces can be placed at any time, but the orthodontist has elected for braces to be placed in 12 months time, allowing for further natural general facial growth to occur once jaw distraction has ended.

Potential complications from this form of surgery include persisting lip numbness, surgical compromise of adjacent teeth, scarring, pain and swelling. In all cases of distraction thus far, no such complications have occurred. You should discuss all surgical risks prior to embarking on any surgical course.

CASE 3. 14 Year old male with moderate mandibular retrognathia and impacted lower 2nd molars

The retruded lower jaw is aesthetically displeasing. Persisting with the growth problem can lead to social teasing and

IMPORTANT POINTS ON DISTRACTION SURGERY

1. Distraction is amongst the most conservative, preserving and enhancing of facial surgical procedures available. It aims to avoid routine orthodontic extraction of teeth, and to maximally enhance the potential growth of the child's under-developed facial structures prior to damaging compensatory dento-alveolar development.
2. Early (adolescent) treatment for the retruded mandible may not be an option for all patients. For some, traditional jaw correction surgery may be more appropriate at a later (early adult) age. It is important to coordinate team plans between the patient, carer, orthodontist and surgeon prior to engaging any particular form of corrective surgical-orthodontic treatment.
3. The pattern and style of distraction therapy varies from patient to patient. Surgical planning varies according to individual anatomy, patient age, and style of orthodontic treatment to be performed.
4. Distraction treatment spans vary from 6-12 weeks, and there are normally two operations; one to place the distractors, and one to remove them (usually 6-8 weeks after placement). Distraction normally occurs between the mandibular first and second molars.
5. Distraction is normally carried out at home, is normally very comfortable, and lasts up to 2 weeks. One-on-one support is provided to parents or carers during the distraction period, and regular review appointments are maintained with the surgeon. There may be several x-rays to assess surgical progress through the distraction period.
6. Patients with cranio-facial disorders may be eligible for placement onto the Cleft-Lip & Palate Scheme to help with dental aspects of care (including orthodontics). Distraction surgery and distractor appliance costs are heavily subsidised by normal Maxillofacial Schedules under Medicare, and through the medical/hospital insurer for coverage of distractor appliance costs (through the National Prostheses Schedule).
7. Only Maxillofacial Surgeons and Specialist Orthodontists are trained to coordinate overall dental and facial growth treatments, and require separate specialist accreditation if treatments are under the Cleft Lip & Palate Scheme. Distraction surgery is specialist level only, and not all surgical or orthodontic practitioners are able to provide a distraction service.
9. There are risks and complications with all types of surgery, and patients should have ample opportunity to carefully discuss all such risks with their surgeon, as well as gain full financial consent.

isolation during adolescence. Distraction surgery is the most conservative and enhancing of jaw proportioning operations and importantly occurs before growth has ceased.



Moderate underset chin is corrected with normalisation of lower jaw length by a bilateral forward distraction distance of ~9mm. Note the improvement in lip alignment, and increased prominence and height of chin, as well as alignment of the front teeth into a normal biting relationship. Time difference between before and after photos is 6 weeks.



Impaction of the lower 2nd molar is relieved with surgical jaw distraction occurring between the 1st and 2nd molars. The time difference is ~6 weeks, with normal bone continuing to consolidate at the distraction site, and normal eruption of 2nd molar has already occurred. The orthodontist will use the distraction space to align and unbuckle the forward crowded arch of teeth.

Following surgery to remove the distractors (or shortly just before), the orthodontist will normally apply orthodontic braces for a normal course of intra-arch tooth alignment.



Braces are placed just prior to removal of distractors, and a normal period of orthodontic treatment follows for 18-24 months. Time difference seen here is 12 weeks.



Final orthodontic result once braces are removed 12 months following initial surgery.

CASE 4. 13 Year old male with moderately retruded mandible



Before and after photos showing definitive over-bite, with lack of lip protection of upper front teeth on smiling. Total correction occurs through surgery. Time difference is 8 weeks.



X-ray series showing placement of distractors, with full lengthening of 8mm achieved after 8 days. Consolidation of new bone occurs over the following 6 weeks. Final x-ray shows bone appearance at 8 week point. Notice the full mineralization of new bone that has occurred at the distraction sites between the 1st and 2nd lower molars.



Before and after photos showing incisor relationship. Small open bites, incisor imbrications, and over-eruptions are imminently treatable with a much reduced and simplified course of orthodontic treatment.

In all cases shown, there have been no complications from surgery. Specifically adjacent teeth maintain a normal periodontium, there is no residual lip numbness, occlusion remains stable, and TMJ health is normal. Swelling and discomfort from surgery is minimal and short lasting (usually swelling is not noticeable by 7 days), with requirements for prolonged hospital in-stay eliminated.

DISTRACTOR APPLIANCES



Left and right distractor appliances. Based on the Ilizarov technique of lengthening short legs and other long bones, and to a smaller degree upon palatal expansion devices used in orthodontics since the late 1800's, the intra-oral distractor uses an internal screw system allowing unilateral or bilateral jaw lengthening of up to 1mm/day. Distraction occurs near wholly within the mouth, with minimal or no post-operative scarring or otherwise late-evidence of surgery.

The appliances may be placed right side up, with right for right side and left for left. To control upward anterior vectoring however, distractors are best placed up side down, with right appliance for left side and vice versa in the technique described above. Vectoring aims to gain lower incisal edge to upper central cingulum relationship once distraction has ended (or in anticipation of this with prediction of orthodontic correction of incisal angles). Any mid-occlusal open bite is corrected through orthodontic flattening of the accentuated curve of Spee. The writer does not recommend any distraction appliance over any other, but does recommend the flexible arm assembly, and short-wide fixator bars, with splayed placement of 5mm retention screws. ♦

Thanks are given for publication of this article to the *Journal of Maxillofacial and Oral Surgery*.

A more definitive peer reviewed article with detailed reference list can be viewed at: Routine osteodistraction for correction of moderately retrusive mandibles in preorthodontic adolescents: Description of interdental osteotomy technique.

Cocancig @ Vaughan. *Journal of Maxillofacial @ Oral Surgery*. 2008, Vol 7:2, p220-225.

QUESTIONS FOR CPD POINTS

1. **What techniques are available to definitively correct for skeletal disproportion between the jaws?**
 - a. Orthopædic dental appliance therapy
 - b. Completion of growth
 - c. Orthognathic surgery
 - d. Orthodontic banding, with tooth extraction
2. **What would not be expected to occur with mandibular orthognathic surgery?**
 - a. Day-stay only surgery, with minimal operation time (~1-2hrs)
 - b. Gross swelling, blood loss, and 2-3 months numbness of lower lip and chin
 - c. Excessive out-of-pocket medical costs of treatment exceeding \$5,000 for surgery
 - d. None of the above
3. **What should an orthodontist or general dentist advise in terms of treatment for the underdeveloped lower jaw?**
 - a. Don't worry, you'll grow out of it
 - b. I'll take out two upper premolar teeth and pull back the upper front teeth to correct your primary complaint of too much upper incisor prominence
 - c. I'm not sure, but you may require surgery to correct your lower jaw. Before I put braces on, I'll send you to a surgeon to advise you on the possibility of corrective surgical options, but here is a brochure that can prepare you with some questions you'd might like to ask her. Once she has explained how she may help you (or not), we can then work together towards a mutually agreed treatment plan, which may include tooth extractions; but I'm hoping to avoid that.
 - d. None of the above
4. **What treatment period would not be expected to correct for both the skeletal and orthodontic management of simple mandibular retrognathia?**
 - a. In a 14 year old male, with moderate mandibular retrognathia of 7mm, and mild intra-arch crowding, distraction surgery would last 6 weeks, with an 11 month post-surgical course of simple edgewise orthodontic appliance therapy to correct for mild crowding.
 - b. In a 13 year old male, with accentuated curve of Spee, requiring distraction surgery of 10mm, and lower arch correction of premolar mid-occlusal open bite, with orthodontic therapy of ~16 months after surgery.
 - c. In a 23 year old male with collapsed maxillary frontal arch, and mandibular retrusion of 6mm, requiring ~12 months of intra-arch dental alignment, with ~4/12 of settling orthodontic therapy after corrective mandibular advancement surgery.
 - d. In a 15 year old female, requiring premolar extractions, and 30 months of orthodontic therapy to pull back the maxillary incisor teeth, close the dental gaps created by extraction, and to create a class I molar and incisor dental relationship on a Class II skeletal base not otherwise corrected surgically.
 - e. None of the above
5. **When should premolar extractions for pull back orthodontic therapy be utilised in cases of moderate (incisor overjet 5-10 mm) mandibular retrognathia?**
 - a. A trial of orthodontic extractions should always be attempted, and if this does not correct the orthodontic incisor relationship from Angle's Class II to Class I, then offer surgery.
 - b. Always offer orthodontic extractions after dismissing the prospect of orthognathic surgical correction as too extreme for the patient to even be informed of the potential.
 - c. Never.
 - d. Occasionally in extremely rare instances of intra-arch crowding that could not be corrected other than by premolar removal, but not for purposes of attempting to correct the skeletal abnormality by pulling teeth into a tentative (but usually) Angle's Class I occlusion.
6. **Who should provide treatment for surgical and orthodontic correction of mandibular retrognathia and the associated malocclusion?**
 - a. A general dentist who works in a large insurance company based group practice, and who's practice is limited to orthodontics, working in concert with another dentist within the same practice, and who has a special interest in oral surgery.
 - b. A specialist orthodontist and a specialist oral and maxillofacial surgeon, both of whom are intimately familiar with each others treatments, and who work inter-dynamically to maximise the patients best treatment interests.
 - c. A combined orthodontist and oral surgical specialist, to provide both arms of both orthodontic and orthognathic care.
 - d. A super generalist dental surgeon, capable of complex orthodontic and surgical management based on an intensive 3 week US course costing \$US25,000 to attend.
7. **What should be expected from mandibular distraction surgery in the post-operative period and after distraction has ended?**
 - a. Full correction of the profile, with normalization of the incisor relationship, minimal swelling, no pain, and normal lip and chin sensation .
 - b. Areas of posterior open bite normally occurs, as pre-surgical dento-alveolar compensation rarely maintains a level occlusal plane.
 - c. Anterior open bite, as vectoring of distraction is rarely predictable at time of distractor placement.
 - d. Swelling, pain, discomfort, and persisting numbness arising from osteotomies transgressing sensory neural pathways.
 - e. Only A & B.
 - f. Only C & D, but rarely A & B.
8. **What treatment subsidies exist for treatment of mandibular retrognathia when surgical treatment is provided by a general dentist?**
 - a. A small amount of dental ancillary insurance coverage for the operation itself under ADA item code 366.
 - b. Considerable medical insurance subsidy for the osteotomy procedure and for placement of the distractor through the Maxillofacial Schedule of Medicare.
 - c. Subsidy through the Cleft Lip & Palate Scheme if the patient is registered under this programme.
 - d. Whole costs National Prostheses Schedule coverage through the patients medical insurer, when surgery is classified under a Medicare itemization.
 - e. Considerable private hospital and hospital stay costs when surgery tiered under a major maxillofacial procedure.