

Routine osteodistraction for correction of moderately retrusive mandibles in pre-orthodontic adolescents: Description of interdental osteotomy technique

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Abstract: Case presentations are made of white Caucasian males aged 12-14 years, demonstrating moderately horizontally retrusive mandibles. All cases had habitual forward posturing habits with associated TMJ problems, and inability generally to properly intercusate and masticate.

All were treated (prior to initiation of formal orthodontic treatment) with distraction of bilateral vertical interdental osteotomies between lower first and second molars. Each site was distracted between 7-12mm. Early removal of distractors allowed for elastic IMF and "callous manipulation" to acquire a Class I occlusion, allowing for placement of orthodontic bands.

Comparisons are shown of pre- and post-operative radiographs and clinical facial photographs. Discussion is made of surgical benefits and risks of routine osteodistraction, in comparison with classical post-orthodontic orthognathic procedures to correct for moderate Class II skeletal malocclusions. A description is provided for the operation itself, with a special emphasis on the unique interdental osteotomy location for distraction (between mandibular 1st and 2nd molars), not otherwise reported in the scientific literature.

Keywords: Osteodistraction, mandible, retrognathia and interdental.

Introduction

Jaw distraction is a relatively a new technique in Oral and Maxillofacial Surgery, and is set to revolutionize the management of mandibular retrognathia in adolescents. Multiple sources of reference are available on general osteodistraction for craniofacial abnormalities, but in general distraction is not conducted for routine orthognathic mandibular correction. Osteotomy between first and second mandibular molars as a distraction site is

not classically considered for routine retrognathia correction, and has only been objectively reported in abstract on craniofacial osteodistraction by two separate presenters.¹

Several authors have however reported on advancement mandibular distraction using intra-oral distractors for correction of Class II skeletal mandibular retrusion. All authors have used the third molar or retromolar site, with van Strijen et al using the technique more routinely as an

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alternative to classical BSSO advancement.^{2,3,4,5,6,7}

The lag-growing mandible leads to a number of secondary dental and facial developmental problems; all of which have their major ramifications towards the end of adolescent growth. Severe orthodontic crowding and over eruption of teeth have secondary effects on mastication, incisor prominence (and proneness to injury), negative facial appearance and potentially retardative psychosocial development.

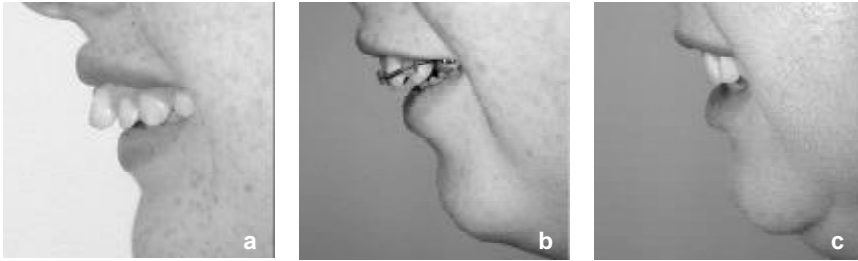


Fig. 1: Series showing (a) Moderate untreated mandibular retrognathia, (b) Treatment with premolar extractions, and retrusion of upper anteriors to mimic Angle's Class I incisor relationship, and (c) an adult female treated 20 years previously, presenting with obstructive sleep apnœa, unstable retruded incisor position, and complaint of excessive chin role.

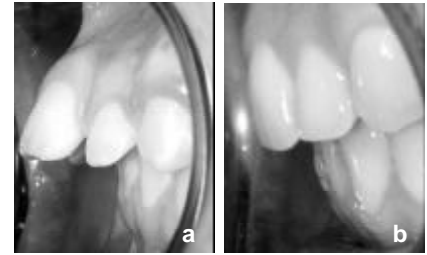


Fig. 2: (a) and (b) Series showing effect on incisor proclination with pull back of upper teeth to achieve a Class I incisor relationship, usually achieved with removal of upper premolar or molar teeth.

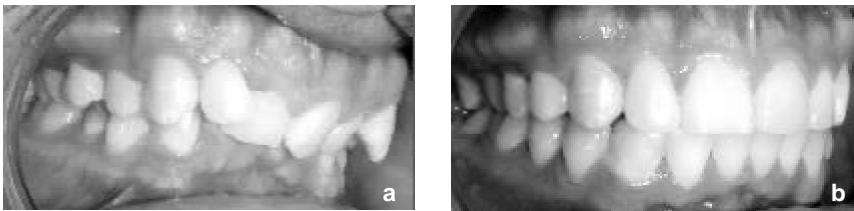


Fig. 3: (a) Angle's Class II malocclusion with severe crowding, and backwards collapse of the upper incisor teeth. (b) Shows correction of occlusion with orthodontic intra-arch alignment and correction of the maxillary incisor collapse, with normalization of the mandibular position with classic bilateral para-sagittal ramus split advancement mandibular osteotomy.

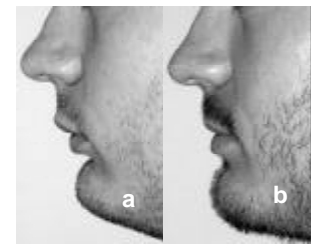


Fig. 4: (a) Profile features of moderately retruded mandible in adult male. (b) Post-surgical profile following surgical correction of facial profile, with positive effect on lip posture, chin advancement and improved lower facial height.

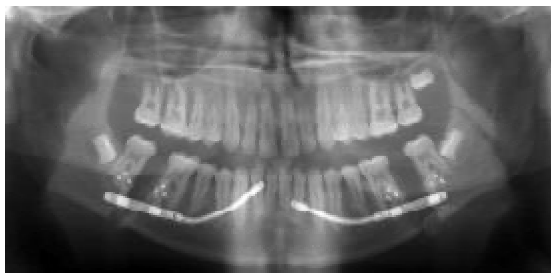


Fig. 5: Appearance of distractor appliances in place. Close up photos show before and after appearance of the distraction gap. Distraction is 1mm day, and progresses over 7-10 days.

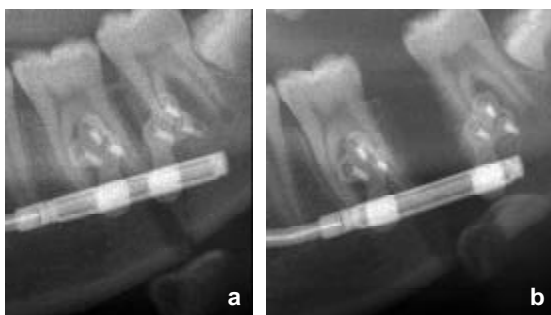


Fig. 6: (a) A preceding oral acetaminophen 500mg tablet (1/2 hr prior to distraction turn) is recommended. The distractors are held in place for 4-6 weeks prior to removal. (b) Normal osteoid forms in the distraction gap, which is almost fully mineralized by 6 weeks, and can be manipulated subtly through elastic IMF.

Skeletal mismatch leads to post-growth issues such as TMJ disease, lip incontinence and adult obstructive sleep apnoea.

Mild cases of retrognathia are classically treated with premolar or molar extractions, so that the orthodontist can retract the prominent maxillary anterior teeth. This type of dental treatment does not correct for skeletal abnormality, and results in a compromised facial developmental profile.

Series of patient photographs showing effect on incisor proclination retraction of upper teeth to achieve a Class I incisor relationship, usually achieved with removal of upper premolar or molar teeth. (Fig. 1 and 2)

Classic advancement mandibular orthognathic surgery aims to prevent orthodontic tooth extractions, and to primarily correct for the shortened mandible after the completion of a formal

orthodontic treatment course, and only once growth has ceased. (Fig. 3 and 4)

Jaw distraction generally compares as a relatively less complex operation, with fewer side-effects and is quicker to perform. The most important fact is that surgery can be done at a much younger age, during the period of growth. The most important distinction for routine jaw distraction surgery for mandibular retrognathia correction 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 the molars) pre-emptively creates spaces for later orthodontic alignment of crowded lower dental arches. Most operations only last a few hours, and overall treatment can be completed over six weeks. (Fig. 5 and 6)

Distraction is 1mm per day, and progresses over 7-10 days. A preceding oral acetaminophen 500mg tablet to distraction is recommended half an hour prior to the distraction turn. The distractors are held in place for 4-6 weeks prior to removal. Normal osteoid forms in the distraction space, which is almost fully mineralized by 6 weeks, and can be manipulated subtly through elastic IMF.

Orthodontic braces normally follow distractor removal, and can occur without orthodontic extractions. Post orthodontic

treatment close the distraction space, allowing for intra-arch dental alignment.

Treatment is carried out by a team of doctors with coordination of the patient, parent or guardian. General dentist, orthodontist and surgeon are involved in the team. Two surgeries are usually required one for the placement of the device and other for the removal after distraction. Actual distraction process is carried out at home with regular reviews by both the orthodontist and maxillofacial surgeon.

Results

Case 1: Mandibular retrognathia in 12 year old male patient

12 year old male patient had a family growth tendency of extreme mandibular retrognathia. There was social teasing, and the mandibular occlusion is almost entirely palatal to the maxillary occlusion, causing compensatory over eruption of the maxillary teeth and alveolus, and accentuation of the mandibular curve of Spee. Severe underset jaw characterised by prominence of upper teeth and caught lower lip. Correction after 8 weeks showed fullness to the lower face and normalisation of the lip posture as well as occlusion. 8 week treatment difference of occlusion. Severe underbite and complete inability to masticate or bite as there was no normal occlusion. Correction creates a stable and inter-digitating occlusion, with the orthodontist places the braces for a normal post surgical orthodontic treatment course. (Fig. 7 and 8)

Distraction of the jaw occurs between the first and second molar teeth. The space created extends the lower jaw forwards, as well as allowing for creation of an orthodontic space for the alignment of the mandibular anterior teeth. (Fig. 9)

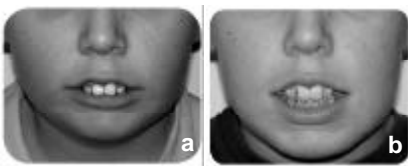


Fig. 7: (a) The underset jaw is characterised by prominence of upper teeth. (b) Correction through distraction allows for the fullness of the lower face, and normalisation of lip posture with normal jaw proportions.

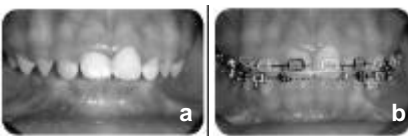


Fig. 8: (a) Severe deep bite. (b) Correction creates a stable and inter-digitating occlusion, with the orthodontist able to place braces for a normal orthodontic treatment course.



Fig. 9: Treatment sequence shown is: (a) Pre-operative view, (b) Three months post operative OPG, (c) Nine months post operative view (with closure of the dental gap using orthodontic brackets). Full distraction was 10mm.

Case 2: Moderate mandibular retrognathia and lower second molar impaction in a 14 year old male patient

A 14 year old male patient had moderately retruded lower jaw. He faced social teasing and isolation during adolescence. Deformity was corrected with normalisation of lower jaw length by a bilateral forward distraction of about 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. There was a time lapse of 6 weeks between the pre and post operative photographs. (Fig. 10)

Impaction of the lower second molar is relieved with surgical jaw distraction between the first and second molar. Callus formation requires 6 weeks and bone consolidation at the distraction site, second

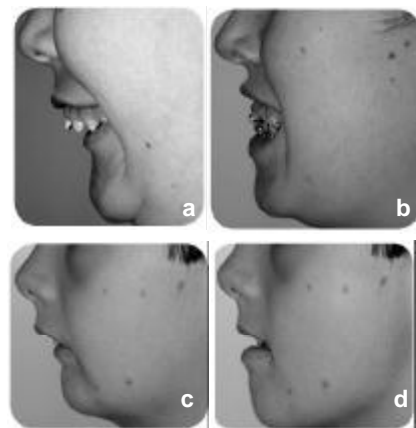


Fig. 10: (a)and (b):Moderate underset chin is corrected with normalisation of lower jaw length by a bilateral forward distraction distance of 9mm. (c)and(d):Note the improvement in lip alignment, and increased prominence and height of chin, as well as alignment of the front teeth into a normal biting relationship after 6 weeks

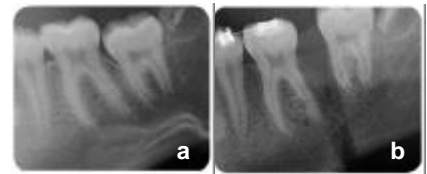


Fig. 11: (a) Impaction of the lower second molar is relieved with surgical jaw distraction occurring between the first and second molars. (b) The time difference is ~6 weeks, with normal bone continuing to consolidate at the distraction site, and normal eruption of 2nd molar has already occurred. The orthodontist will use the distraction space to align and unbuckle the forward crowded arch of teeth. Following distractor removal (or shortly just before), the orthodontist will normally apply orthodontic banding for a normal course of intra-arch tooth alignment.



Fig. 12: (a) and (b) Braces are placed just prior to removal of distractors, and a normal period of orthodontic treatment follows for 18-24 months.



Fig. 13: Final orthodontic result once braces are removed 12 months following initial surgery.

molar eruption occurs normally. The orthodontist utilises the distraction space for the alignment of the crowded lower anterior teeth. (Fig. 11)

Following distractor removal or shortly before removal, the orthodontist will normally apply orthodontic banding 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 for 18-24 months. Time difference seen here is 12 weeks. (Fig. 12 and 13)

Advantages of distraction to correct moderately retrusive mandibles in adolescents

- Allows for skeletal treatment as soon as adult dentition has erupted.
- Potentially corrects skeletal base to Class I before abnormal dento-alveolar compensatory growth and eruption occurs.
- Allows for a normal and quicker course of orthodontics to commence on a Class I skeletal base.
- Quicker operation over traditional orthognathic surgery most cases are day-stay.
- Do not have to wait for growth to end as for conventional orthognathic surgery.
- Instant facial-fix prior to full-development of adolescent-adult psyche.
- Potentially creates inter-dental space for intra-arch alignment of teeth.

Disadvantages of distraction in moderately retruded mandibles in adolescents

- Distractors are very expensive
- Requires parental cooperation for home distraction.
- Multiple visits and second operation required.
- Infection around distractor barrels and arms a problem if retained beyond 6 weeks.
- Lip ulceration over distractors arms (ulceration risk decreases with distractor application experience).
- Distraction precise over conventional orthognathic surgery.
- Open bite development a potential pit-fall.
- Little overall professional experience with routine use of distractors.
- Period of potential IMF required after distractors are removed.
- Potential for operative severance of IDN.

Complications

- Small nick on mesio-buccal cusp of mesially impacted 47 with evident post-eruption.
 - Fixed with composite restoration by dentist.
- Small amount of granulation tissue surrounding in two cases of distractors 5-6/52 post cessation of 10/7 distraction period.
 - Normal healing after distractor removal.
 - Avoided by removing distractor earlier or by local saline irrigation.
- Small anterior open bite developed in four cases.
 - Cured with either orthodontic or Famey elastic IMF.
 - Advise removal of distractors at 2-3 weeks after distraction period, with 1-2/52 of strong elastic anterior IMF so as to allow for callous manipulation.
 - Advise placing distractors upside down to increase upward vector of distraction.
- Re-operation to re-mobilise one osteotomy site after found to be sticking.
 - Avoided by opening up distractors (at placement) about 7mm to check for fluid operation.
- Screws pulled out of proximal fragment without effect on distraction process.
 - As distraction proceeds distractors become more parallel, potentially pulling screws out of proximal fragment.
 - Avoided with use of 7mm depth screws, placed in flaring pattern.
- Ulceration of overlying lip resting against distractor arms.
 - Avoided with careful adaptation of arms against lower anterior alveolus.
 - Avoided with use of 9mm silicone (fish-tank) tubing placed over distractor arm as sleeve.

Case 3: Mandibular Retrognathia in 13 year old male patient

A 13 year old male patient with moderate mandibular retrognathia is been presented with the pre operative and post operative photographs. (Fig. 14)

X-ray series showing the 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 weeks. The full mineralization of new bone that has occurred at the distraction sites between the first and second lower molars. (Fig. 15)

Small inter-arch open bites, incisor imbrications, and over-eruptions can be eminently treated within a much reduced and simplified course of post-surgical orthodontic treatment. (Fig. 16)

In all the cases shown, there was no complications after surgery. Specifically, adjacent teeth maintain a normal

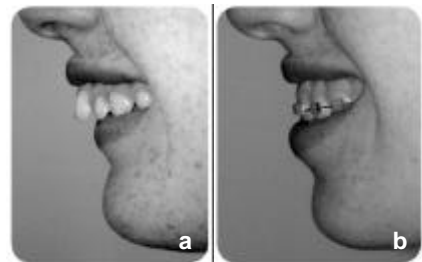


Fig. 14: (a) Before and after photos showing definitive over-bite, with lack of lip protection of upper front teeth on smiling. (b) Total correction occurs through surgery. Time difference is 8 weeks.

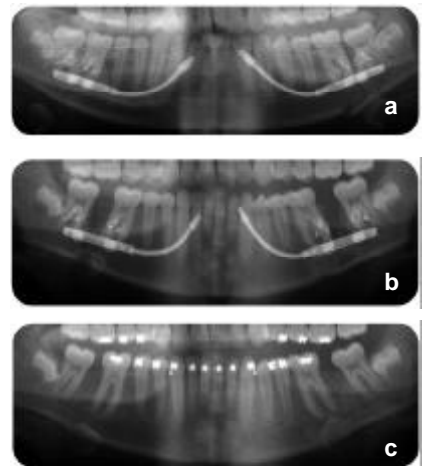


Fig. 15: (a, b, and c) X-ray series showing placement of distractors, with full lengthening of 8mm achieved after 8 days. Consolidation of new bone occurs over the following 6 weeks. Final x-ray shows bone appearance at 8 week point. Notice the full mineralization of new bone that has occurred at the distraction sites between the 1st and 2nd lower molars.

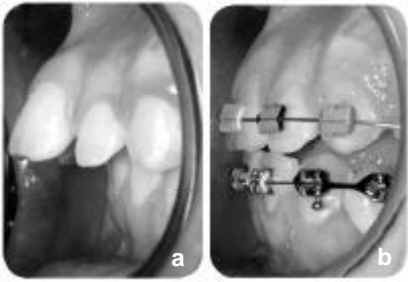


Fig. 16: (a) Before and after photos showing incisor relationship. (b) Small inter-arch open bites, incisor imbrications, and over-eruptions are imminently treatable within a much reduced and simplified course of post-surgical orthodontic treatment.

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



Fig. 17: 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 upto 1mm/day. Distraction occurs near wholly within the mouth, with minimal or no post operative scarring or otherwise late-evidence of surgery.

Osteotomy technique

- Gingival sulcus incision, with vertical relief forward of distal papilla lower canine.
- Corticotomy cut with fissure bur between 1st and 2nd molars, and through to medial on inferior border.
- Fine osteotome between teeth above IDN.
- Smith's distractor to open cut, with fine chisel on medial cortex, until fractured
- Fully mobilise fragments. (must be no bone fragment adhesions)

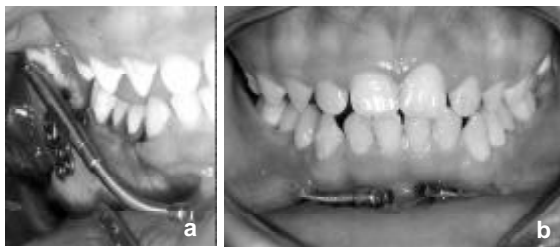


Fig. 18 : (a) Intra-operative photo showing cortical cut vertically between 47 and 46 teeth, with distal barrel nestled into vertical anterior ramus. Screws are splayed to prevent pull-out during distraction. Relief incision involves distal papilla of 43. (b) Distractor arms should curve into lower sulcus, pointing up to incisal edge level for ease of access during distraction turns.

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. (Fig. 17)

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 upside-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

Distractor application

- Vector should be as aligned as parallel as possible with arch, or preferably pointing up (with accentuated curve of Spee, distractor should be angled upwards, and not parallel with occlusion).
- Splay uni-cortical screws to avoid pull-out. 5-7mm depth only required.
- Personally easier to place distractor after fragment mobilisation.
- Pre-curve arm to lie above mental nerve, and around into sulcus.
- Once attached open up distractor to desired distance, then close again leaving minimal separation.
- May burr slot in external oblique ridge to accommodate distal barrel.

- Only use a 15mm (short barrel) paediatric distractor. Shorter barrels are easier to manipulate.
- Right for right side and left for left side if placed right way up.
- For intra-oral placement, screws are more easily placed (and removed) when sited above the barrel, with recommendations for upside-down placement., i.e. right for left side and left for right side.
 - Easier application of distractor if placed upside down.
 - Easier screw removal possible.
 - Vectors distraction slightly upwards.
 - Reduces the chance of open bite.
 - Possible impingement of distractor arm on mental foramen.
 - Left distractor for right side, and vice-versa.

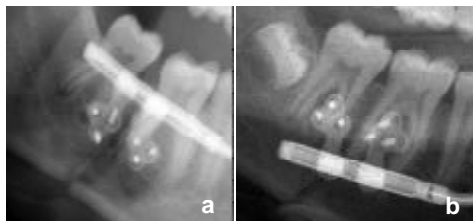


Fig. 19 : (a) Left photo showing right distractor on right mandible. Right photo shows left distractor on the right mandible when placed upside down. This method gives easier screw placement and removal, and places the barrel more deeply. (b) By vectoring the barrel slightly upward anteriorly, the distractor arm lies well above the mental nerve exit, and reduces the chance for an anterior open bite developing.

Post-operative course

- Clindamycin 300mg bd and Piroxicam 20mg od, with 0.2% aqueous chlorhexidine soaks tds.
- Start distraction 2-3/7 post surgery, ½ mm twice daily, and titrate to final effect.
- Distractors are to be removed no later than 4-6 weeks. Soft callous formation occurs for bite closure.
- Over distract as can easily re-wind distractor about 4mm to achieve symmetry. Callous can contract a further 2 mm over 2/52.
- Open bite is almost unavoidable, and totally correctable within 1-2 weeks of elastic IMF.
- Arms of distractors can bury into the lower lip. Avoid use of silicone tubing sleeves.

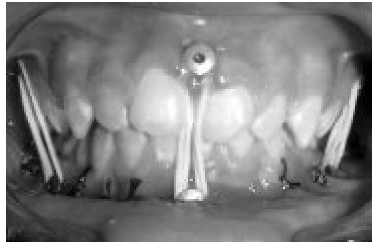


Fig. 20: Photo showing uses of Famey screws to provide post-distractor-removal IMF, and for local callous manipulation to close any residual open bite.

distraction appliance over any other, but does recommend the flexible arm assembly, and short-wide fixator bars, with splayed placement of 5mm retention screws.

Discussion

Distraction is among the most advanced preserving and enhancing technique of correcting facial deformities. It aims at avoiding 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.

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 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. Importantly, 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.

Conclusion

Distraction treatment spans vary from 6-12 weeks, with normally two operations; one to place the distractors, and one to remove them usually 6-8 weeks after placement. The distraction technique illustrated here, uniquely occurs between the mandibular first and second molars, and without any post operative effects on mandibular sensory nerve function. Risks apply with surgical cutting of adjacent teeth, and is minimized with used of cortical cuts only, and with osteotome progression of inter-dental mandibular fracture. Open-bite is also a risk, which is minimised by upward vectoring of distractor barrels, and by post distractor removal callous manipulation through IMF.

Distraction is normally carried out at

home, is normally very comfortable, and lasts upto 2 weeks. One-on-one support should be 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.

Bibliography

1. Balaji, SM. Craniofacial Distraction Transactions. 3rd Asia Pacific Congress on Craniofacial Surgery & Distraction Osteogenesis. Republic of Maldives. May 1-4, 2007.
2. Guerrero CA, Bell WH, Contasi GI, Rodríguez AM. Intraoral mandibular distraction osteogenesis. Seminars in Orthodontics. 1999 Mar; 5(1):35-40.
3. Mattick CR, Chadwick SM, Morton ME. Mandibular advancement using an intra-oral osteogenic distraction technique: a report of three clinical cases. Journal of Orthodontics. 2001 Jun; 28(2):105-14.
4. Van Strijen PJ, Perdijk FB, Becking AG, Breuning KH. Distraction osteogenesis for mandibular advancement. International Journal of Oral & Maxillofacial Surgery. 2000 Apr; 29(2):81-5.
5. Van Strijen PJ, Breuning KH, Becking AG, Tuinzing DB. Stability after distraction osteogenesis to lengthen the mandible: results in 50 patients. Journal of Oral & Maxillofacial Surgery. 2004 Mar; 62(3):304-7.
6. Van Strijen PJ, Breuning KH, Becking AG, Perdijk FB, Tuinzing DB. Cost, operation and hospitalisation times in distraction osteogenesis versus sagittal split osteotomy. Journal of Craniomaxillofacial Surgery. 2003 Feb; 31(1):42-5.
7. Van Strijen PJ, Breuning KH, Becking AG, Perdijk FB, Tuinzing DB. Complications in bilateral mandibular distraction osteogenesis using internal devices. Oral Surgery Oral Medicine Oral Pathology Oral radiology and Endodontics. 2003 Oct; 96(4):392-7.

