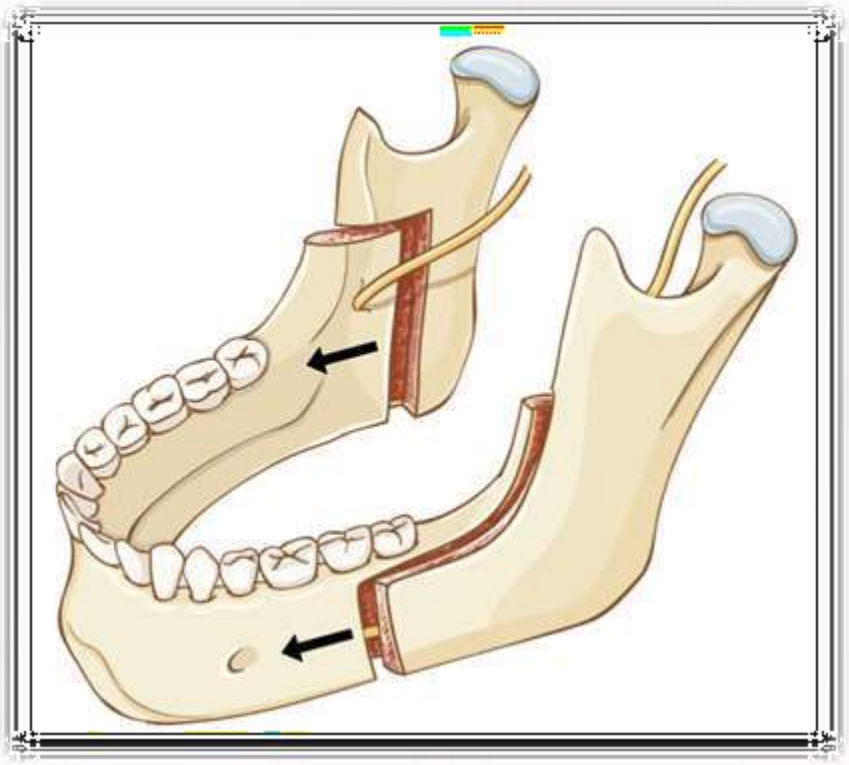
MANDIBULAR OSTEOTOMIES



CONTENTS

- Introduction
- History
- Aims of mandibular osteotomies
- Principals in treatment of mandibular deformities
- Surgical anatomy- Vessels, Nerves, Muscles
- Classification
- Sagittal split osteotomy
- IVRO
- Body osteotomy- Anterior & Posterior
- Subapical Osteotomies- Anterior,Posterior, Total
- Genioplasty
- Conclusion

INTRODUCTION

Orthognathic in Greek

Orthos- straight ; Gnathos- jaw

Orthognathic surgery refers to surgical procedures designed to correct jaw deformities.

Orthognathic surgery is the art and science of diagnosis, treatment planning, and execution of treatment by combining orthodontics and oral and maxillofacial surgery to correct musculoskeletal, dento-osseous, and soft tissue deformities of the jaws and associated structures

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

Basic Therapeutic Goals For Orthognathic Surgery

- To establish proper function (normal mastication, speech, respiratory function)
- To establish aesthetics (Establishment of facial harmony)
- Provide stability (Prevention of short and long term relapse)
- Minimizing of treatment time

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

INTRODUCTION

Once growth has ceased, the combination of orthognathic surgery with orthodontics, usually becomes one of the common means of correcting severe dentofacial deformities

In severe malocclusion there are three possibilities for correction:

- Growth modification
- Orthodontic treatment
- Orthognathic surgery in conjunction with orthodontics to establish proper jaw relationship

Orthognathic procedures are divided into three categories

Maxillary surgery

Mandibular surgery

Bimaxillary surgeries

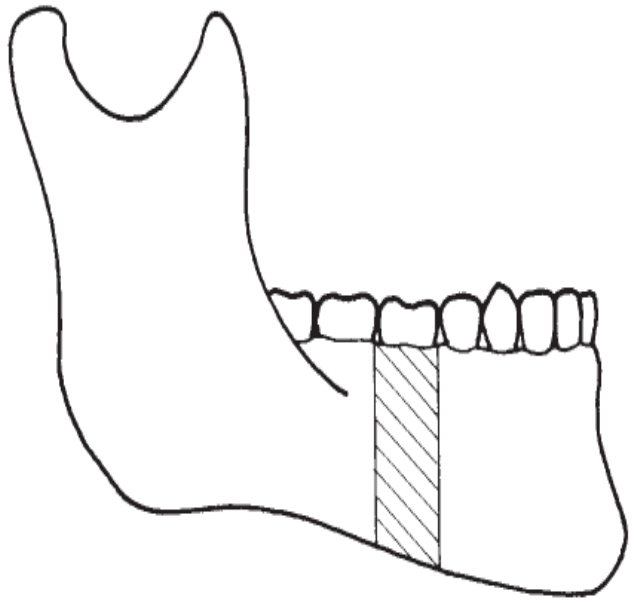
Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

HISTORY

- Orthognathic surgery was originally developed in the United States of America (**Steinhäuser**).

- The first mandibular osteotomy is considered to be ***Hullihen´s procedure*** in ***1846*** to correct anterior open bite & mandibular dento-alveolar protrusion with an intraoral osteotomy.

- 50 years later Osteotomy of the mandibular body for the correction of mandibular horizontal excess was performed by ***Vilray Blair. 1906***

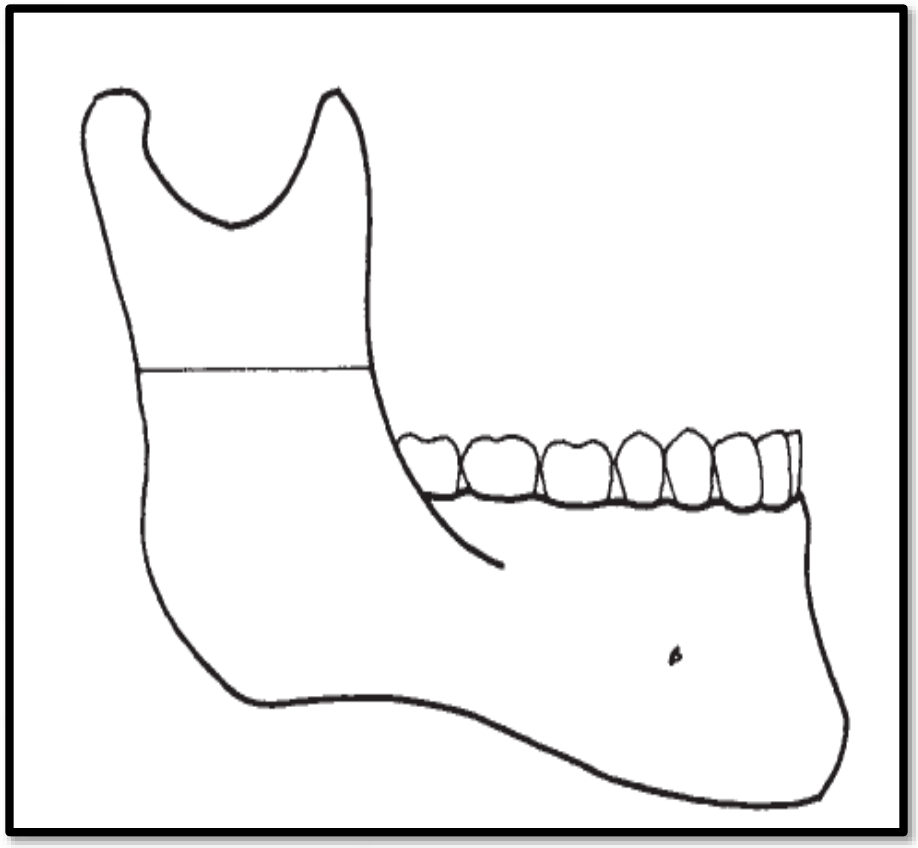


Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

HISTORY

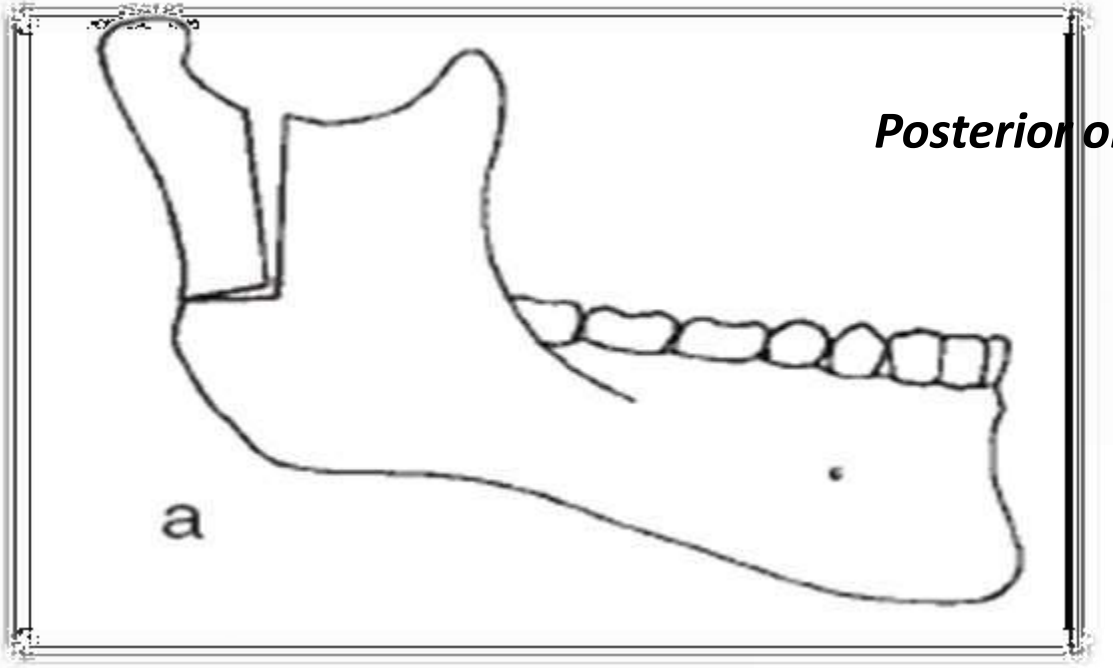
1907 - Blair – Horizontal Subcondylar osteotomy of the ramus, external approach

1932 Intraoral Subcondylar osteotomy was given by ***Earnst***



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

HISTORY

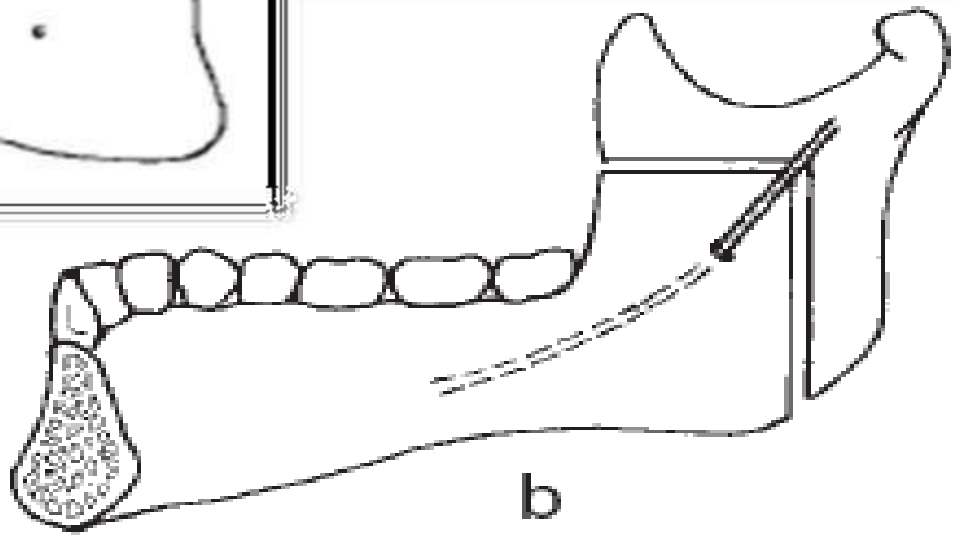


1925 - Limberg

Posterior oblique vertical ramal osteotomy, external approach

Wassmund 1927

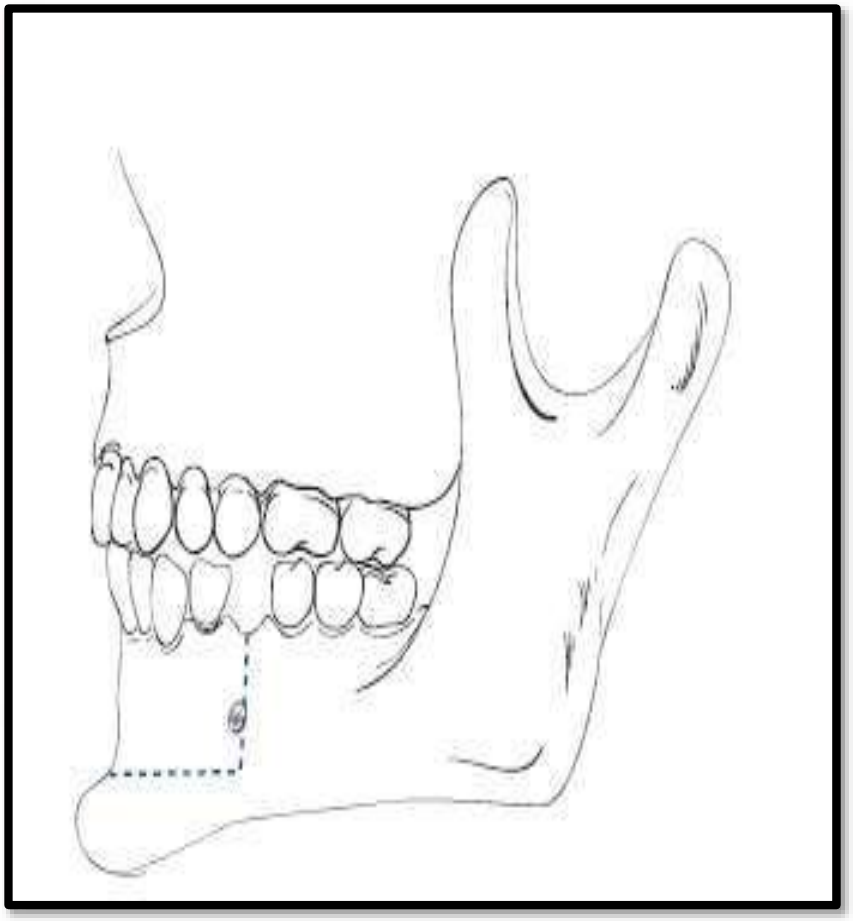
Vertical subcondylar osteotomy inverted –L-osteotomy.



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

HISTORY

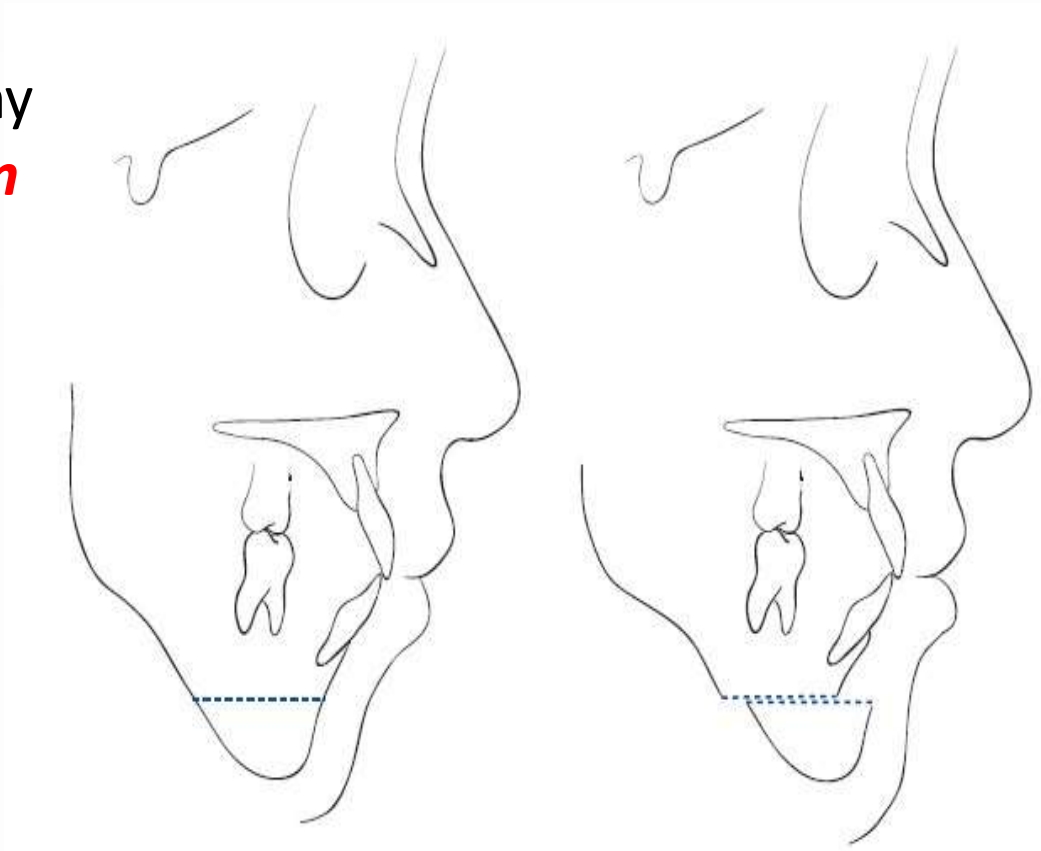
Hofer in 1936 demonstrated an anterior mandibular alveolar osteotomy to advance anterior teeth in correction of a mandibular dentoalveolar retrusion.



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

HISTORY

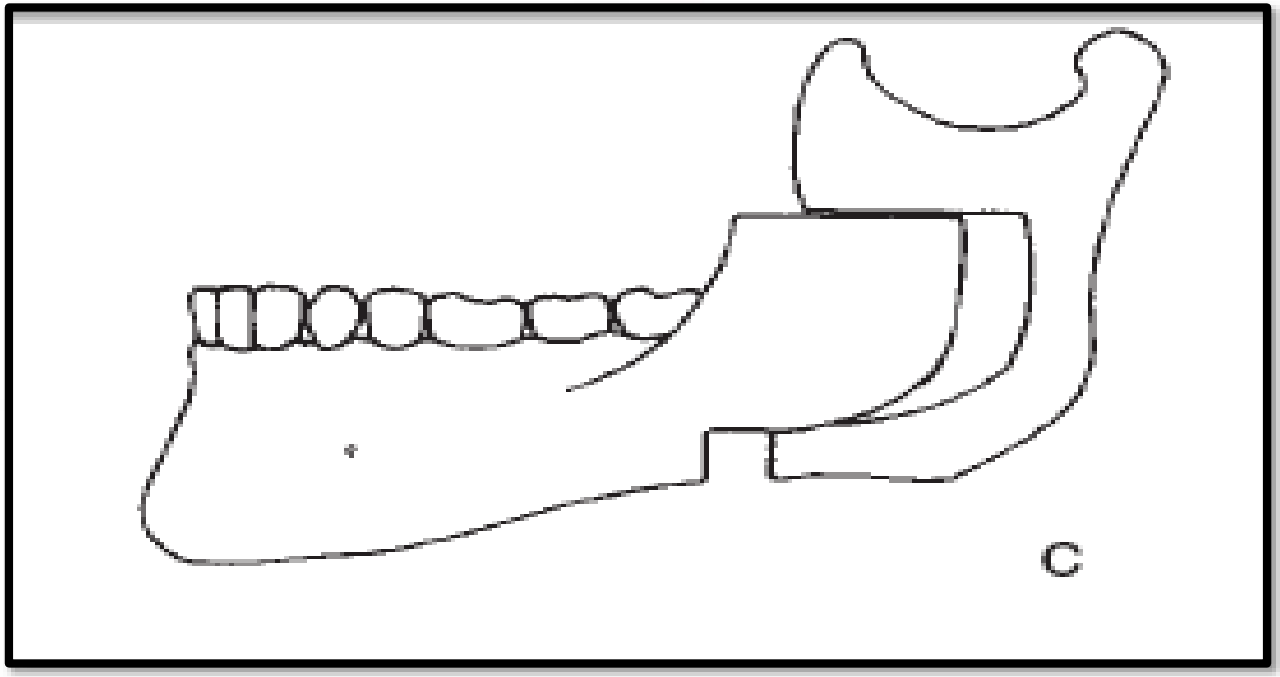
Horizontal sliding osteotomy first described by ***Hofner in 1942***



Hofer O. Operation der prognathic and mikrogenie. Dtsch Zahn Mund Kieferheilkd. 1942;0:121-32.

HISTORY

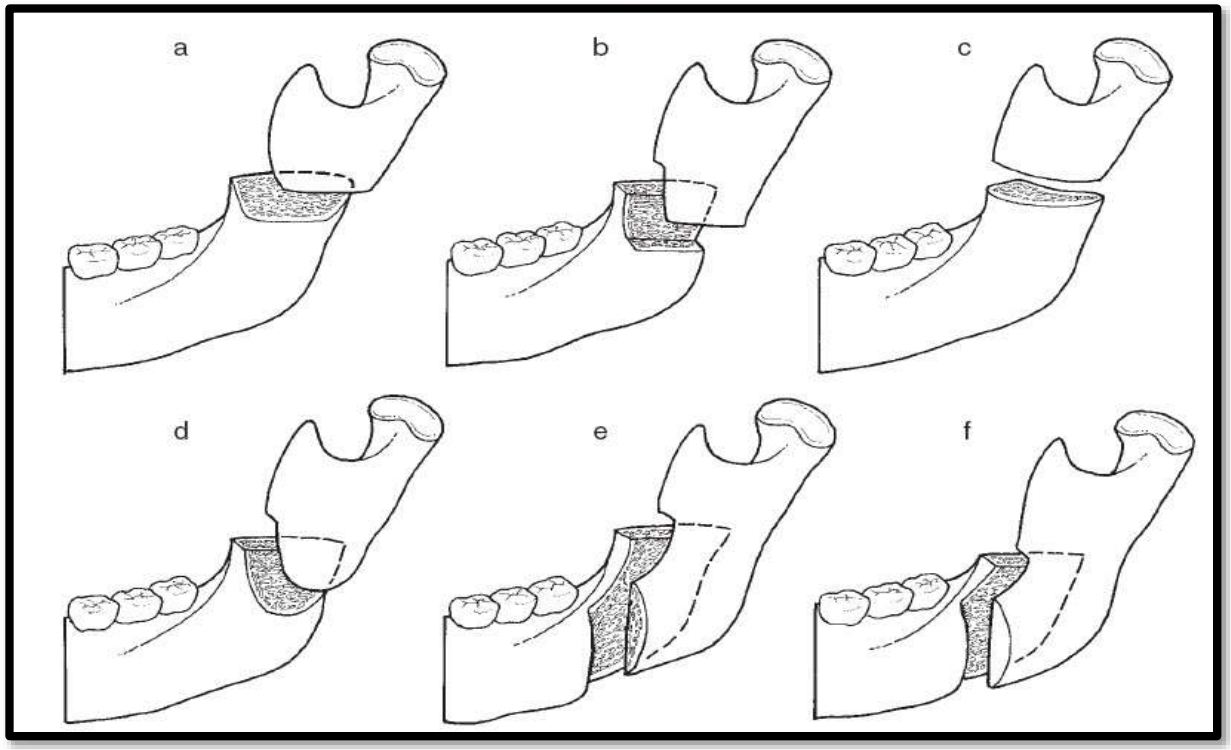
In 1954, Caldwell and Letterman developed a ***vertical ramus osteotomy technique***, which had the advantage of minimizing trauma to the inferior alveolar neurovascular bundle.



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

HISTORY

The greatest development in osteotomies of the ***vertical ramus is the sagittal split osteotomy*** credited to ***obwegeser in 1955***. The major modifications in the osteotomies design were first made by ***Dalpont in 1961***.This was further discussed by ***Hunsuck in 1968*** in order to decrease the trauma to overlying soft tissues.



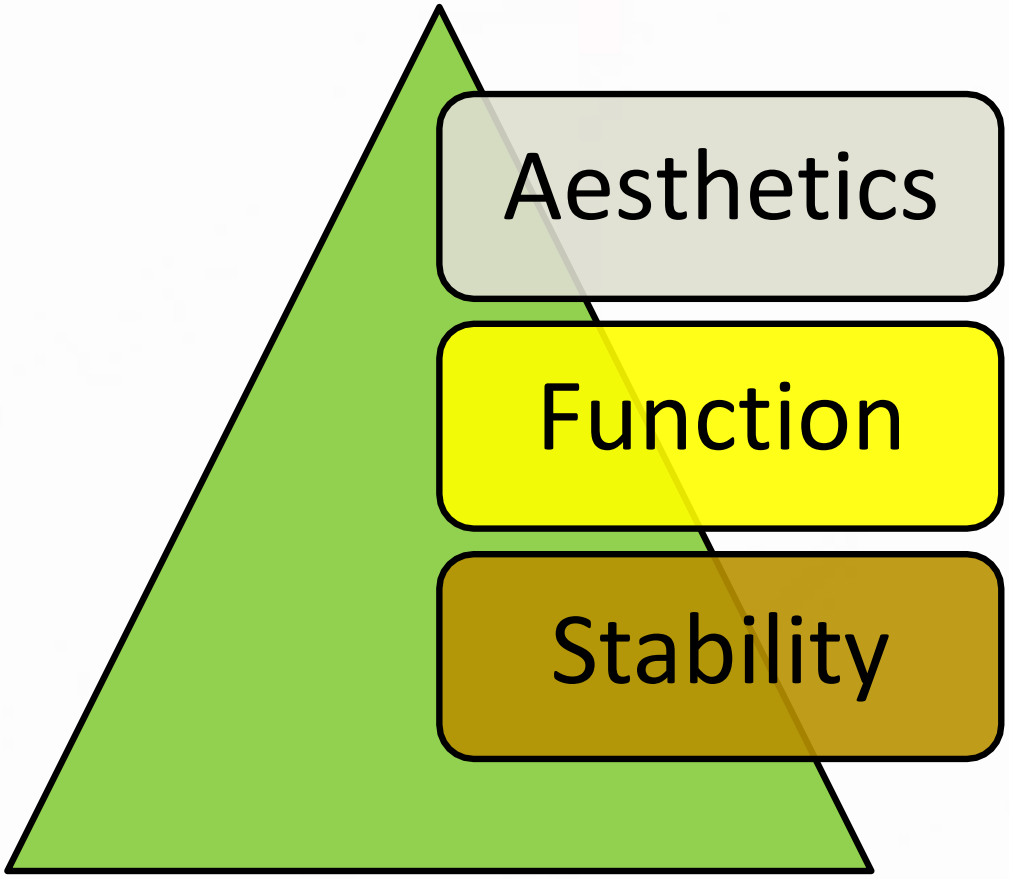
HISTORY

Kent & Hinds in 1971 initially presented the use of single tooth osteotomies of the mandible.

Macintosh closely followed with his description of the **total mandibular alveolar osteotomy in 1974**.

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

AIMS OF MANDIBULAR OSTEOTOMIES



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

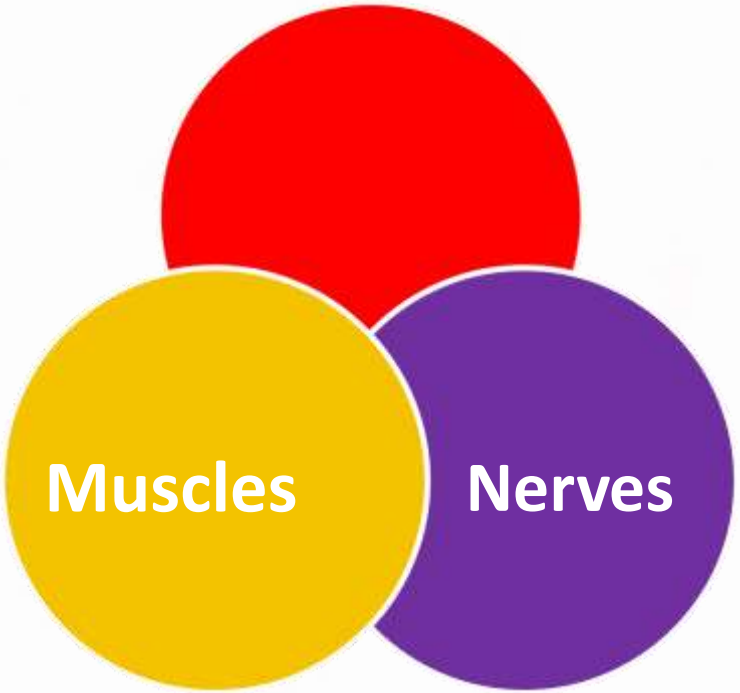
PRINCIPLES IN TREATING MANDIBULAR DEFORMITIES

- Patient's perception of the deformity and expectations
- Surgeon's recognition of the deformity
- Complete physical examination, model surgery, cephalometric analysis
- Optimal treatment plan
- Counseling of the patient
- Informed consent

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

Surgical Anatomy

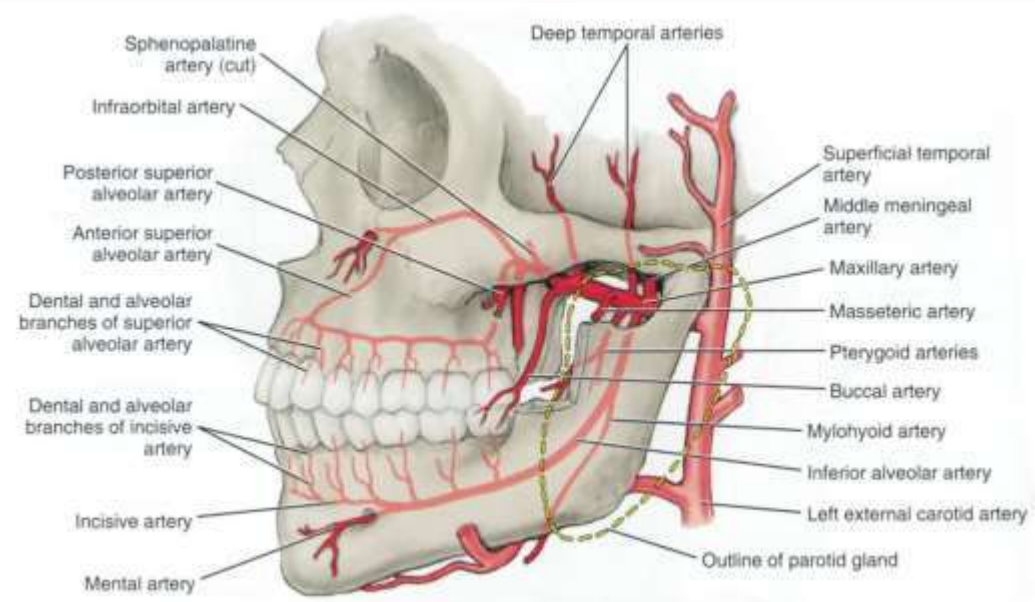
ANATOMICAL & PHYSIOLOGICAL CONSIDERATIONS OF MANDIBULAR OSTEOTOMIES



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

VASCULAR STRUCTURES

- Bell and Levy's work {1970} demonstrated that blood flow through the mandibular periosteum could easily maintain a sufficient blood supply to the teeth of a mobile segment, even when the labial periosteum was degloved.



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VASCULAR STRUCTURES

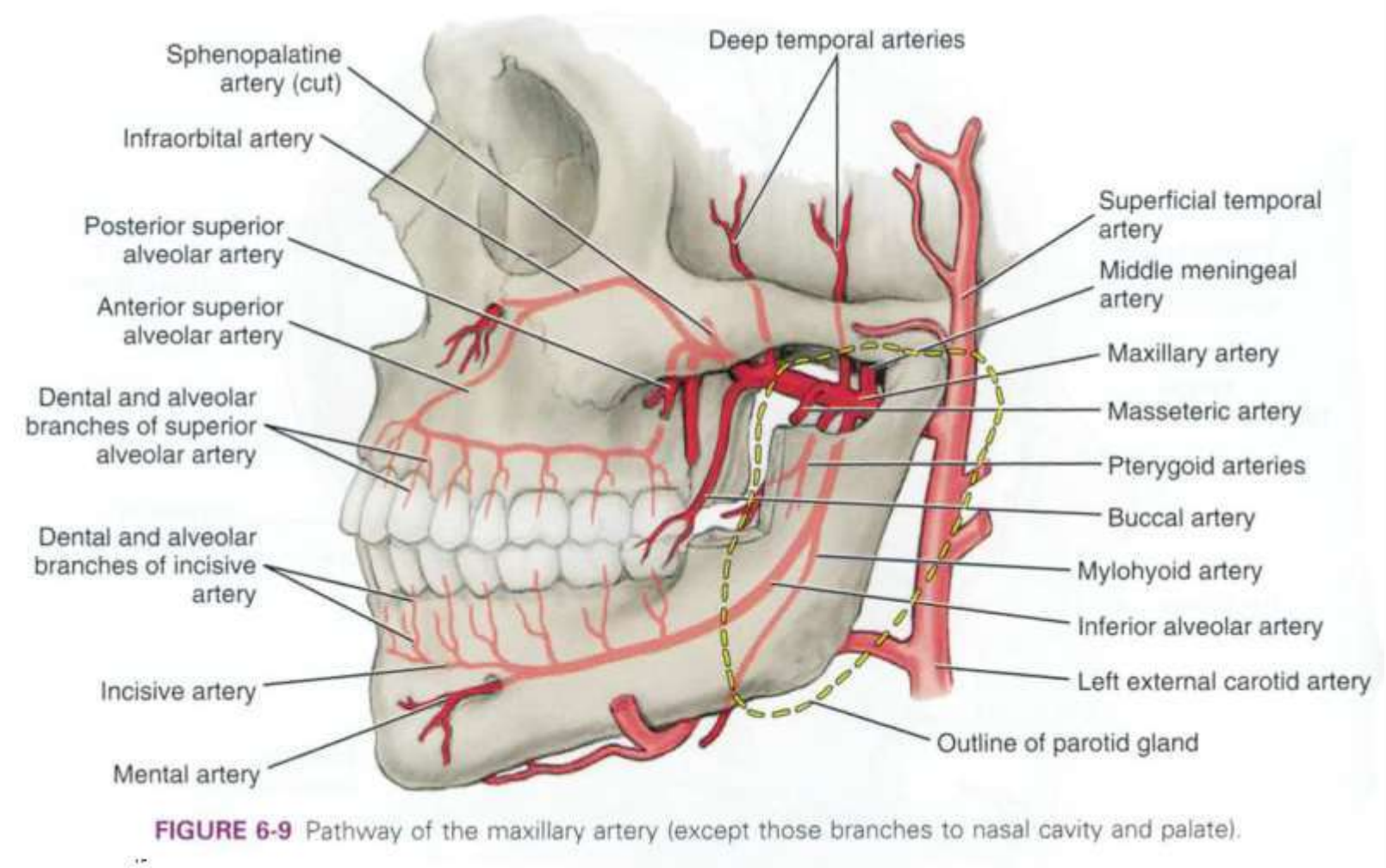


FIGURE 6-9 Pathway of the maxillary artery (except those branches to nasal cavity and palate).

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

VASCULAR STRUCTURES

- The proximal segment of VRO maintains its blood supply through TMJ & capsule and attachment of lateral pterygoid muscle.
- But inferior tip of this segment undergoes avascular necrosis.

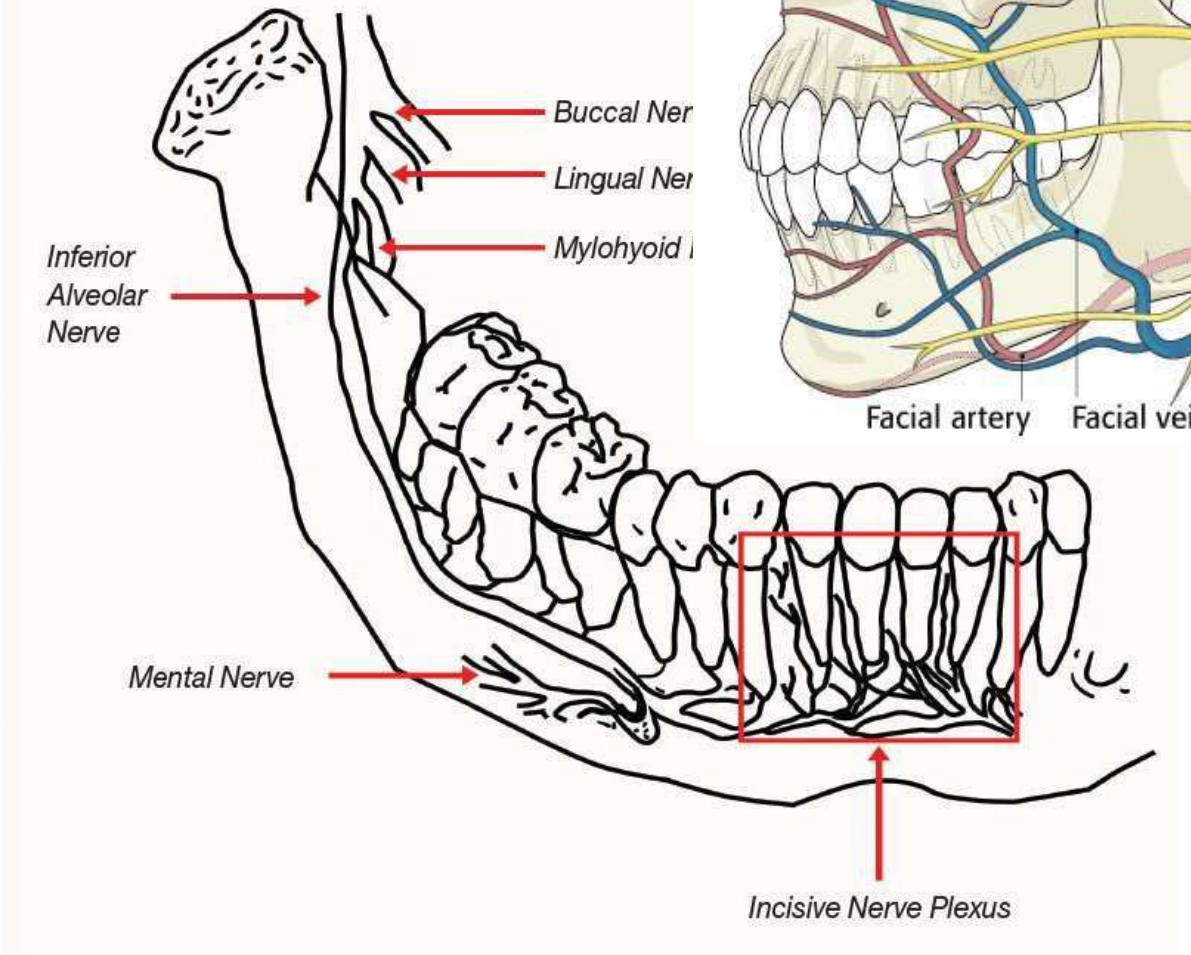
Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

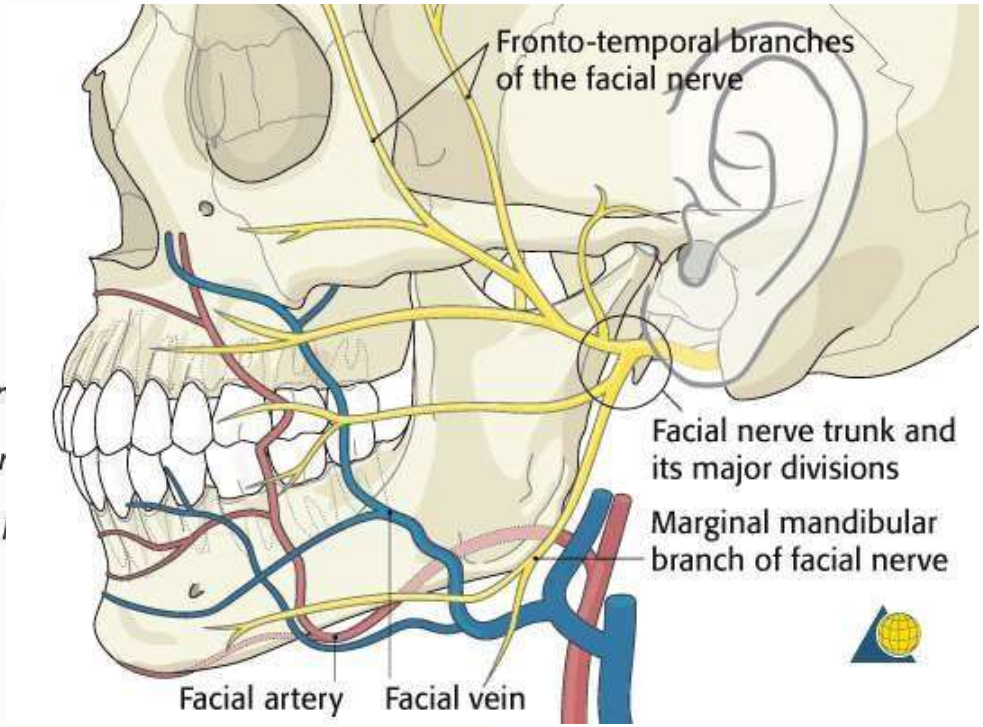
VASCULAR STRUCTURES

- Determination of safe distance away from the apex of teeth is vital factor to be considered
- If the vascularity of the segments and teeth are to be preserved. *The safer distance is 5 mm* but studies have shown even 10 mm distance shows pulpal changes.
- A cut of ***10 mm below apex shows greater safety***.

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

NERVE SUPPLY





NERVE SUPPLY

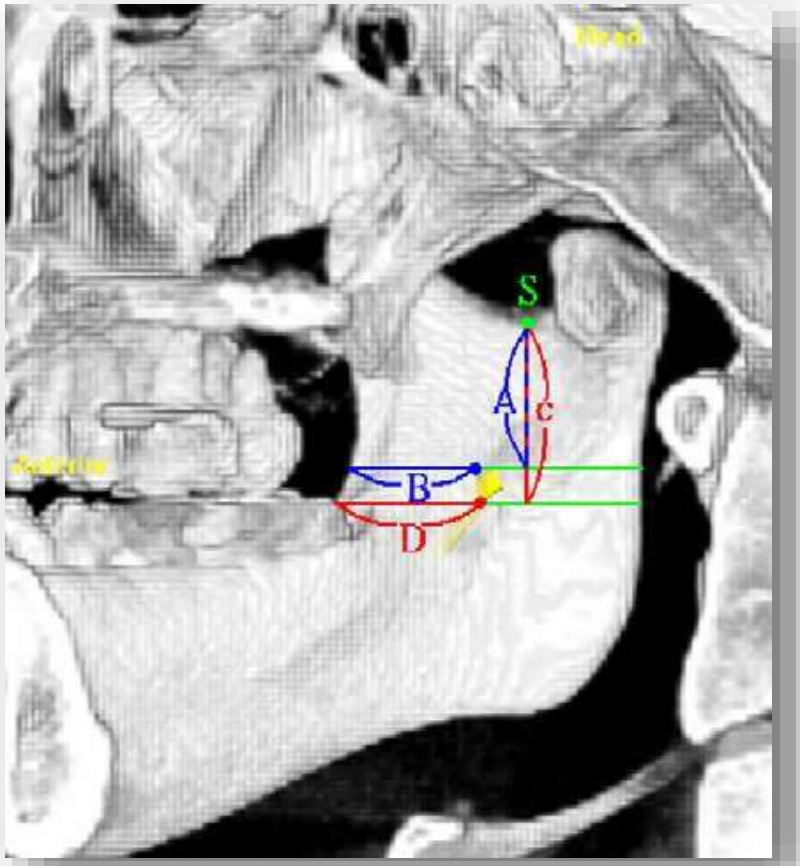
- The position of the lingula is posterior-inferior relative to the position of the antilingula

- Any osteotomies performed at a measurement of 5 mm posterior to the antilingula (at the level of the antilingula)- no risk of damaging the neurovascular bundle

Aziz SR, Dorfman BJ, Ziccardi VB, Janal M. Accuracy of using the antilingula as a sole determinant of vertical ramus osteotomy position. Journal of oral and maxillofacial surgery. 2007 May 31;65(5):859-62.

NERVE SUPPLY

- A- S to lingula - 14.8 +/- 2.90 mm
- C- S to mandibular foramen –
  21.6 +/- 3.31 mm
- B- Horizontal distance from linguala to anterior border of ramus –
  17.7 +/- 2.89 mm
- D- Mandibular foramen to ramus –
  18.6 +/- 2.49 mm



Aziz SR, Dorfman BJ, Ziccardi VB, Janal M. Accuracy of using the antilingula as a sole determinant of vertical ramus osteotomy position. Journal of oral and maxillofacial surgery. 2007 May 31;65(5):859-62.

NERVE SUPPLY

At a distance between 7.5 to 13.3 mm above the lingula Buccal and lingual cortex fusion occurs at a rate of

- 20% in the anterior ramus
- 39% in the posterior ramus

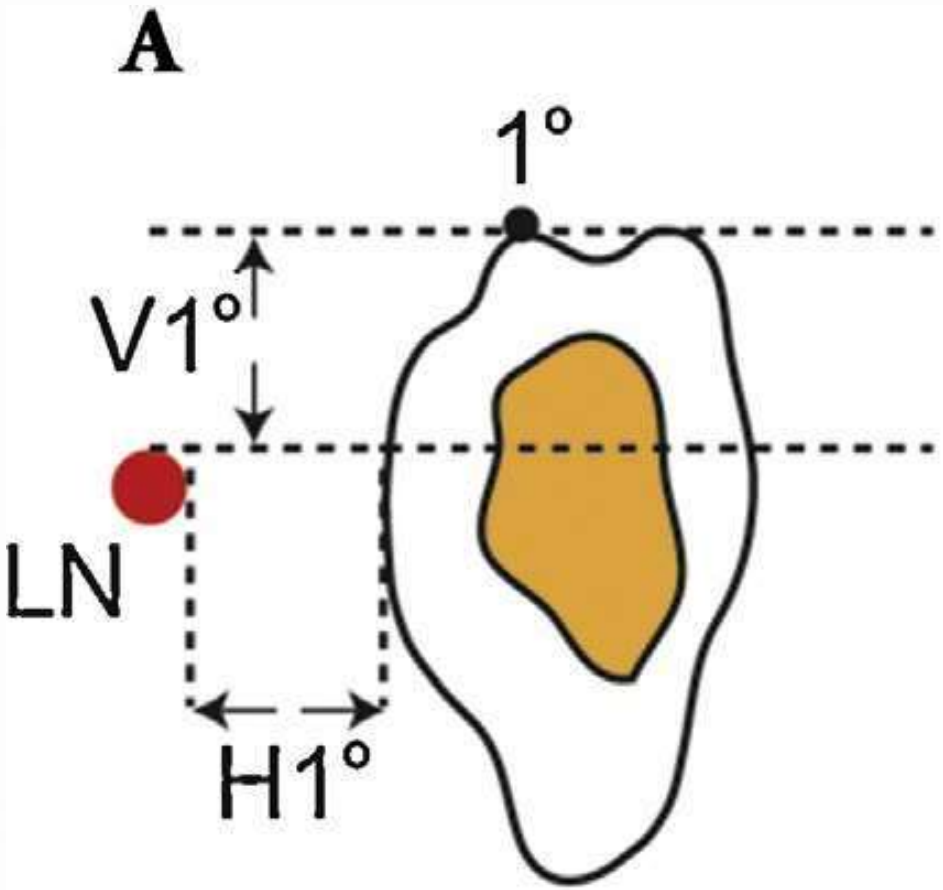
- The medial horizontal cut be at or just above the tip of the lingula because a higher cut may be associated with an increased difficulty in splitting or incidence of unfavorable fracture.

Aziz SR, Dorfman BJ, Ziccardi VB, Janal M. Accuracy of using the antilingula as a sole determinant of vertical ramus osteotomy position. Journal of oral and maxillofacial surgery. 2007 May 31;65(5):859-62.

NERVE SUPPLY

V1- 9.15 mm

H1-0.57mm



Dias GJ, de Silva RK, Shah T, Sim E, Song N, Colombage S, Cornwall J. Multivariate assessment of site of lingual nerve. British Journal of Oral and Maxillofacial Surgery. 2015 Apr 30;53(4):347-51.

MUSCLES

Orthognathic surgery affects muscles in primarily two ways:

- It changes the length of a muscle or it changes the direction of muscle function.

The muscles commonly discussed in orthognathic surgery of the mandible have been the muscles of mastication and the suprahyoid group of muscles **.**

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology

Volume 104, Issue 6, December 2007, Pages 747–751

Oral and maxillofacial surgery

Condylar luxation following bilateral intraoral vertical ramus osteotomy

Kensuke Yamauchi, DDS[a], Toshihiko Takenobu, DDS, DMSc[b], Tetsu Takahashi, DDS, PhD[c]

Removal of masseter & medial pterygoid attachment

↓

Condylar luxation

(lateral pterygoid muscle pulling the condyle forward)

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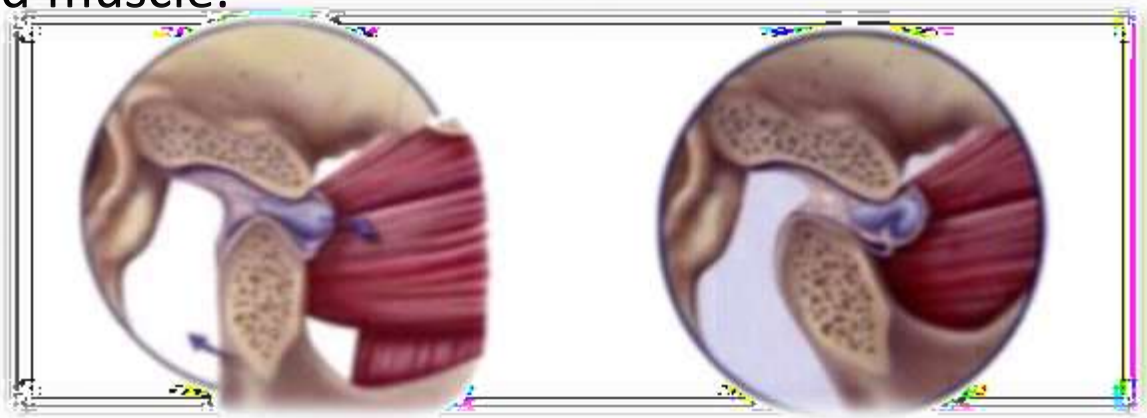
Condylar luxation following bilateral intraoral vertical ramus osteotomy

Kensuke Yamauchi, DDS[a], Toshihiko Takenobu, DDS, DMSc[b], Tetsu Takahashi, DDS, PhD[c]

2 postulates

- Medial and forward displacement of the mandibular disk- by the upper head of the lateral pterygoid muscle.
- After sectioning - the mandibular condyle is displaced in the same direction as the disk - by the pull of the lower head of the lateral pterygoid muscle.



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

REVASCULARISATION & HEALING

Immediate post-operatively

- Intermedullary circulation between the proximal and distal segments
- Margins of osteotomy- avascular

One week post-op

- Level of hypervascularity around surgical site
- No soft tissue re-attachment
- Isolated areas of sub- periosteal bone formation

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

REVASCULARISATION & HEALING

2 weeks post-op

- Avascular zone at the proximal osteotomy site
- Necrotic zone at the distal osteotomy site
- No soft tissue attachment at the distal necrotic zone

3 weeks post-op

- Soft tissue re-attachment
- Vascular anastamoses between proximal and distal segments
- Osteoid formation through out marrow formation

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

REVASCULARISATION & HEALING

6 weeks post-op

- Circulation reconstituted across the osteotomy site
- Soft tissue re- attachment established

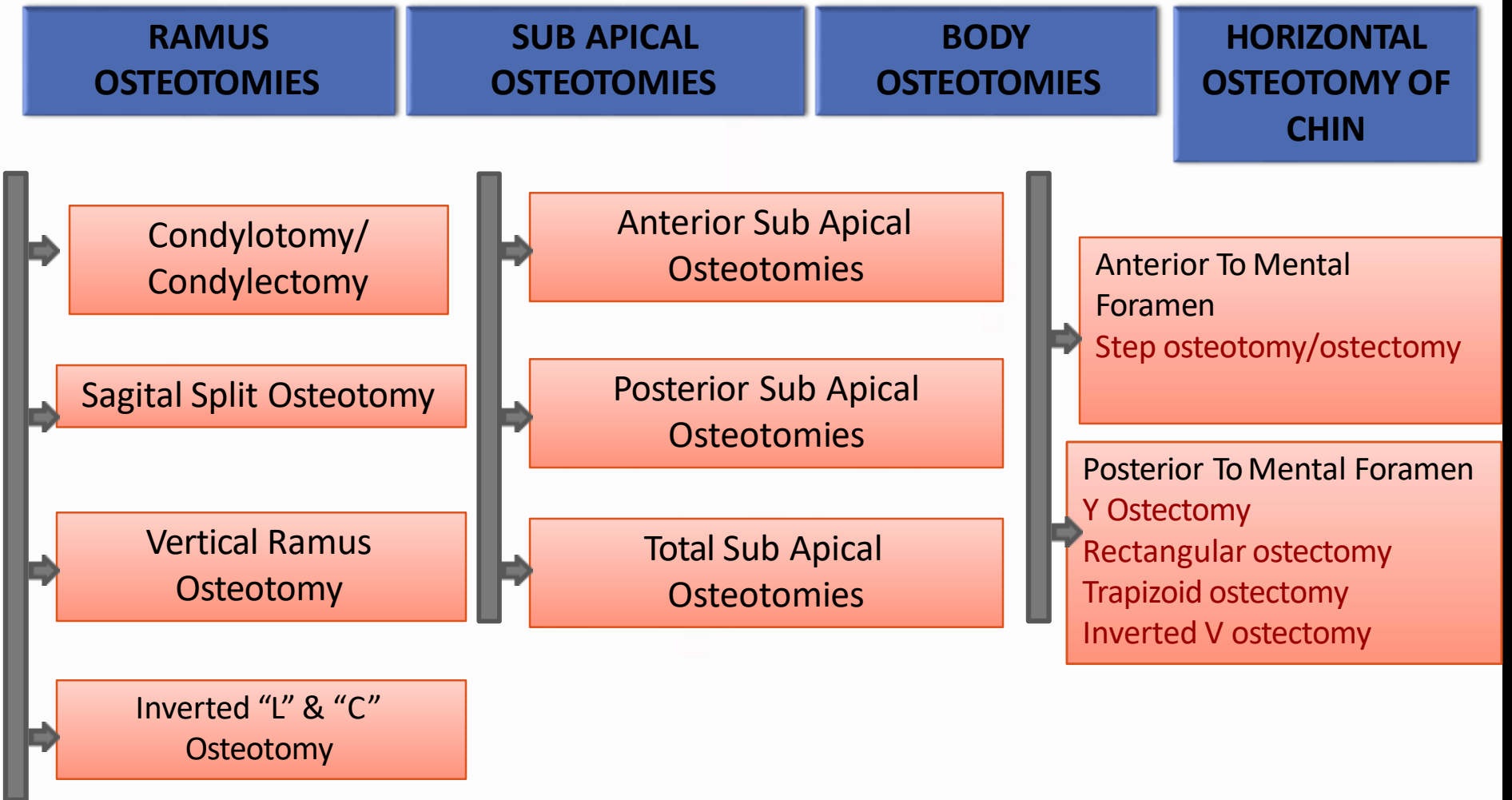
12 weeks post- op

- Circulation between the segments is continuous

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

CLASSIFICATION

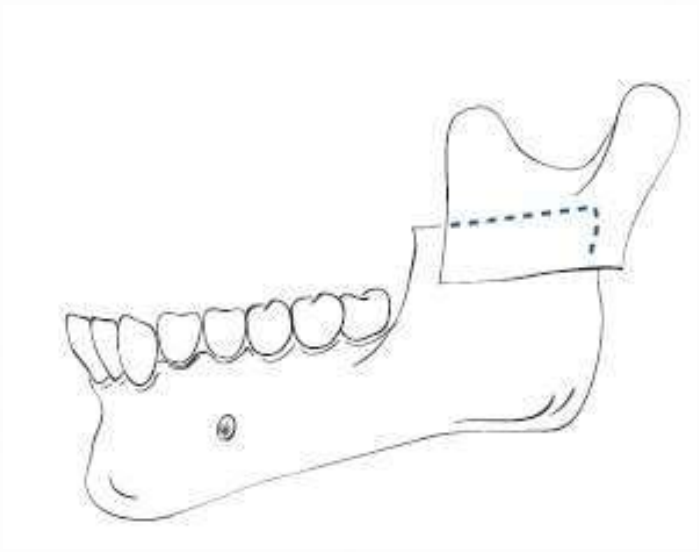
MANDUBULAR ORTHOGNATHIC PROCEDURES



SAGITTAL SPLIT OSTEOTOMY

- A surgical procedure resembling the saggital split osteotomy was described in 1942 in the German literature by *Schuchardt*.
- *Lane* evidently described a similar procedure earlier, which was done extraorally.

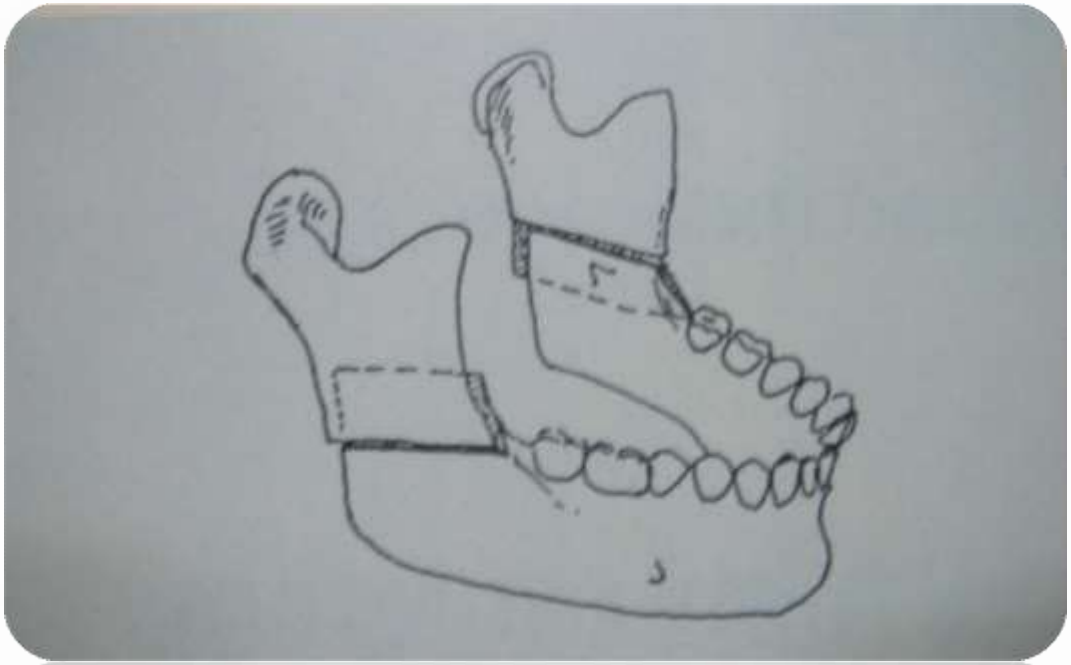
Parallel horizontal cuts through the cortex of the vertical ramus, the medial cut being placed above the lingula and a lateral cut being made about 1 cm below that.



Schuchardt G: Ein Beitrag zur chirurgischen Kieferorthopadie unter Berucksichtigung ihrer fur die Behandlung angeborener und erworbener Kieferdeformitaten bei Soldaten. Dtsch Zahn Mund Kieferheilkd 1942;9;73.

HUGO OBWEGESER & TRAUNER 1957

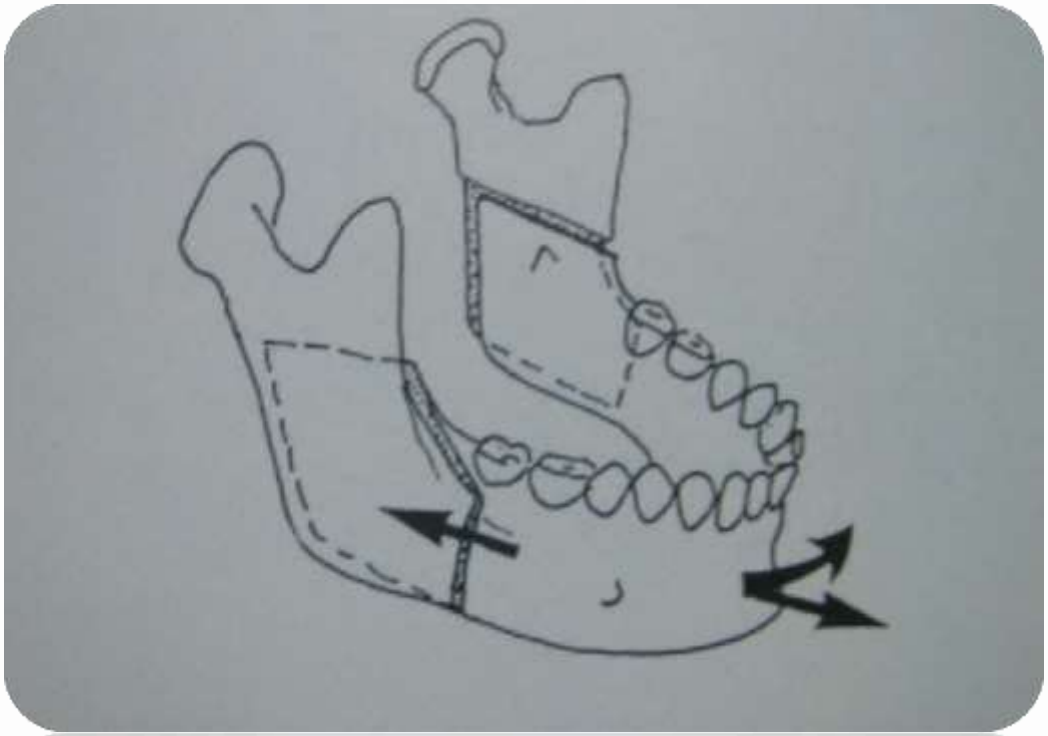
- The first to discuss its use in English literature
- Satisfactory for prognathism but very little bone contact in mandibular retrusion.



Traunar R, Obwegeser H: Operative Oral Surgery: The surgical correction of mandibular prognathism and retrognathia with consideration of genioplasty. Oral Surg Oral Med Oral Pathol 1957;10;677

DALPONT (1961)

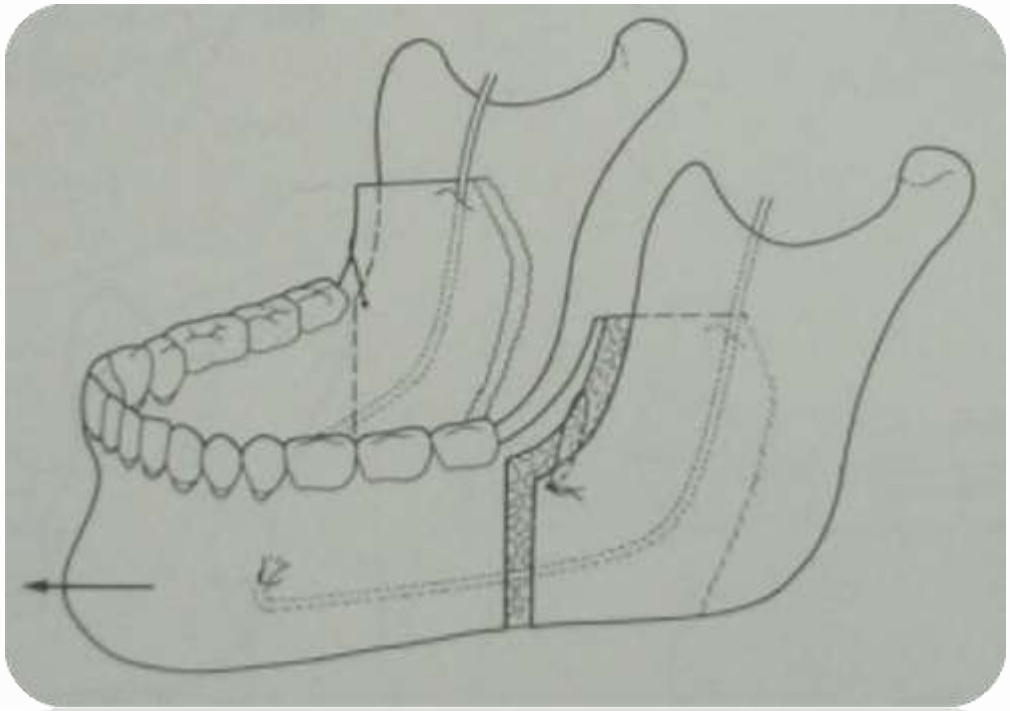
Advanced the oblique cut towards molar region and made it vertical through the lateral cortex.



Dal Pont G: Retromolar osteotomy for correction of prognathism. J Oral Surg 1961:19:42

HUNSUCK (1968)

Shortened the cut through the medial cortex taking it only as far as the mandibular foramen.



Hunsuk E: A modified intraoral saggital splitting technique for correction of mandibular prognathism. J Oral Surg 1968;26;249

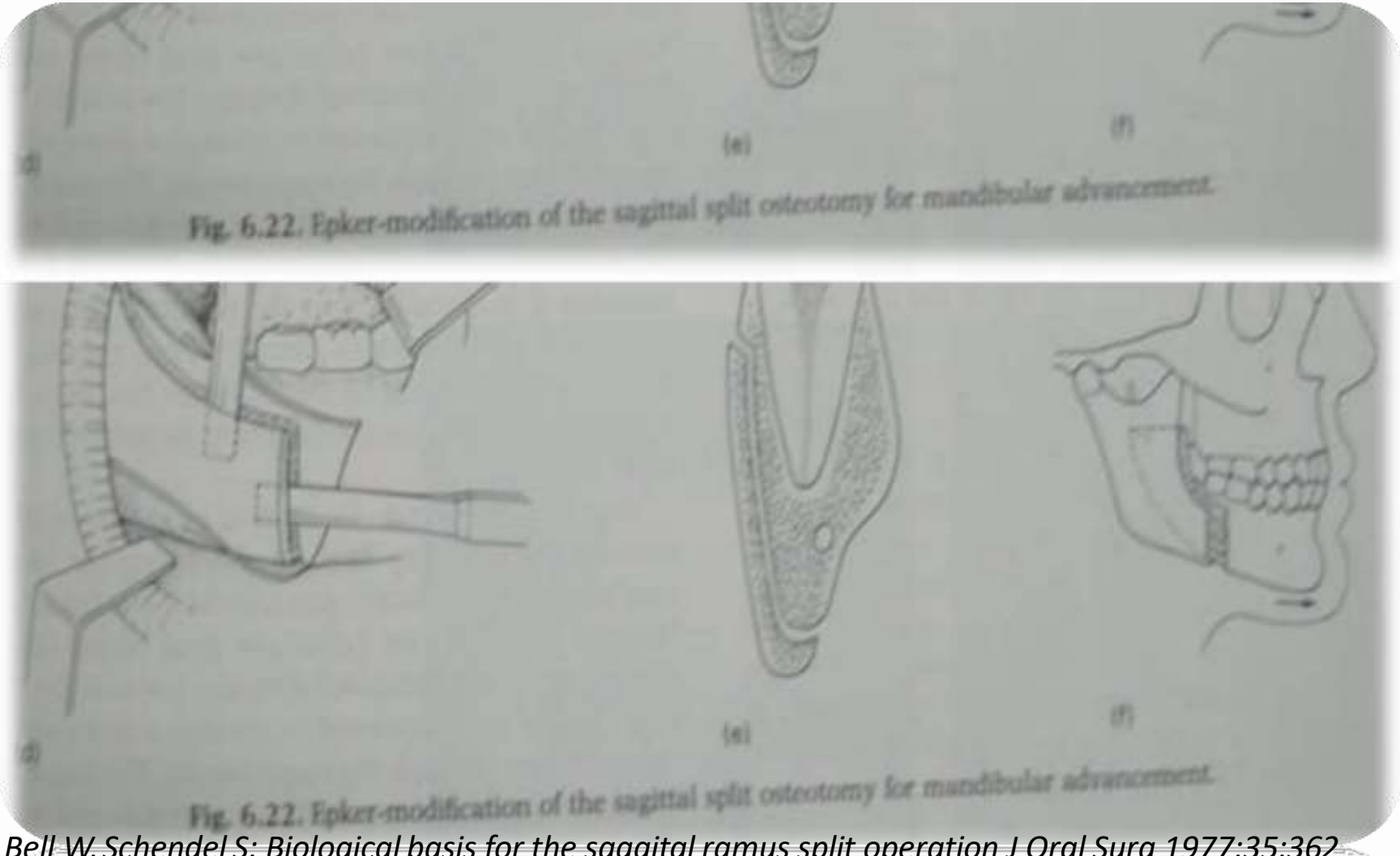
BELL SCHENDEL (1977) & EPKER (1978)

- Hunsuck technique is adopted but on the lateral aspect the vertical cut is taken downwards from an oblique line through outer cortex to lower border where the lower border is sectioned.
- Minimal detachment of the pterygomassetric sling there is decreased intra- osseous ischemia, and necrosis of the proximal segment

Bell W, Schendel S: Biological basis for the saggital ramus split operation J Oral Surg 1977;35;362

Epker BN: Modifications in the saggital split osteotomy of the mandible. J Oral Surg 1977;35;157.

SAGITTAL SPLIT OSTEOTOMY
Bell schendel (1977) & Epker (1978)



(e)
(f)
Fig. 6.22. Epker-modification of the sagittal split osteotomy for mandibular advancement.

Bell W, Schendel S: Biological basis for the saggital ramus split operation J Oral Surg 1977;35;362

Epker BN: Modifications in the saggital split osteotomy of the mandible. J Oral Surg 1977;35;157.

FIXATION- ADVANCEMENT

- Development of rigid internal fixation by Spiessl in 1974 replaced osteosynthesis by wire fixation or IMF.
- Jeter described technique of placing 3 bicortical 2.0 mm position screws to fix the proximal and distal segments.
- Blomqvist and others showed no significant difference in terms of relapse between monocortical screws with miniplates and bicortical screws for mandibular advancement.
- Recently good stability after BSSO is also shown by polylactate bone plates and screws

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

INDICATIONS

1. **Mandibular deficiency-**with normal or short face,

   -with long face- increase maxillary vertical dimension

   - excessive chin height

   - for correction of sleep apnea

Limitation-

- Advancements beyond 10- 12 mm, extra oral approach should be considered
- Additional surgery for most dentofacial deformity

2. **Mandibular prognathism-** short face

   - long face

- Limitation -Large setbacks of more than 7 -8 mm, IVRO/ inverted L osteotomy should be considered

3. **Mandibular asymmetry-** Hemi mandibular hypertrophy

   - Hemi mandibular elongation

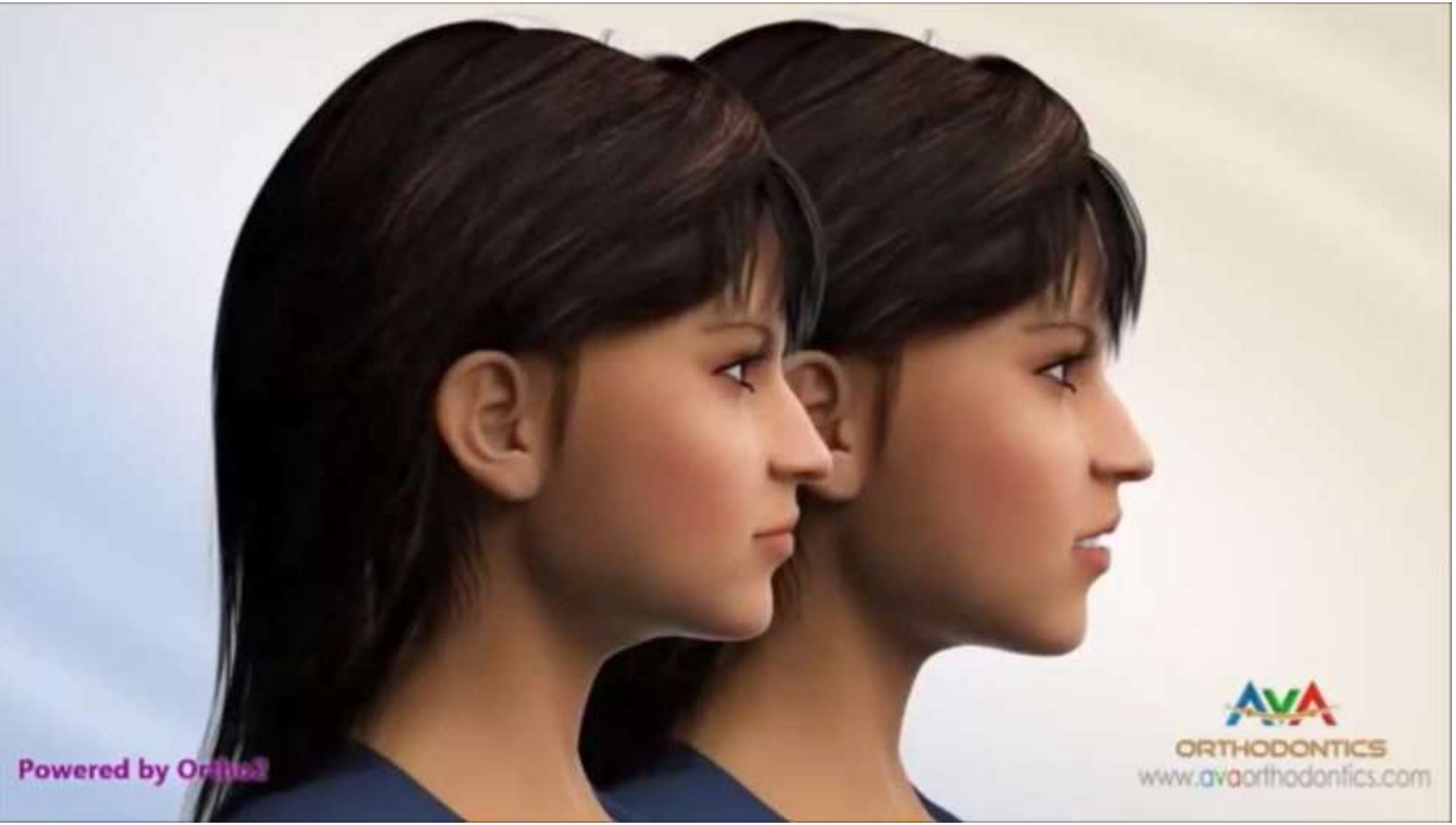
4. **Open bite**
5. **Cross bite**

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

CONTRAINDICATIONS

- Severe decreased posterior mandibular body height
- Extremely thin medial –lateral width of ramus
- Severe ramus hypoplasia and
- Severe asymmetries

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.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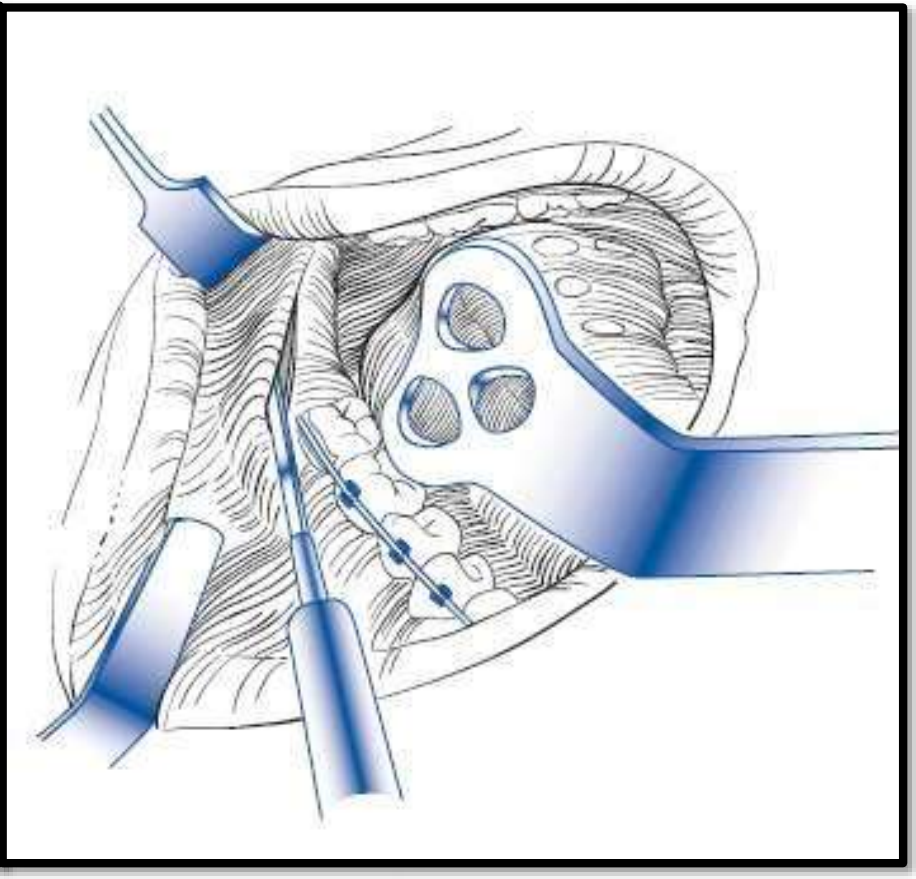
Incision & Dissection



Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

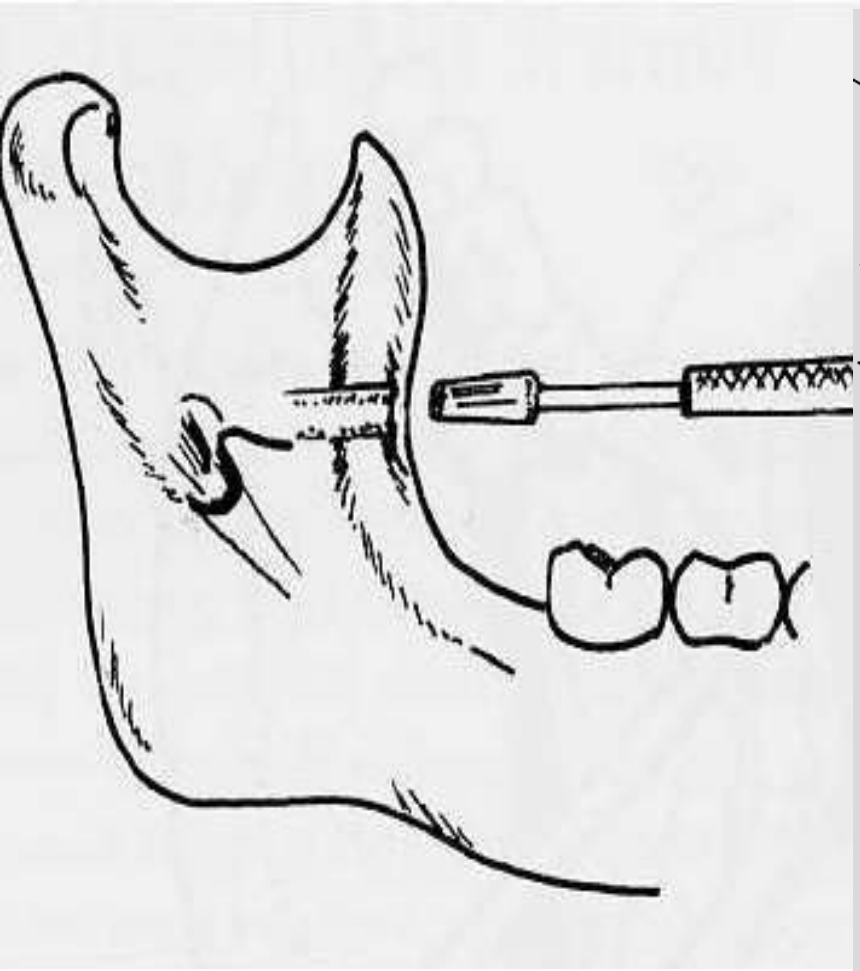
Incision & Dissection

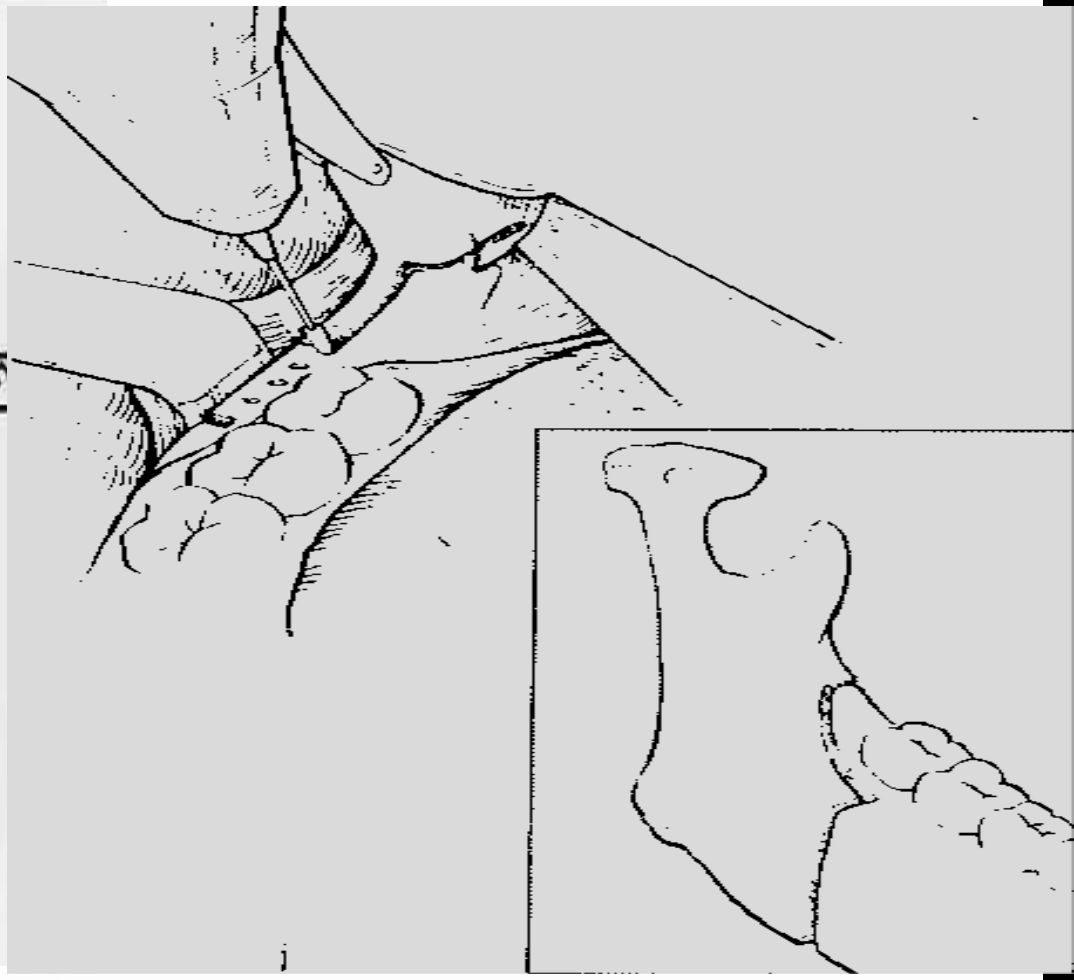
- Medial dissection done after ascertaining the position of lingula
- Sigmoid notch identified
- Minimal traction on medial side to avoid injury to the neurovascular bundle.

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

Osteotomy cut

Sagittal Bone Cut 5mm Above The Mandibular Foramen With Long Lindemann Burr

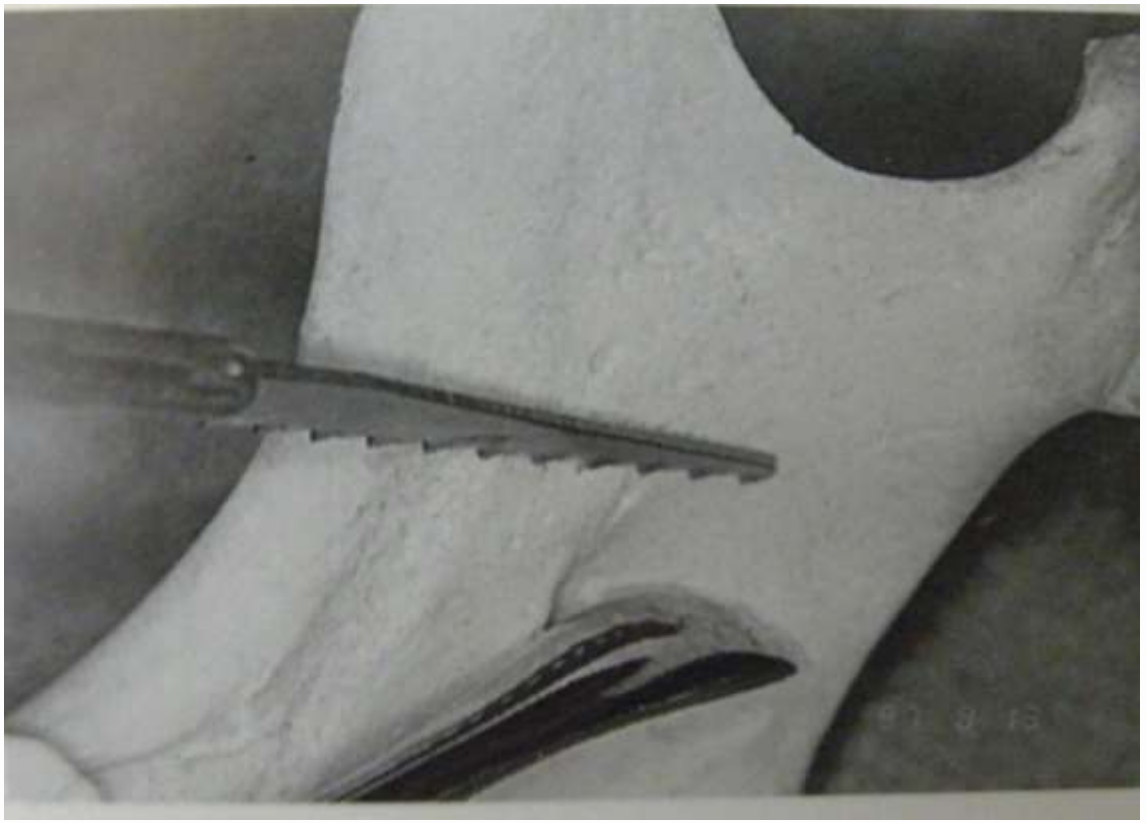




Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

Osteotomy cut

Smith & colleagues noted that in 2% of cases cortical plates were fused inferior to the lingula at the anterior portion of the ramus.



Smith B, Rajchel J, Waite D, et al: Mandibular ramus anatomy as it relates to the medial osteotomy of the saggital split osteotomy J Oral Maxillofac Surg 1991;49;112

Osteotomy cut

- Vertical cut in 2nd molar region
- Depth of cut should be just enough to reach the cancellous bone
- Rotary instrument or reciprocating saw

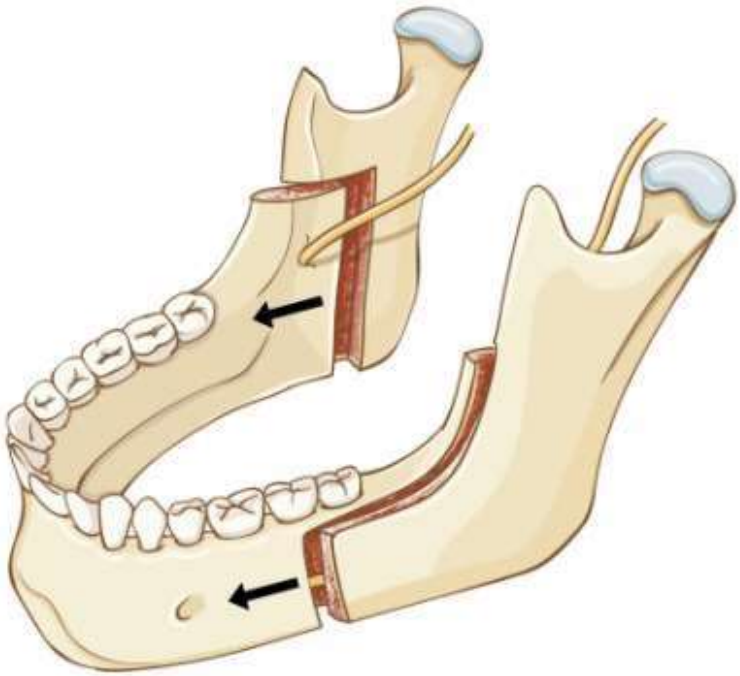
- Small spatula osteotome is malleted and directed laterally
- Smith spreader used to separate the segments

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

Great care should be undertaken to avoid fracturing the buccal plate or the proximal extension of the distal segment, especially if the Smith spreader instrument is used ,either of those fractures may preclude the use of rigid internal fixation. Any prying or torquing of these segments should be minimized.

Care Of The Neurovascular Bundle

- Neurovascular bundle visualized
- It should be on the medial fragment
- If mandible is to be advanced, medial pterygoid is separated from the inferior border
- If mandible is to set back, medial pterygoid and masseter needs to be stripped off to prevent posterior displacement of the condylar segment



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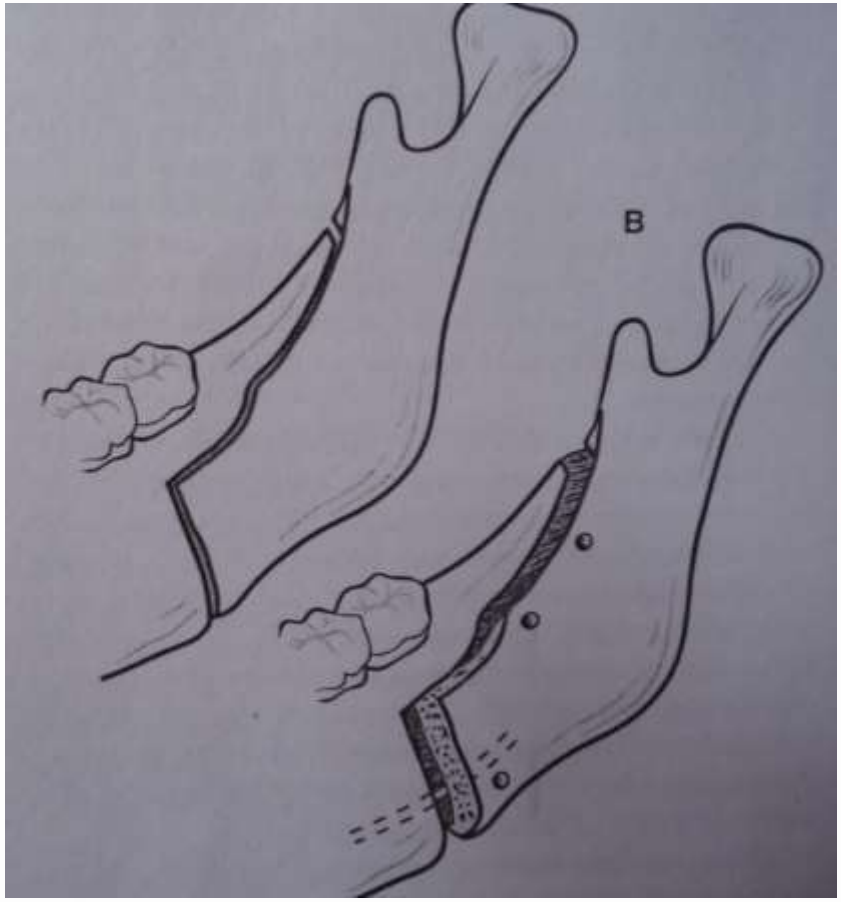
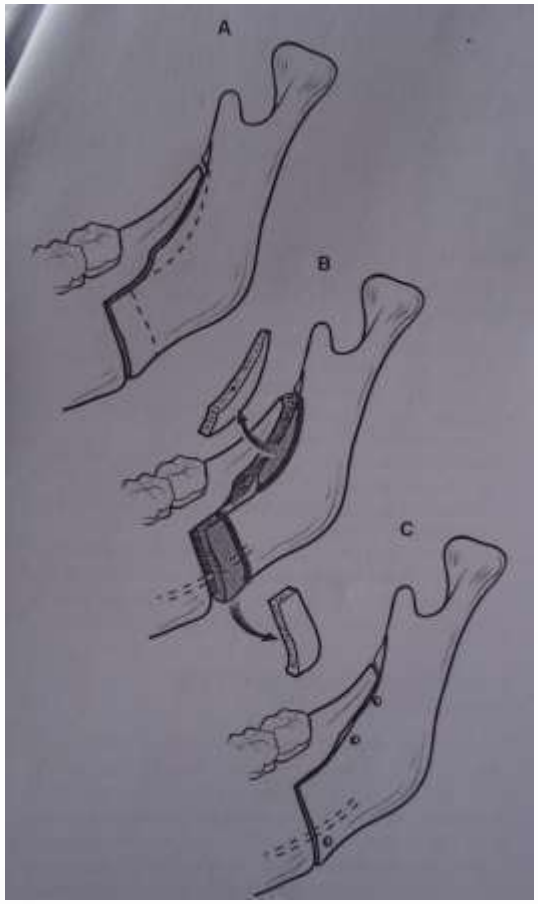


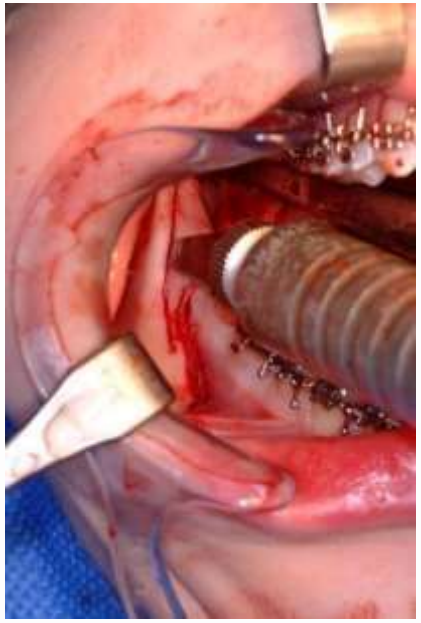
Mandibular Advancement



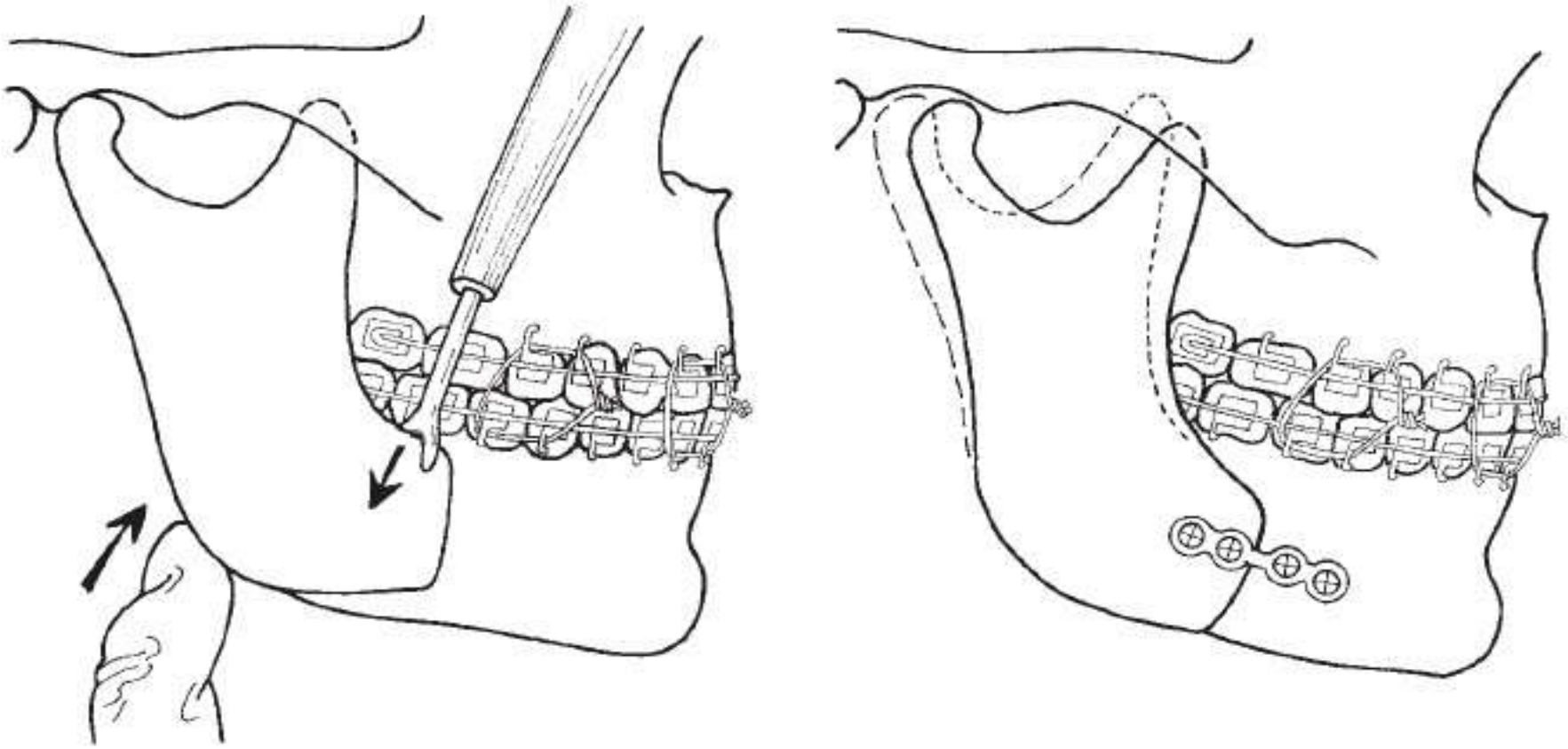
Mandibular Setback

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.






Fixation techniques



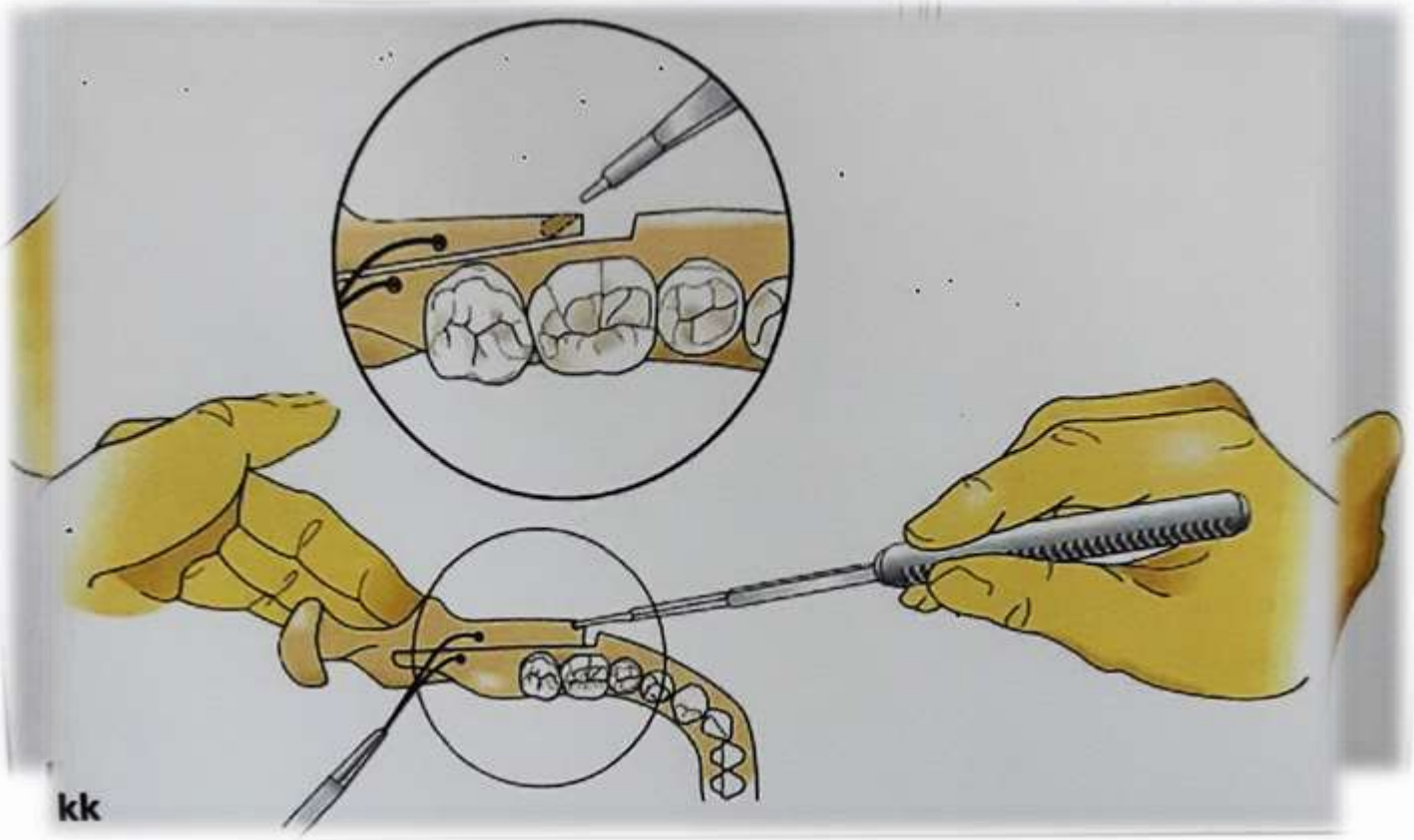
Fujioka M, Fujii T, Hirano A**. Comparative study of mandibular stability after sagittal split osteotomies: bicortical versus monocortical osteosynthesis. **Cleft palate craniofacial journal 2000; 37:551.

Atlas of the Oral and Maxillofacial Surgery Clinics

Volume 24, Issue 1, March 2016, Pages 27–36

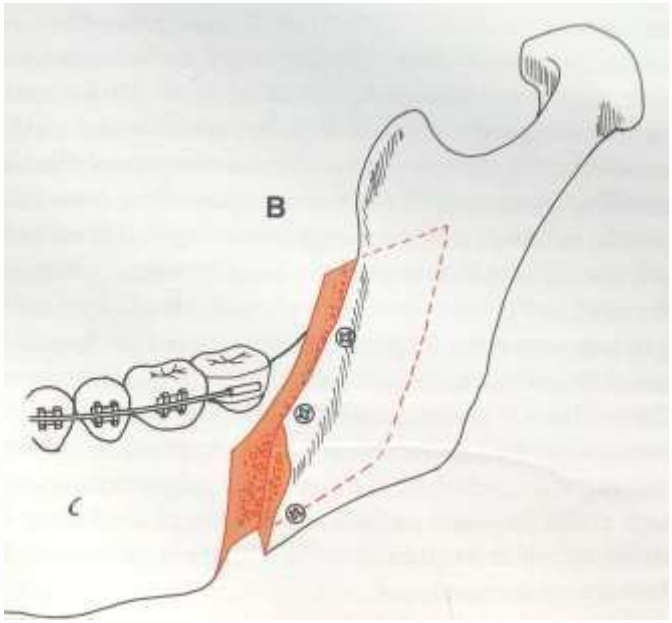
The Bilateral Sagittal Split Mandibular Ramus Osteotomy

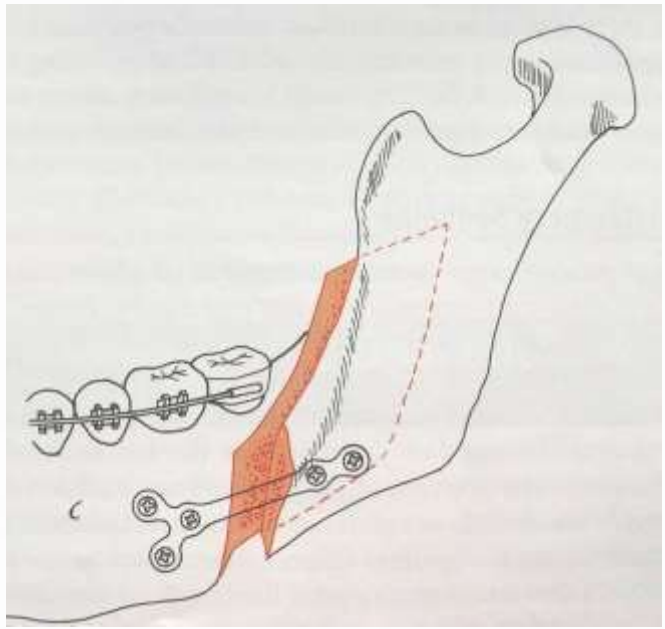
Johan P. Reyneke, BChD, MChD, FCMOS (SA), PhD[a, b, c, d, e], Carlo Ferretti, BDS, MDent (MFOS), FCD (SA) MFOS[f]



Fixation techniques

- With wire at upper and lower border
- Lag screws
- Bicortical screws – 2 or 3 screws are used
- Mini plates
- Bioresorbable plates and screws





Fujioka M, Fujii T, Hirano A**. Comparative study of mandibular stability after sagittal split osteotomies: bicortical versus monocortical osteosynthesis. **Cleft palate craniofacial journal 2000; 37:551.

ADVANTAGES

- Healing is quick because of a good bony interface
- Three dimensional flexibility in repositioning the distal fragments.
- Broad bony overlap of osteotomized segments
- Minimal alteration of the position of muscles of mastication – prevents relapse from muscular traction
- The surgery can advance or set back the mandible, correct most asymmetries
- Rigid fixation can be used, eliminating the need for MMF. Rigid fixation significantly improves the stability and predictability of results.
- Minimal alteration of the position of TMJ – prevents Post operative TMJ dysfunction

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

COMPLICATIONS

- Relapse
- Nerve injury
- TMJ Dysfunction and hypomobility
- Haemorrhage

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

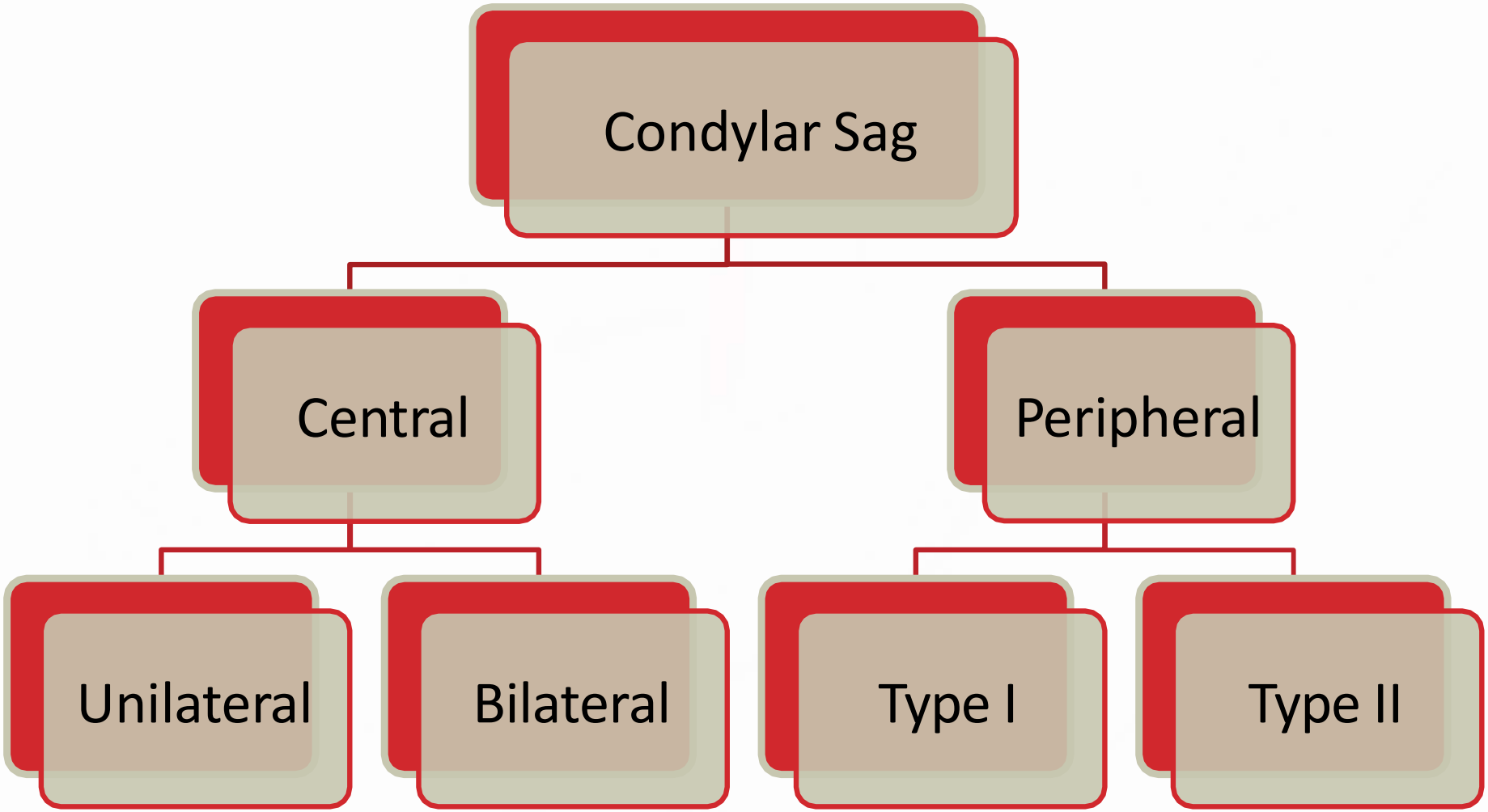
CONDYLAR POSITION

- Rotation of the proximal segment
- Condylar sag
- Condylar torque

These malpositions can lead to

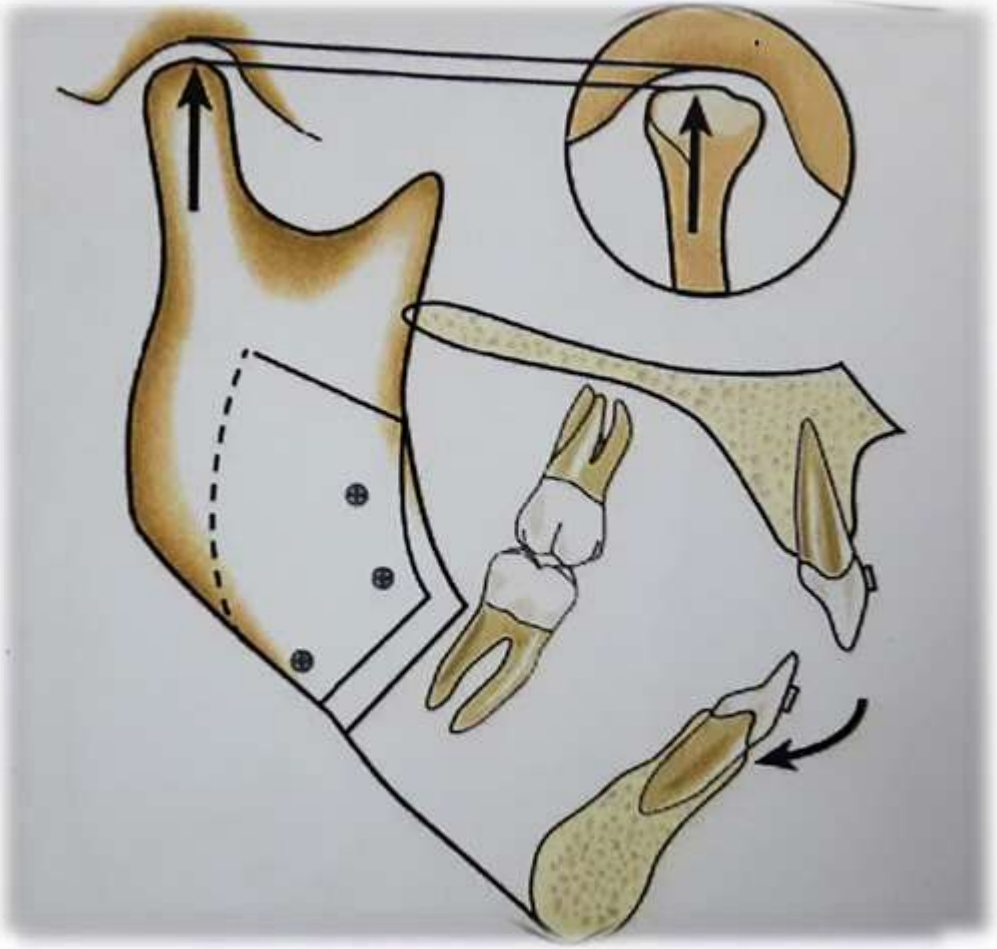
- Skeletal relapse
- Malocclusion
- Hypomobility
- Remodeling of the condylar head

TYPES



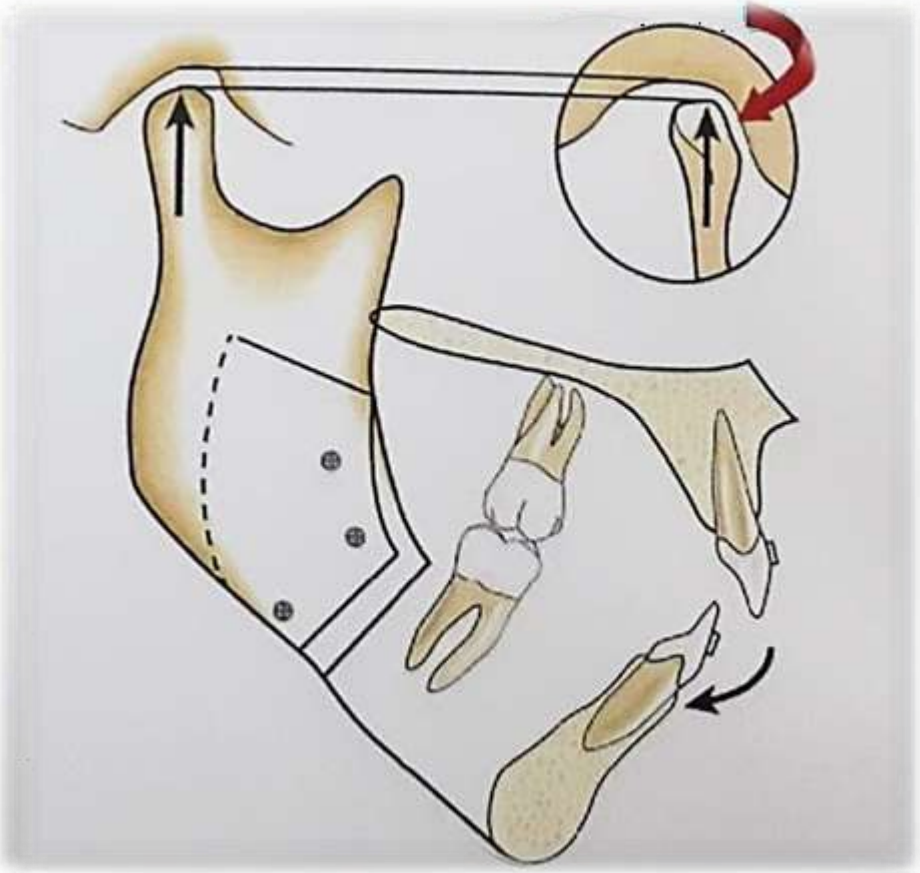
Johan. P. Reyneke, C. Ferretti, Intraoperative diagnosis of condylar sag after bilateral sagittal split ramus osteotomy ,British Journal of Oral and Maxillofacial Surgery (2002) 40, 285–292

CENTRAL CONDYLAR SAG



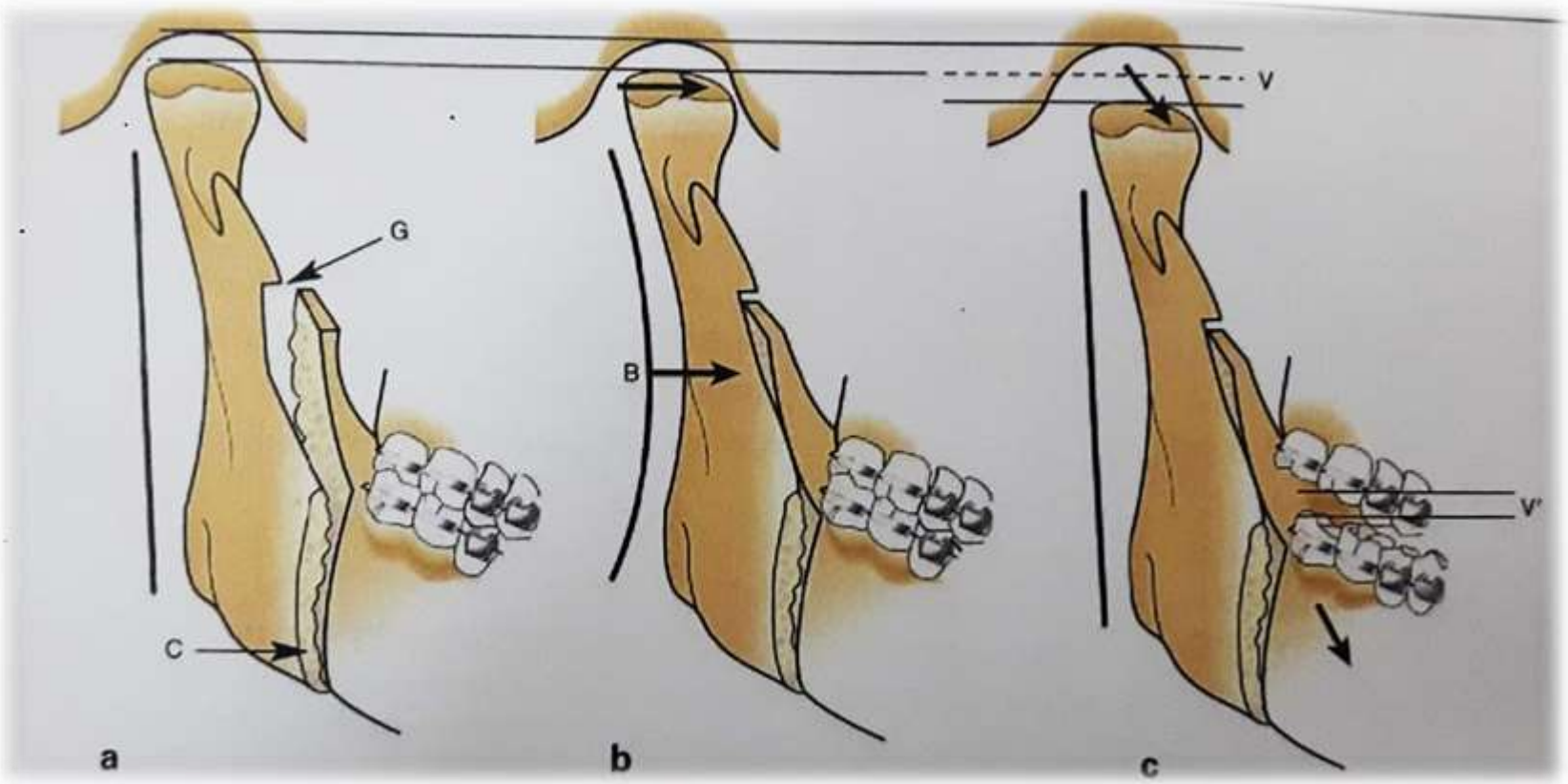
Johan. P. Reyneke, C. Ferretti, Intraoperative diagnosis of condylar sag after bilateral sagittal split ramus osteotomy ,British Journal of Oral and Maxillofacial Surgery (2002) 40, 285–292

PERIPHERAL CONDYLAR SAG - I



Johan. P. Reyneke, C. Ferretti, Intraoperative diagnosis of condylar sag after bilateral sagittal split ramus osteotomy ,British Journal of Oral and Maxillofacial Surgery (2002) 40, 285–292

PERIPHERAL CONDYLAR SAG - II



Johan. P. Reyneke, C. Ferretti, Intraoperative diagnosis of condylar sag after bilateral sagittal split ramus osteotomy ,British Journal of Oral and Maxillofacial Surgery (2002) 40, 285–292

MALOCCLUSION

Open Bite

- Inadequate Fixation
- Posterior open bite during fixation

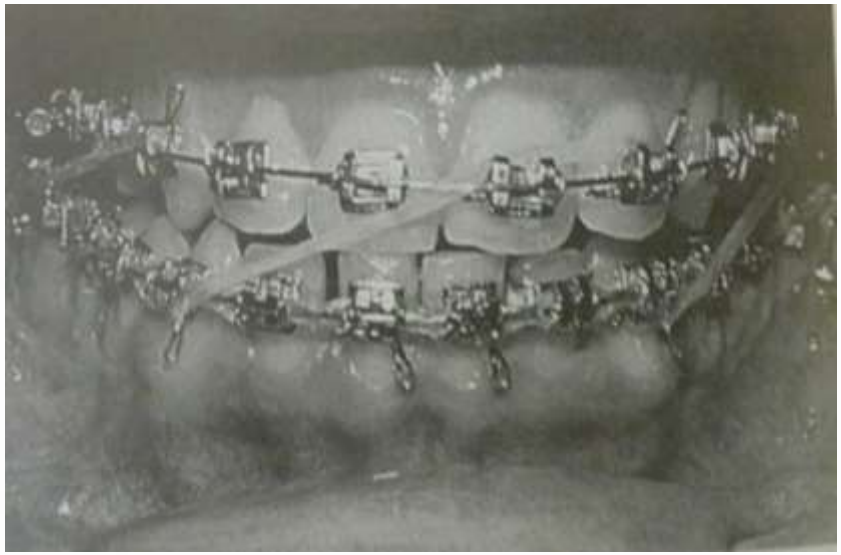
Lateral shift

- Inadequate advancement on 1 side
- Equal bilateral advancement with midline shift
- Torquing of the proximal segment

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

MALOCCLUSION

- Elastic traction when there is no anterioposterior discrepancies for 2-3 weeks
- When there is AP discrepencies reenter, explore and advance the descrepant site



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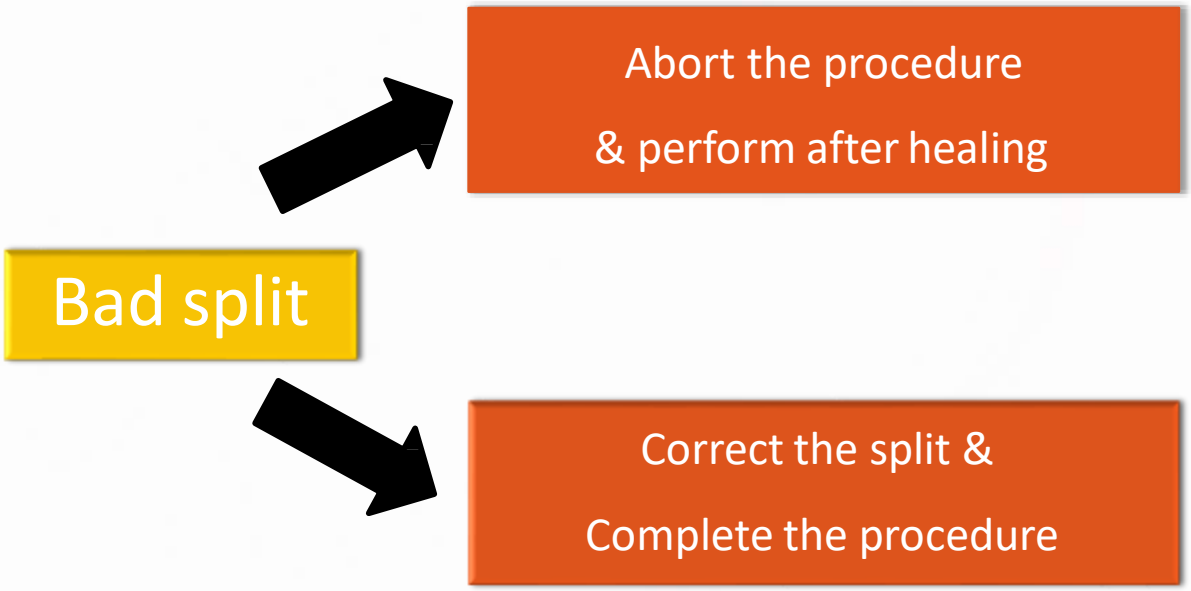
BAD SPLIT

Incidence-18%



Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

BAD SPLIT

- Fracture of buccal plate
- Fracture of lingual flange
- Inferior border left in the proximal fragment
- Condylar split
- Impacted 3rd molars

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

FRACTURES ON THE PROXIMAL PORTION

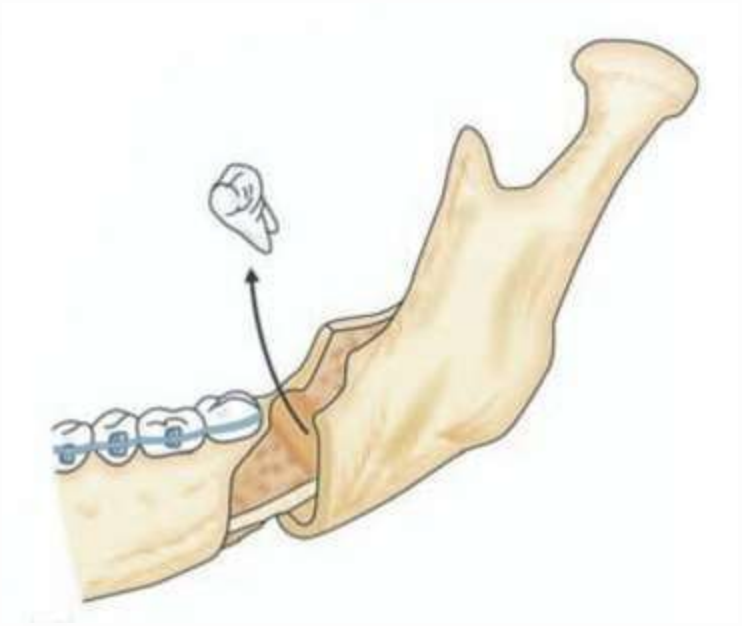
- **Also called "Buccal plate fracture"**
- Small Proximal Fragment
- Bicortical Screws
- Free Fragment is checked for compatibility
- Secure the segment with plate

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

FRACTURES ON THE PROXIMAL PORTION

Most frequent

- Presence of impacted 3rd molar
- Recent removal of 3rd molar
- Age of the patient
- Incomplete transection of the inferior border
- Surgeon's experience



Role of impacted 3rd molars in unfavorable # is debatable

Advocated removal 6months prior surgery

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

Medial Splits Up The Condyle

- Medial cut more superior to the lingula
- Angling the cut in an oblique fashion towards condylar neck
- Chiesel should not be used

Fracture of coronoid process

- Occurs when the horizontal cut is placed too high where the ramus is thin

Fracture of distal segments

- Inferior border remains attached to distal segment

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

RELAPSE

- Mandibular advancements greater than 7 mm
- Suprahyoid myotomies and orthodontic overcorrection

- ***Prevention***
- Proximal segment control
- Proper condylar positioning
- Avoidance of condylar rotation
- Decreased when 1-2 week skeletal fixation used
- Suprahyoid myotomies and orthodontic overcorrection

Van Sickels JE: a comparative study of bicortical screws and suspension wires versus bicortical screws in large mandibular advancements. J Oral & Maxillofac Surg 1991;49;1970

TMJ DYSFUNCTION & HYPOMOBILITY

- 20 – 25%
- Prolonged immobility
- Intraarticular haemorrhage
- Fibrosis
- Preexisting TMJ disorder

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

NERVE DAMAGE

-*Injury to the Inferior Alveolar Nerve (IAN)*

-***White et al*** pointed out that damage to the inferior alveolar nerve most likely occurs either during the medial retraction of the soft tissues and the nerve as it enters the canal or during the vertical bone cut

-***Guernsey et al*** felt that damage occurred during the splitting of the mandible and reported the problem of parts of the nerve staying in the proximal fragment after the split.

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

NERVE DAMAGE

Injury to the Lingual Nerve

- Less common
- Higher incidence of neurosensory disturbance with bicortical screws than monocortical screws

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NERVE DAMAGE

Reasons for Tear or Cut Inferior Alveolar Nerve (IAN)

- Application of local anesthesia
- Stretching of the nerve from the medial protecting retractors
- Forced osteotomy with reciprocating saw or chisel during splitting
- Abnormal anatomic position of the IAN canal
- Presence of an Impacted third molar

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

NERVE DAMAGE

Measures to Prevent Injury to the IAN During BSSO

- Preparation subperiosteal at the medial side of the ascending ramus
- Prevent Stretching of the nerve from the medial protecting retractors
- Rotating instruments and saws may be used only to open the mandibular cortex
- Osteotome may penetrate only very superficially into the mandible during splitting
- Removal of impacted third molars at least 6 months before surgery

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

NERVE DAMAGE

Measures to Prevent Lingual Nerve

- Measurement of the depth of the drilling hole when screws longer than 15mm are used
- Drainage of larger hematomas to allow quick recovery from pressure on lingual nerve

Beukes J, Reyneke JP, Damstra J. Unilateral sagittal split mandibular ramus osteotomy: indications and geometry. British Journal of Oral and Maxillofacial Surgery. 2016 Feb 29;54(2):219-23.

HAEMORRHAGE

Incidence decreased from 38% in 1972 to 1% in 2005

Most common sources

- Maxillary artery and its branches (massetric and inferior alveolar artery)
- Retromandibular vein
- Facial artery and vein

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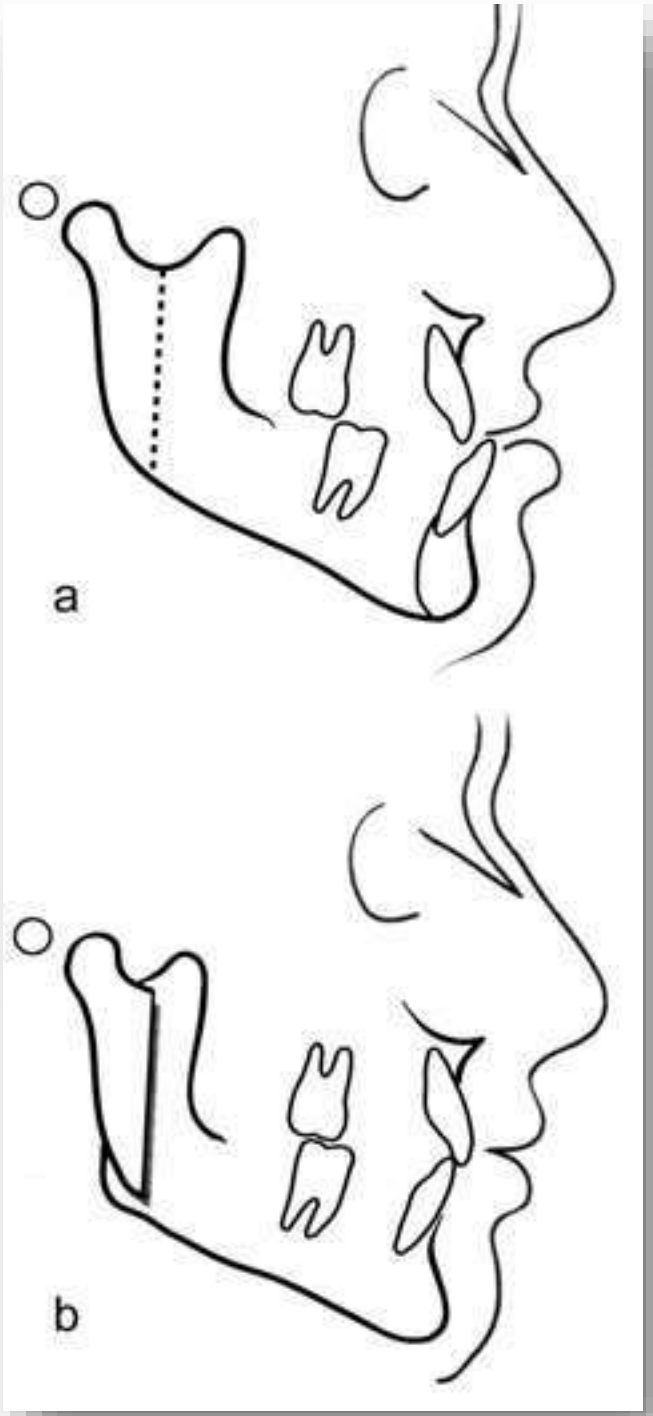
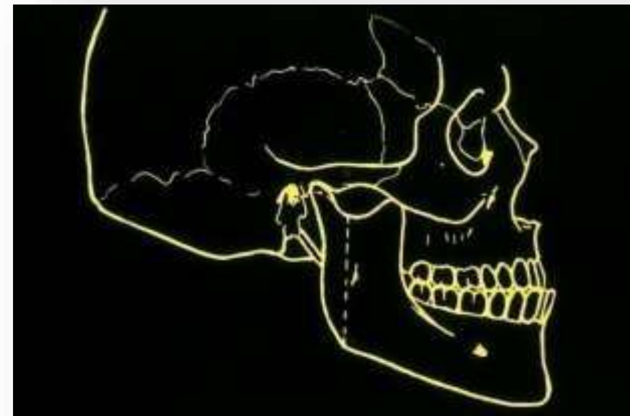
VERTICAL RAMUS OSTEOTOMIES

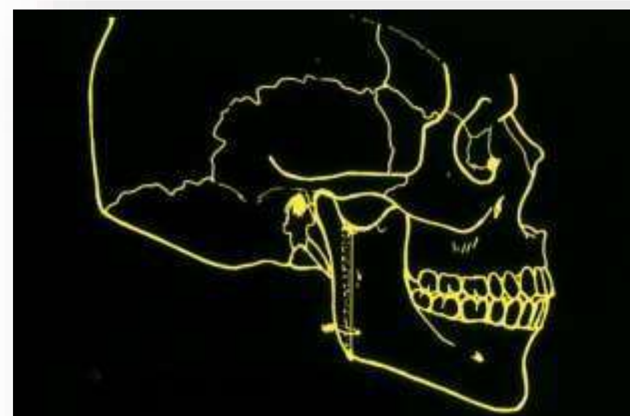


INTRA-ORAL VERTICAL RAMUS OSTEOTOMIES

- 1st described by Caldwell and Letterman in 1954- extra oral



- Introduced by Moose in 1964- intra-oral technique performed from lingual aspect



- Wistanley, 1968- performing the technique from the lateral aspect of the mandible
- Modified by herbert in 1970. used at present

McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

INDICATIONS

- Horizontal mandibular excess
- Mandibular asymmetry
- Minor occlusal discrepancy after isolated Le Fort I osteotomy
  - Asymmetric lateral open bite
  - Failure to achieve passive rotation of the mandible after the release of MMF
- Patients with significant TMJ complaints

McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

CONTRAINDICATIONS

- Advancement of the distal segment
- Aesthetic assessment of the soft tissues of the neck is the integral factor in planning mandibular set back by ramus surgery
- Recent condylar fractures
- A-p decrepany more than 6-7mm
- Prexisting heavy neck

McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

ADVANTAGES

- Can be performed on OPD basis
- Inherent anatomic architecture of the mandible poses little interference to place the cuts
- Less chance of damaging the IAN bundle
- Found to have curable effects in pts with pre-op TMD
- Excellent post op stability

DISADVANTAGES

- Need for MMF 7-10 days
- Post op physiotherapy- for 1-2 week

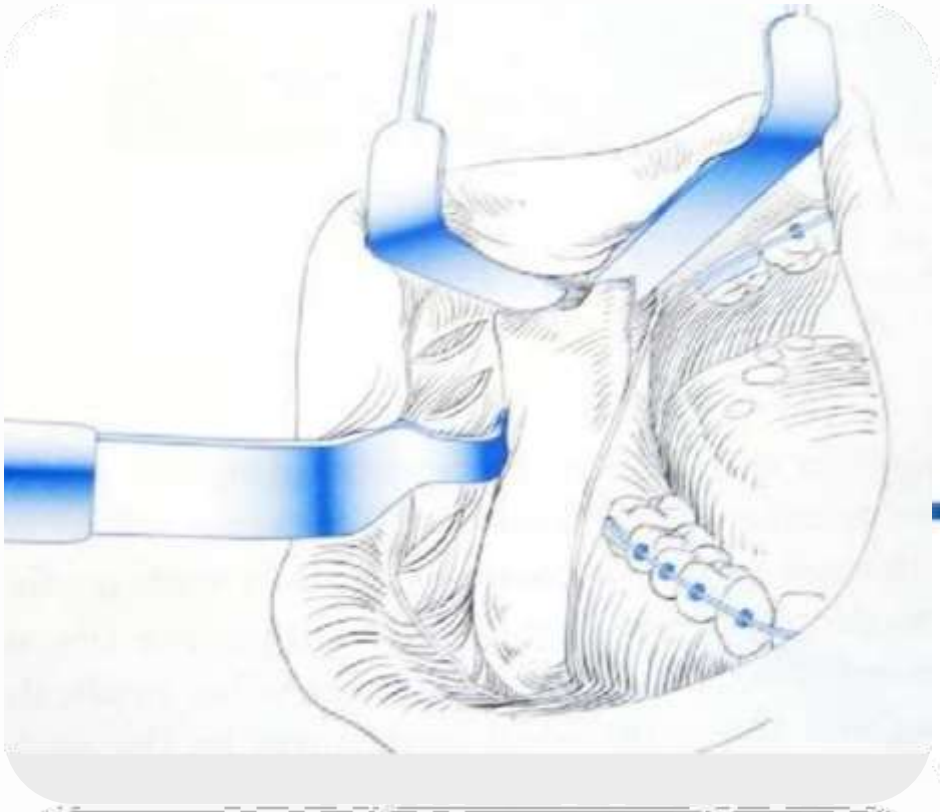
McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

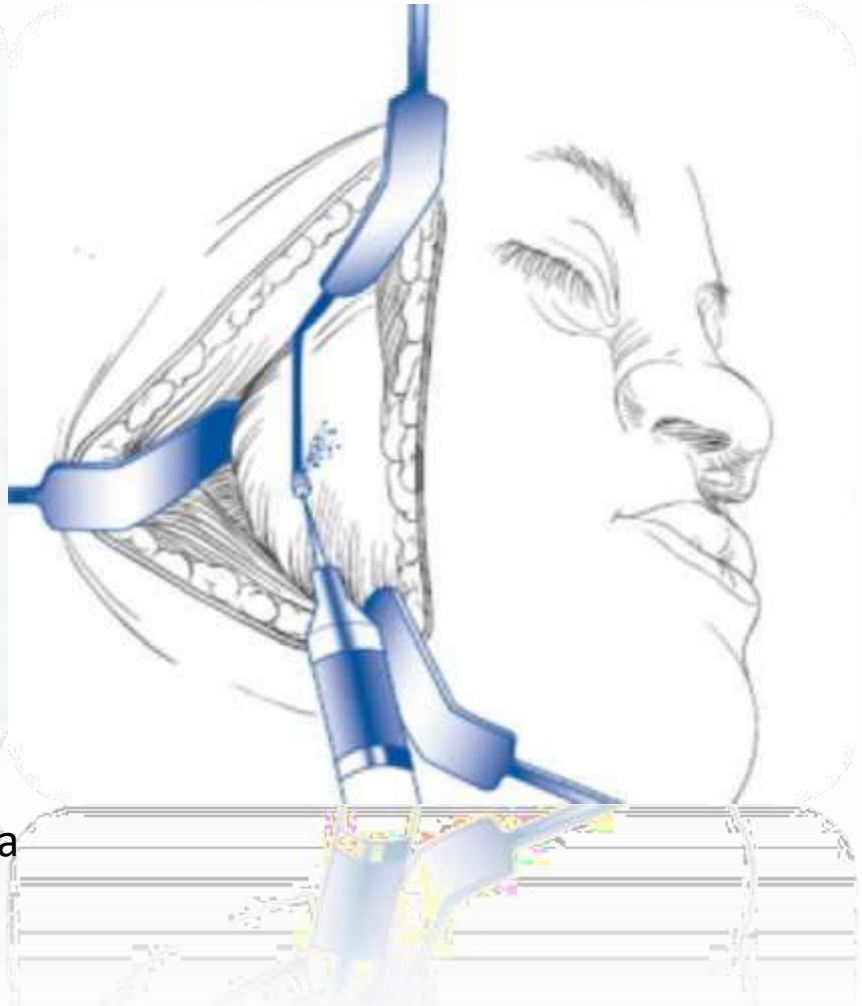
OSTEOTOMIA VERTICAL INTRAORAL DE RAMA PARA LA RETRUSION MANDIBULAR

Modelos cedidos por Viewpoint

Animación 3D realizada por Alfonso Borja

SURGICAL PROCEDURE





Intra orally the incision is made in the mucosa from midway up the anterior border of the ramus to the first molar area

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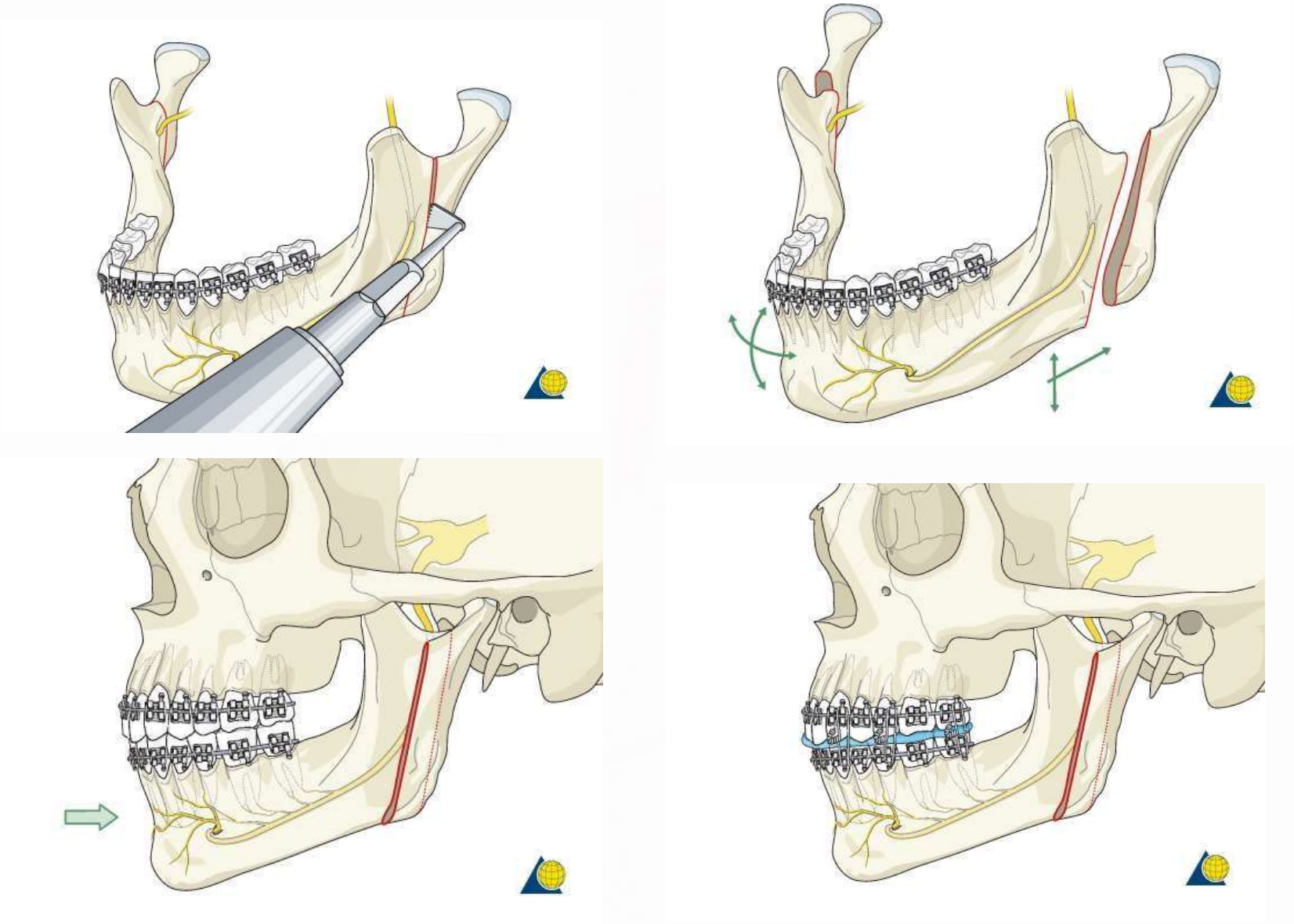
SURGICAL PROCEDURE



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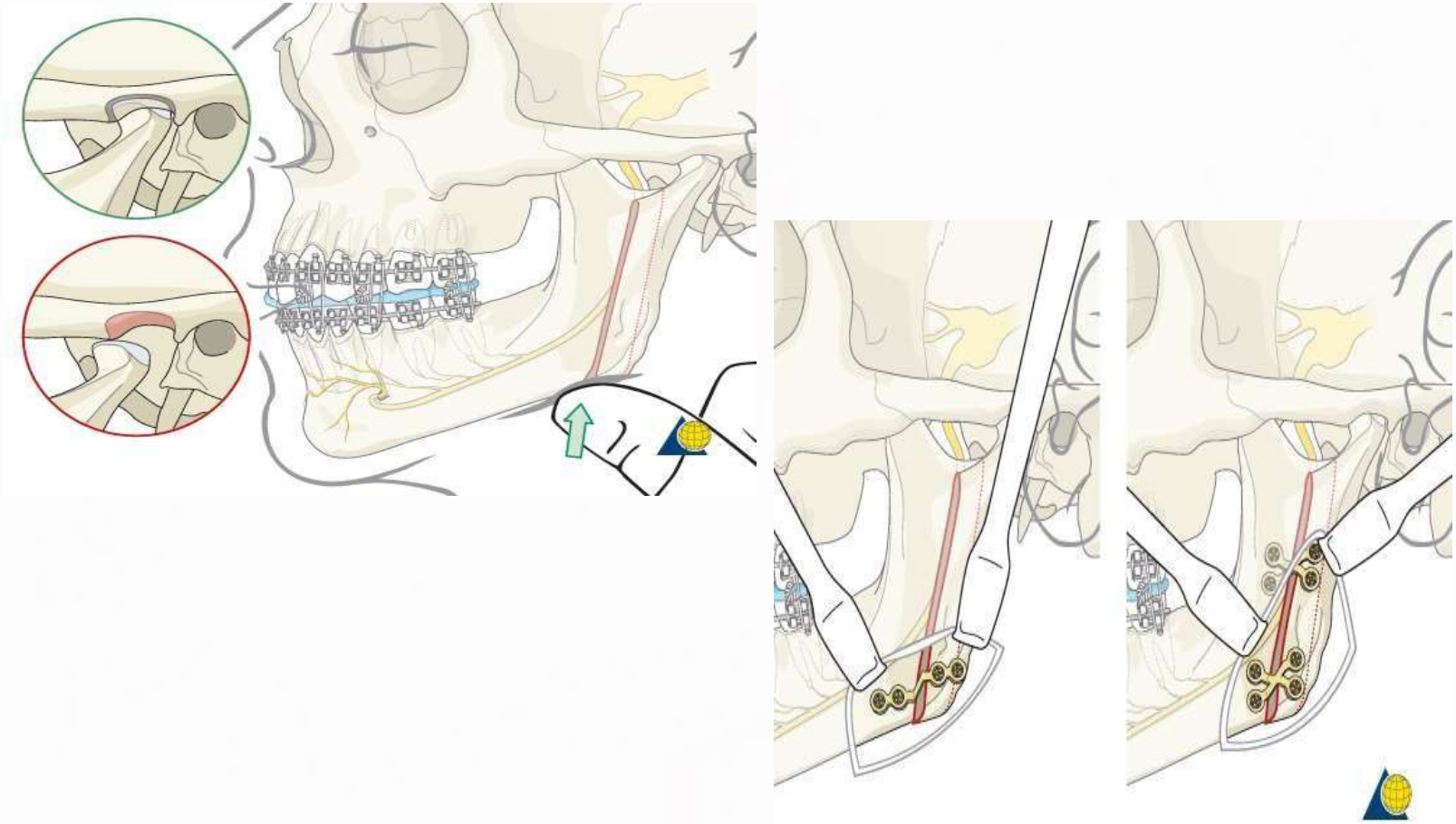
SURGICAL PROCEDURE



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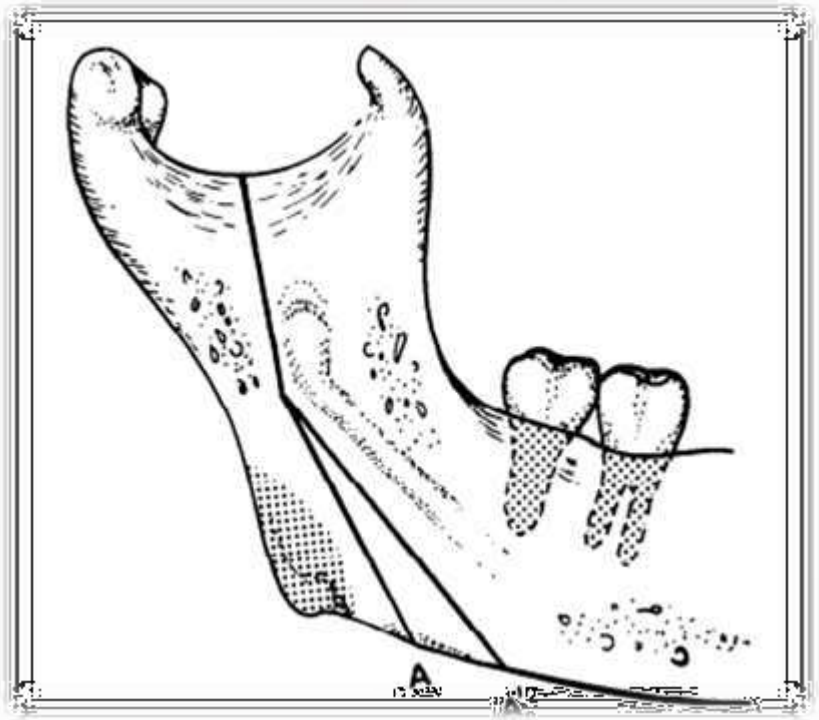
Journal of Oral and Maxillofacial Surgery
Volume 45, Issue 8, August 1987, Pages 684-688

Clinical update

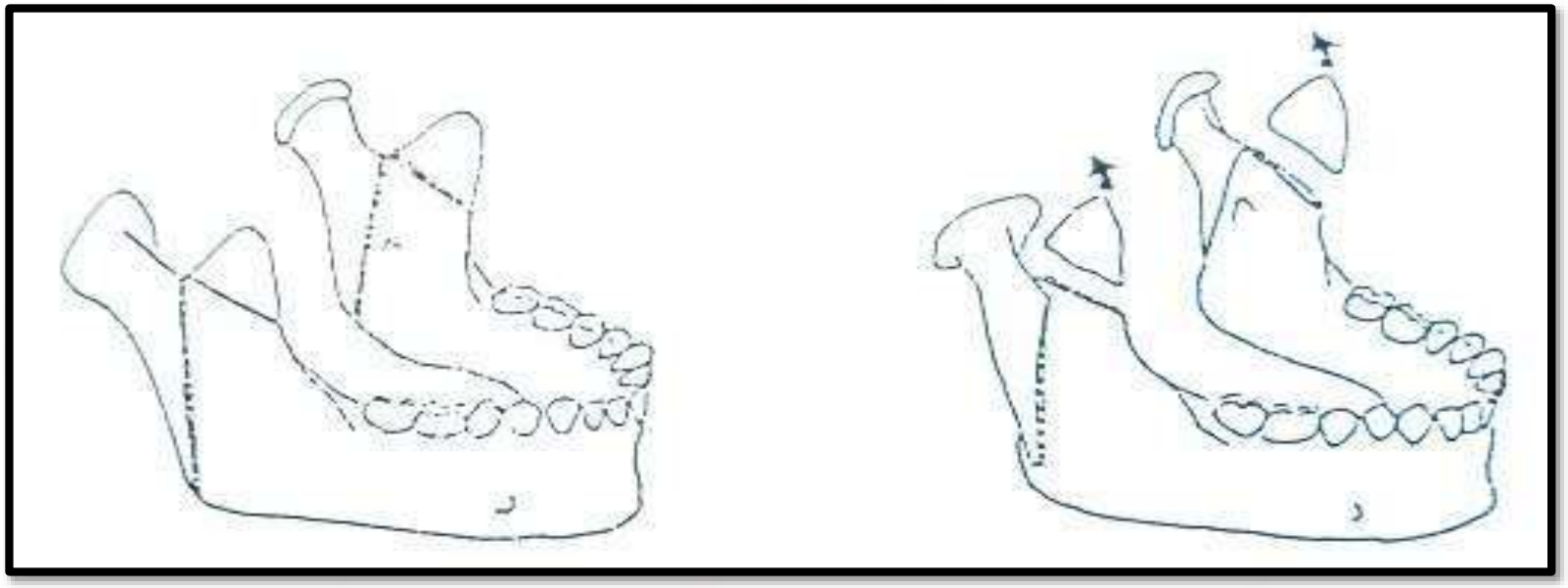
Further refinement and evaluation of intraoral vertical ramus osteotomy

H.David Hall DMD, MD*, Samuel J. McKenna DDS, MD†



McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

The effect of the temporalis on relapse has led to other recommendations that include either stripping the temporalis attachment completely off the coronoid or cutting off the coronoid.



Hamid Mahmood . Evaluation of intraoral verticosagittal ramus osteotomy for correction of mandibular prognathism : A 10 yr study . J Oral Maxillofac Surg 2008: 66:509

COMPARISON BETWEEN SSRO AND VRO

	SSRO	VRO
OSTEOTOMY	PA Saggital split	Latero medial cut
	Open procedure	Blind procedure
	Along IAN	Rear to IAN
	Frequent exposure of IAN	No exposure of IAN
BONE HEALING	Contact on marrow to marrow	Contact on cortex to cortex
BONE FIXATION	Rigid internal fixation	No fixation
CONDYLAR HEAD	Original position	New equilibrated position
POST OP IMF prognosis	None or shorter period Weakly dependent on pt	Required 7-10 day Strongly dependent on pt

McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

COMPLICATIONS

- **UNFAVOURABLE OSTEOTOMY**

Inadvertent subcondylar osteotomy

More likely in

- Prognathic mandible with high mandibular plane angle and ill-defined gonial angle

McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

NERVE INJURY

Incidence ranges from 0%- 14%

Less incidence when compared to SSO

Can occur in 2 phases

- If osteotomy is close to mandibular foramen
- Medial displacement of the proximal segment compressing and tearing the nerve

McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

Bleeding

Common source- maxillary artery and its branches

Proximal Segment Malpositioning

Control of proximal segment- major disadvantage

- May be displaced antero- medially, anteriorly towards articular eminence or can be displaced medially and inferiorly

McKenna SJ, King EE. Intraoral Vertical Ramus Osteotomy Procedure and Technique. Atlas of the oral and maxillofacial surgery clinics of North America. 2016 Mar 1;24(1):37-43.

CONDYLOTOMY

Mild mandibular prognathism

TMJ internal derrangements

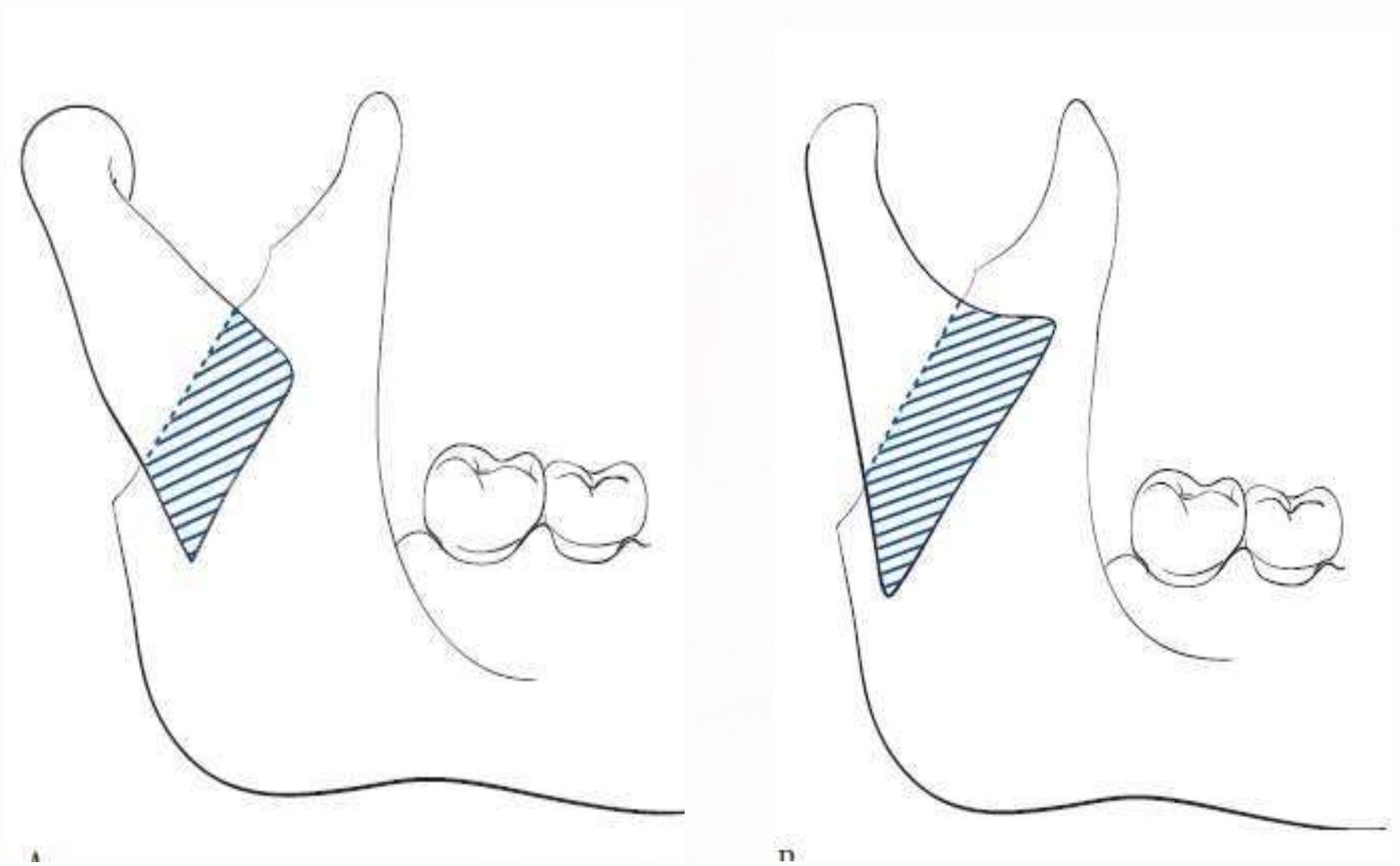
Approaches:

Extra oral

Intraoral

Blind :gigli saw

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

CONDYLECTOMY

Indications:

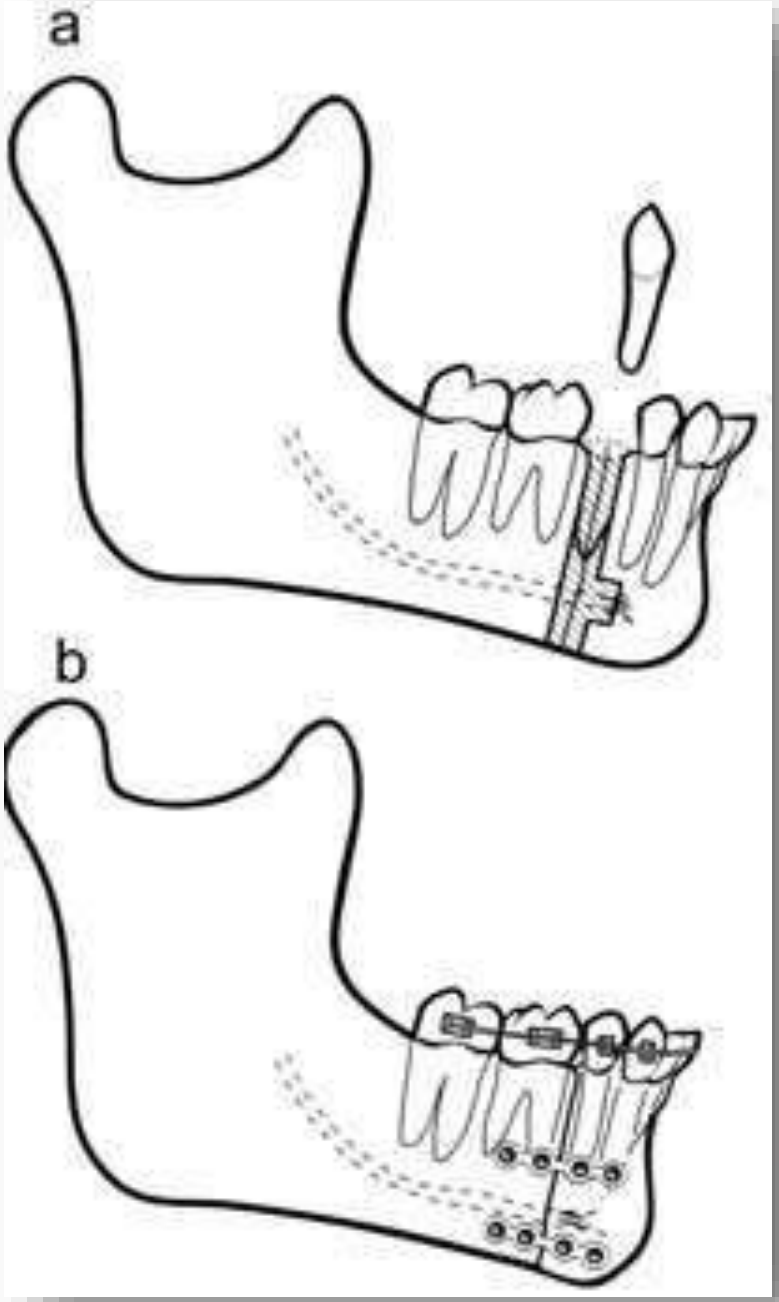
- Ankylosis
- Tumors
- Condylar hyperplasia
- Mandibular asymmetry:

1. **Hemifacial microsomia**
2. **Unilateral: Hypertrophy**

   Elongation

Can be combined with joint reconstruction Or with other osteotomy procedures

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.



VERTICAL BODY OSTEOTOMIES

VERTICAL BODY OSTEOTOMIES

Blair -1907-as an extra oral procedure

Dingman –combination of extra-oral and intra oral access with

preservation of IAN and bon grafting-assist bony union.

Now contemplated only as an intraoral procedure.

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

INDICATIONS

Mandibular setback

- In Mandibular prognathism with ramus procedure.
- In Mandibular prognathism where long body in relation to ramus

Anterior open bite closure-superior repositioning with sub apical will make increase ant teeth show

Curve of spee reduction

Progenia jaw correction

- In class III-anterior body osteotomy –wedge of bone removed and set back

Mandibular advancement- less used

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

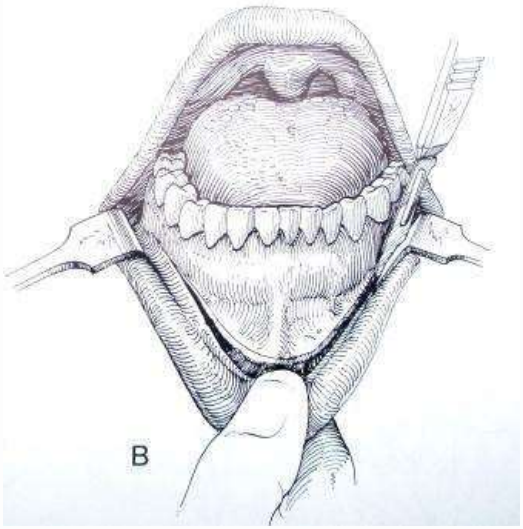
CONTRAINDICATIONS

Potential for sensory problem

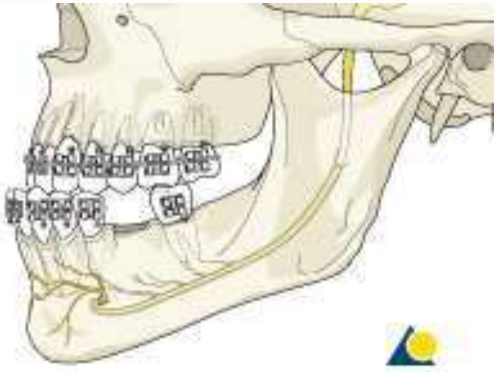
PITFALLS

- **Anatomic discrepancies leading to reduction in bone to bone contact-** distal segment is set back into wider proximal segment intra-bony width.
- **Segment control**
- Torqueing of the proximal segments is the classic problem.
  - Intermediate wafers , cast cap splints can be used- some control over displacing muscle pull.
  - **Neurovascular bundle position-** lingual orientation in 2nd molar region to more buccal position at mental foramen. Lowest point of canal is distal half of 1st molar
- **Root anatomy is variable**
  - Difficult to perform osteotomy in the premolar region when trying to protect the mental nerve and root of the 1st premolar
  - Root torquing may help

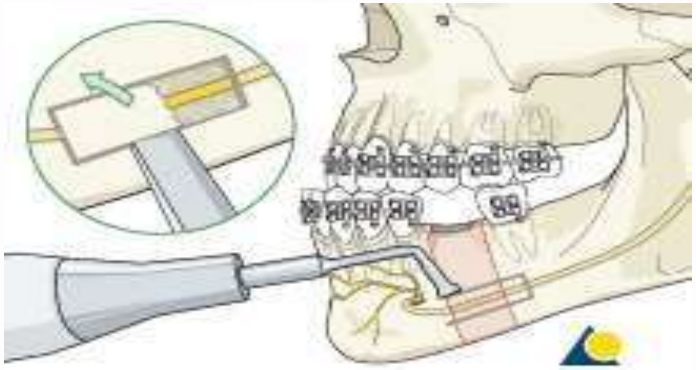
Anterior body osteotom
(Straight Vertical osteotomy)



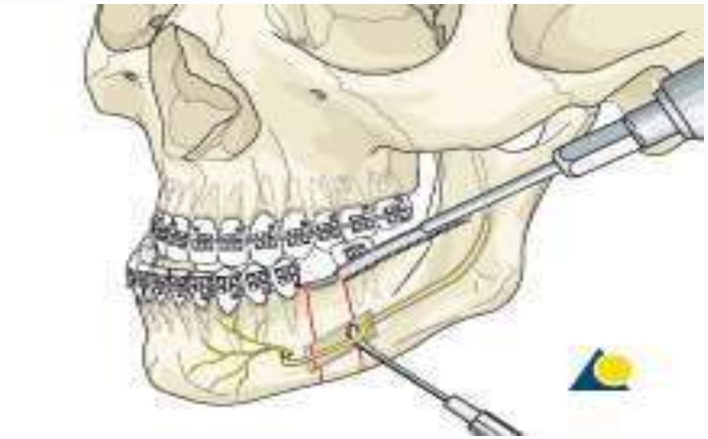
Bilaterally small vestibular incisions are taken leaving attached gingiva intact, into first or second premolar regions, depending on the extraction.



Extract the tooth in the segment which is going to be resected before performing the osteotomies.

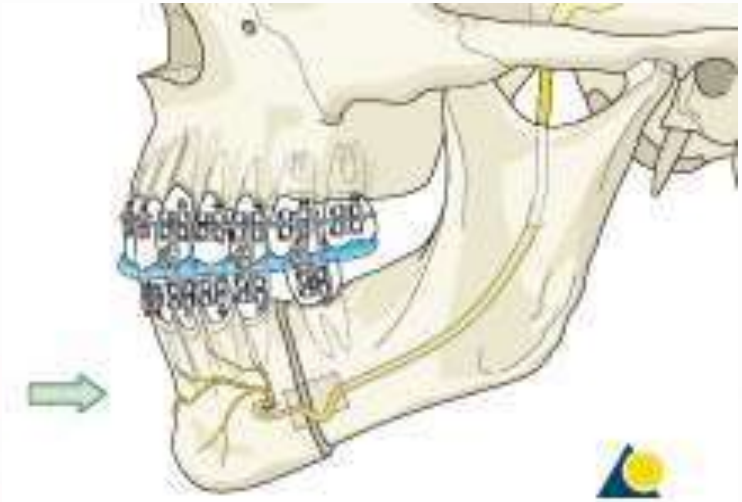


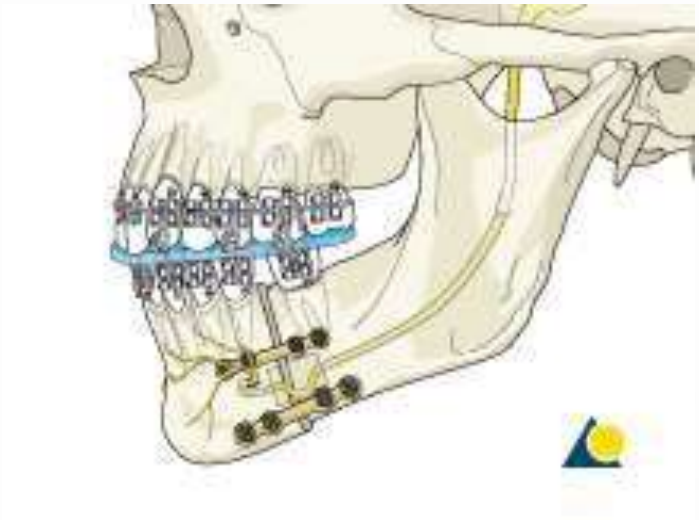
The inferior alveolar nerve can be identified and mobilized after removing the lateral cortical bone overlying the nerve.



After the alveolar nerve is identified and mobilized, two parallel vertical osteotomy lines are marked with a pen or drill on the bone surface. The lingual mucoperiosteal layer is detached from the bone with a periosteal elevator. The osteotomy is then performed with either a saw, drill .

After completion of both osteotomies the segment of bone is removed.

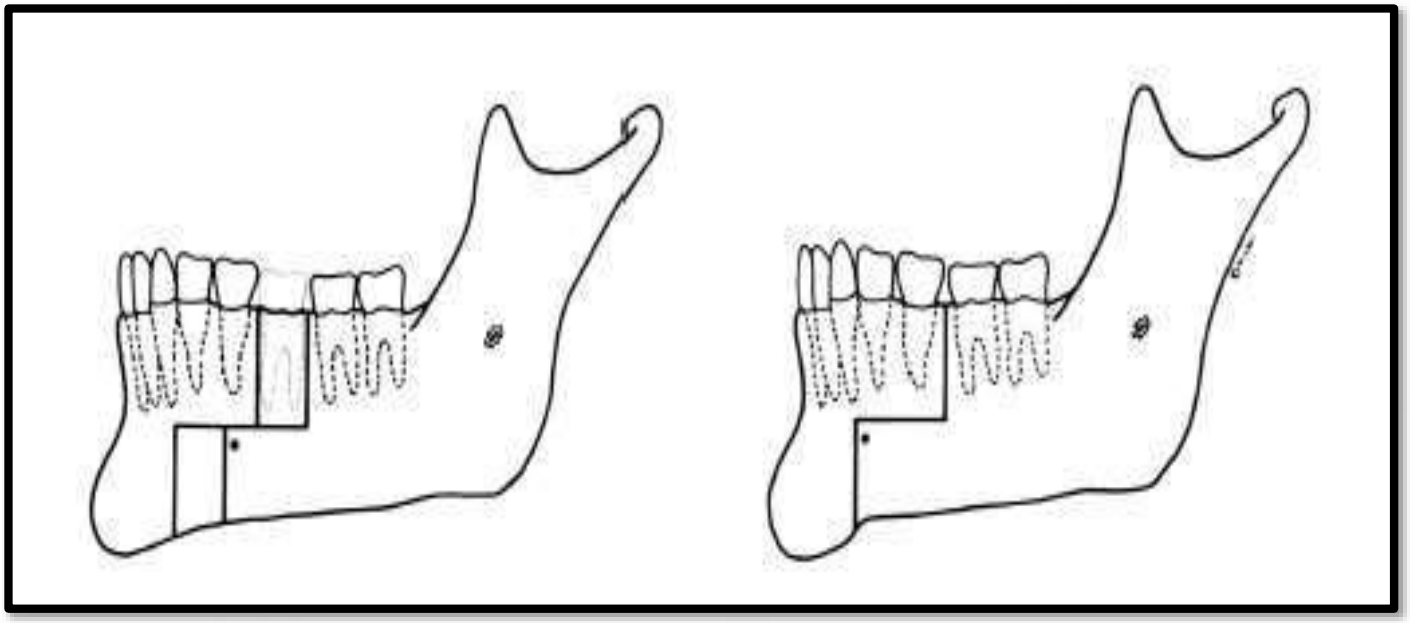




After bilateral resection, the anterior segment of the mandible is moved posteriorly into the preplanned position. Mandibulo-maxillary fixation is performed to position the mandibular segments to the desired relationship with the maxilla. A prefabricated surgical splint (or wafer) may be used to facilitate this.

Internal fixation is usually performed with two straight miniplates one above and one below the inferior alveolar nerve. The plate placement and drilling is usually performed from the transoral route

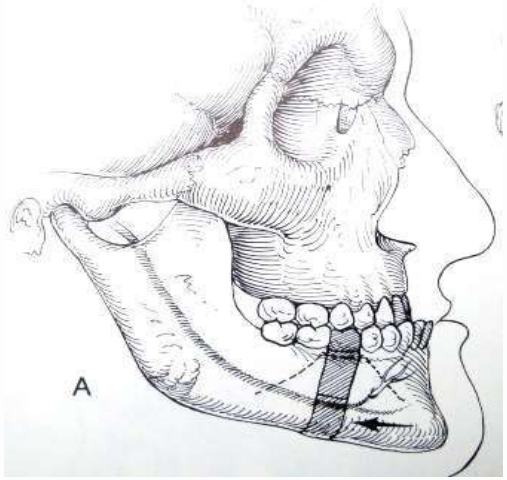
Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.



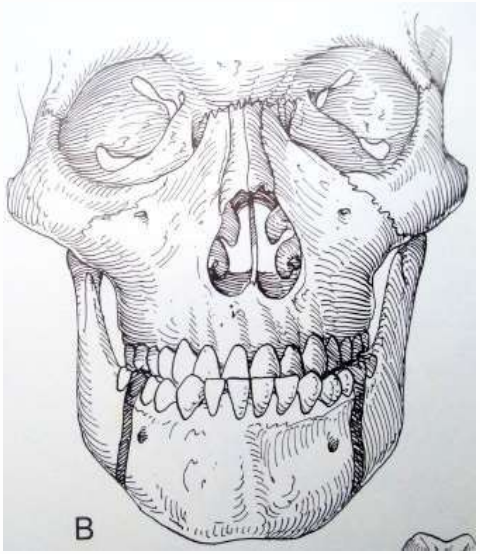
•The **step osteotomy** may be indicated in cases of mandibular prognathism, retrognathism, asymmetry, and apertognathia.
•

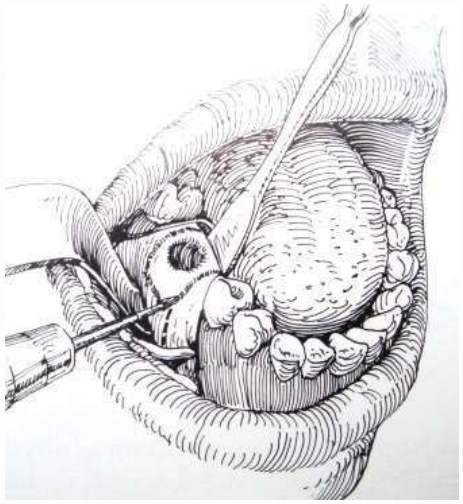
Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

Posterior Body Osteotomy



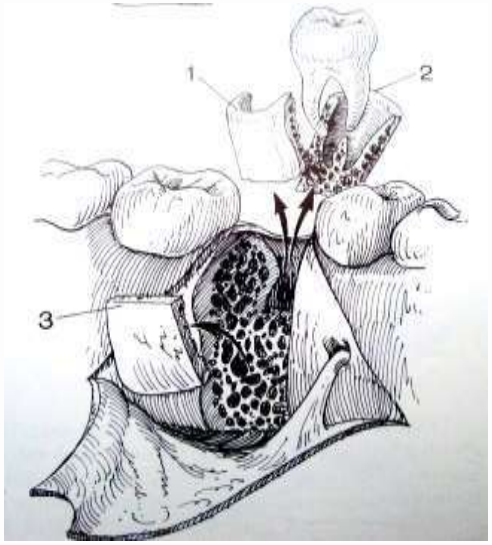
Planned osteotomies in 1st molar region



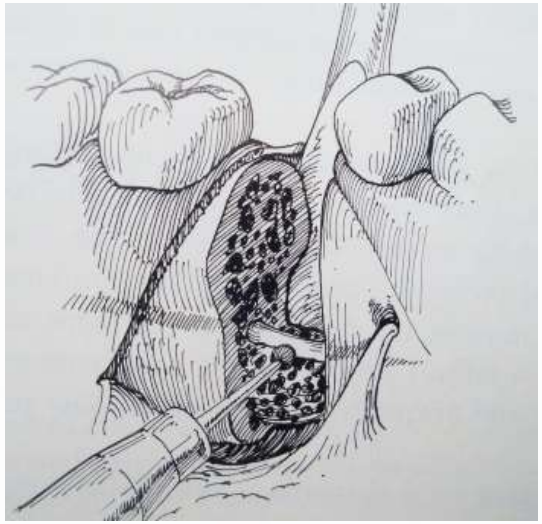


Diverging vertical incisions in buccal vestibule adjacent to area of planned osteotomy; horizontal osteotomy is made superior to level of inferior alveolar nerve to intersect with vertical bone incisions.

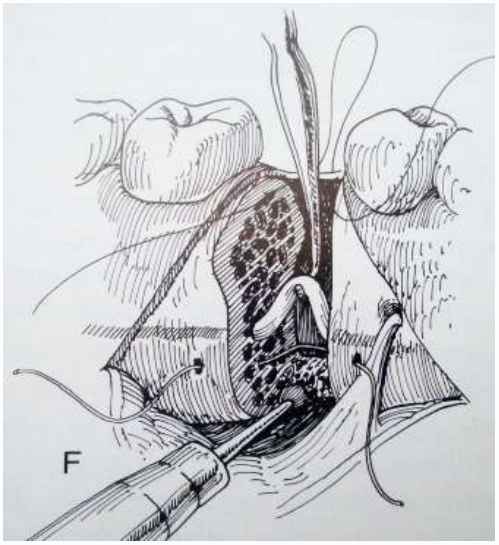
Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.



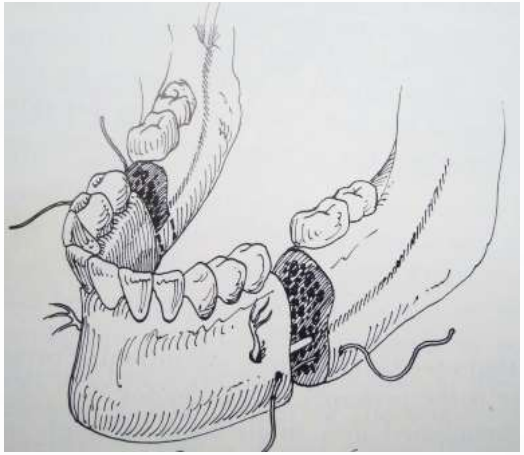
Sequential excision of buccal, lingual and inferior cortical plates



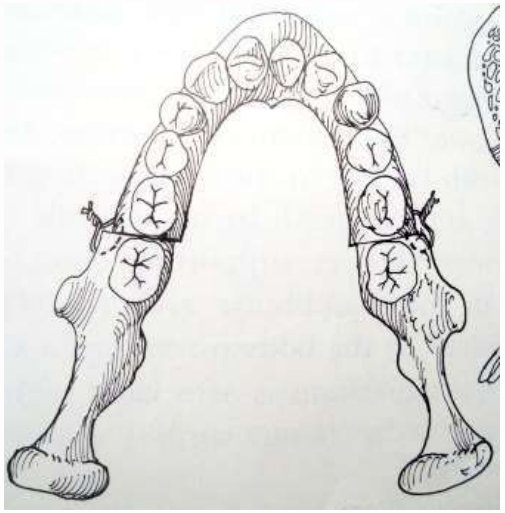
Exposure of inferior alveolar bundle by careful excision of cancellous bone



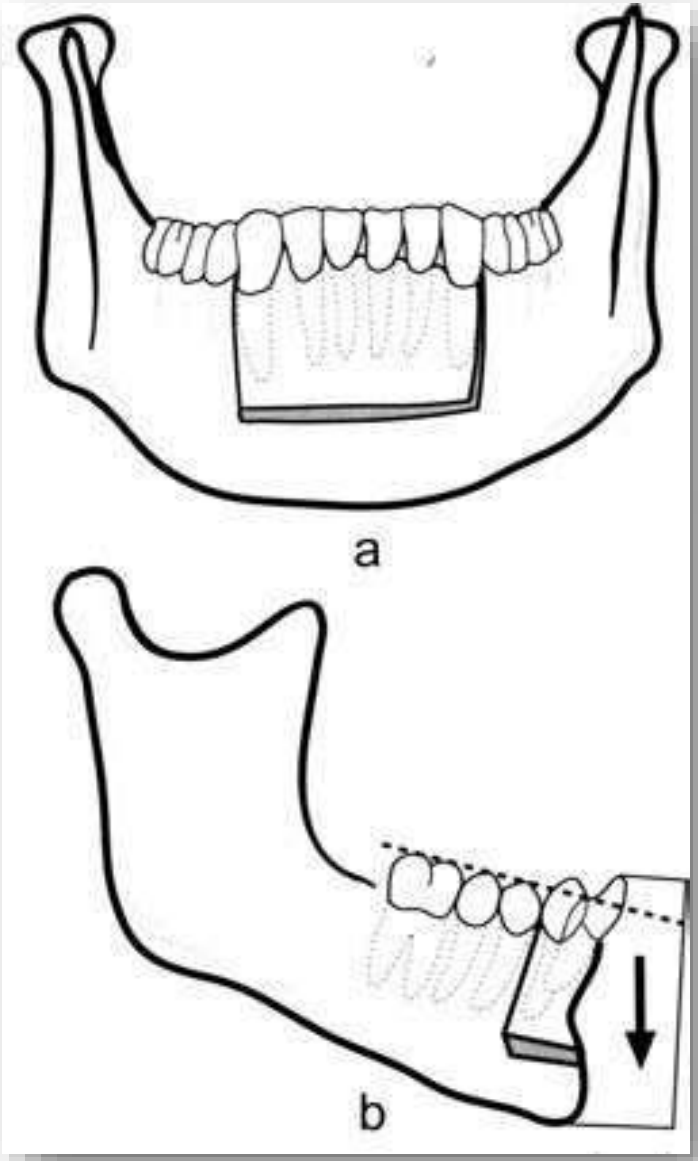
Excision of residual inferior lingual cortical bone facilitated by retraction of the inferior alveolar nerve



Interosseous wire placed through margins of osteotomised bone before body osteotomy is completed



Apposition of segments fixed with interosseous wires

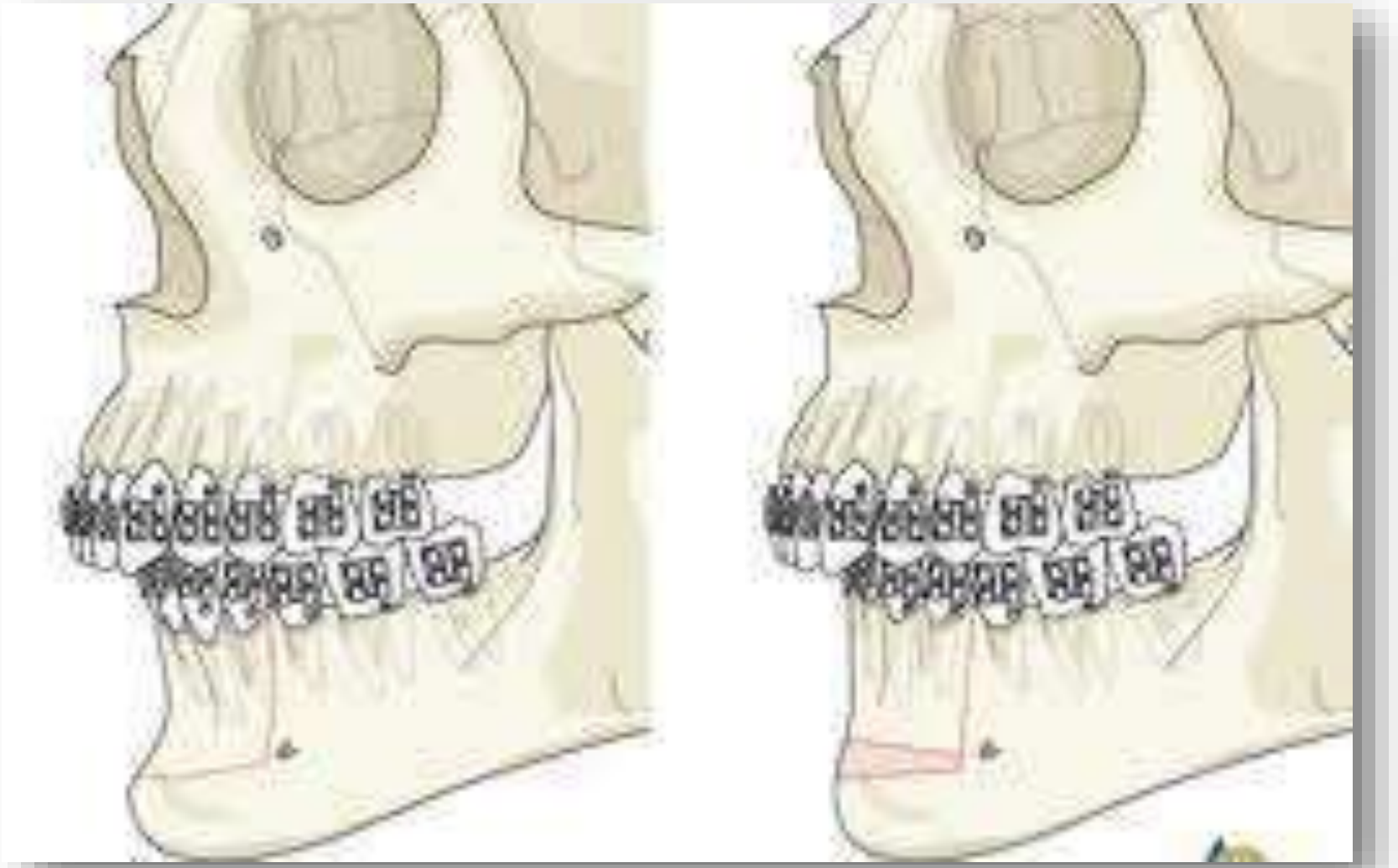


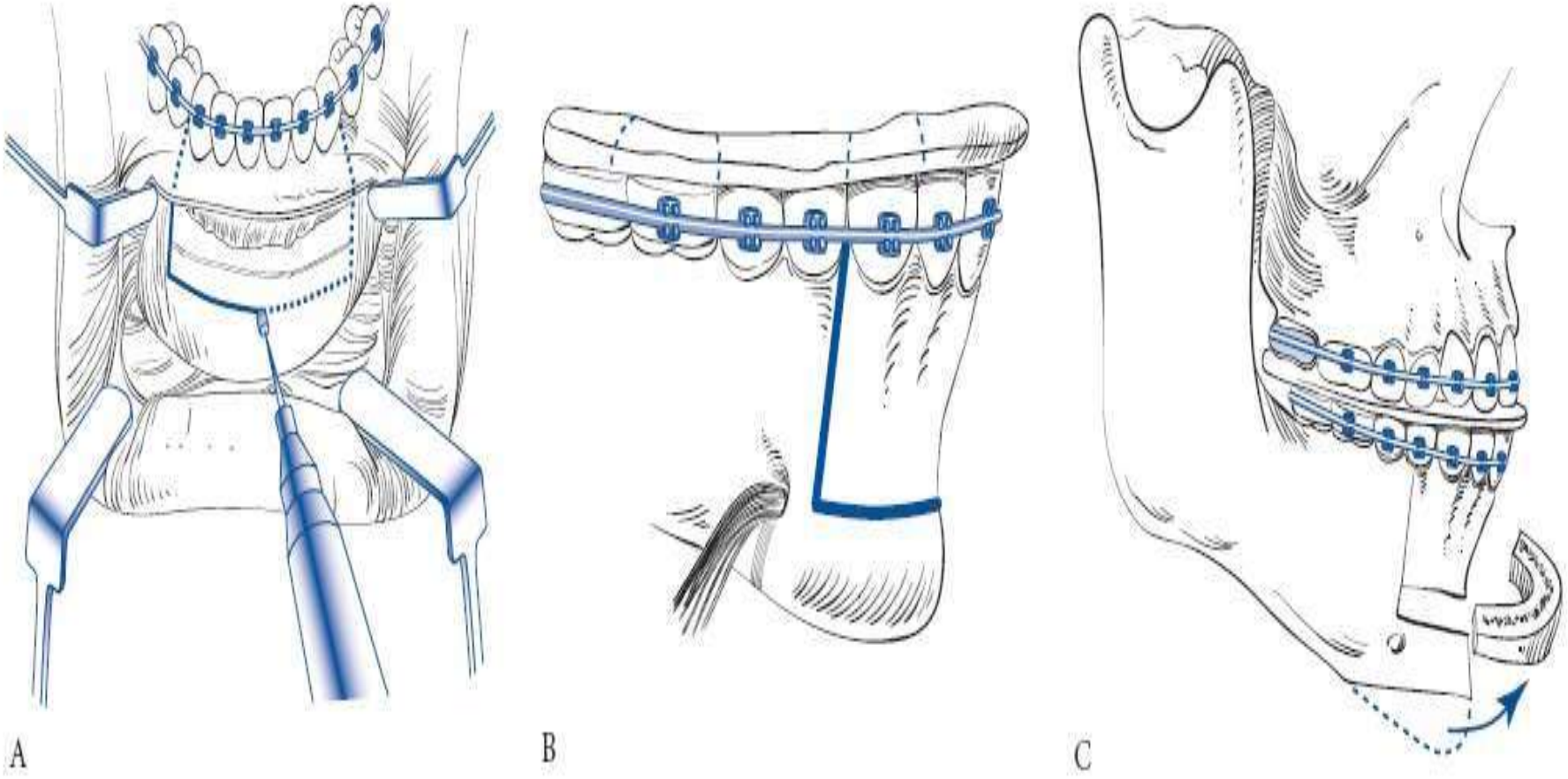
SUB-APICAL OSTEOTOMIES

ANTERIOR MADIBULAR SUB-APICAL OSTEOTOMY

- Earliest referenced description of symphyseal osteotomies was by Trauner in 1952
- Aids in correction of dentofacial deformities.
- When combined with AMO non skeletal open bite or bimaxillary protrusion can be corrected
- Useful to level the plane of occlusion with out decreasing the vertical facial height

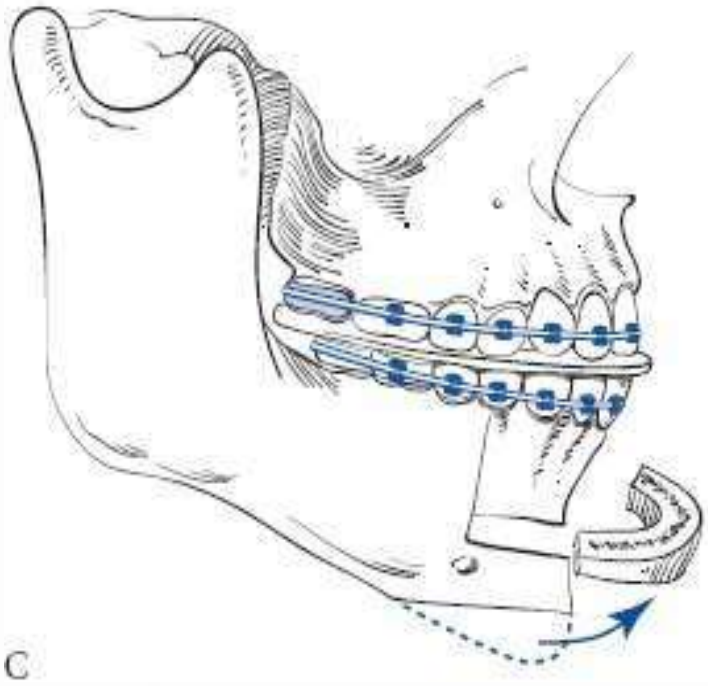
Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.





Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

Modification by KOLE



Bone gaps caused by movement of the segment,especially by vertical movement necessary for the closure of an anterior open bite, should be grafted. The use of cortical bone from the symphysis, as advocated by **Kole**

Kole H. Surgical operations on the alveolar ridge to correct occlusal abnormalities. Oral Surg Oral Med Oral Pathol 1959; 12:277.

COMPLICATIONS

- Loss of bone or teeth in osteotomised segment.(lingual tissues not protected-decrease in blood supply)

- Bone cuts placed close to the teeth-loss of vitality and periodontal defects

- Mental nerve paresthesia-directly related to the amount of trauma

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

POSTERIOR SUBAPICAL OSTEOTOMY

First described by- Peterson

Indications

- Correction of super eruption of posterior mandibular teeth
- Ankylosis of one or more posterior teeth
- Abnormal buccal or lingual position of these teeth especially if orthodontics is not feasible

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

TOTAL MANDIBULAR SUBAPICAL OSTEOTOMY

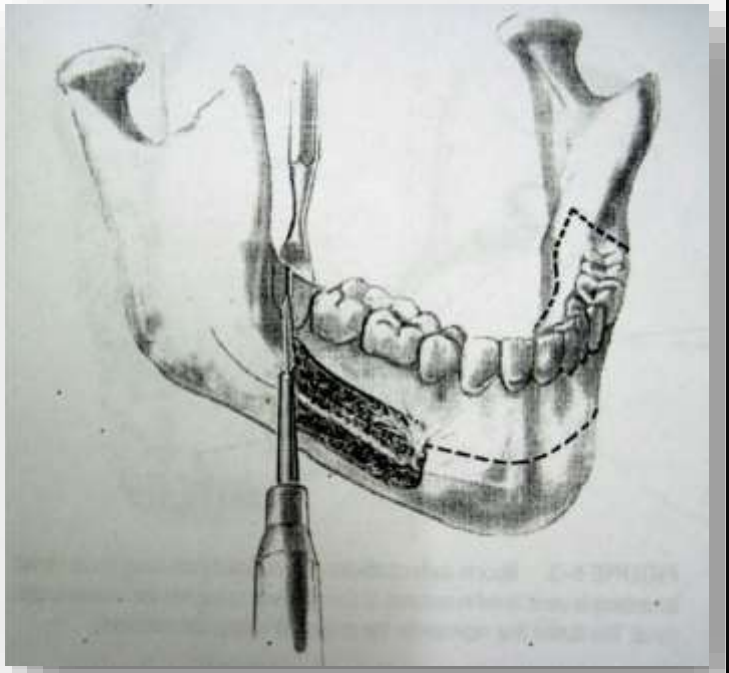
- Oldest procedures used to correct Jaw Deformity.
- Described by HULLIHEN in 1849.
- Popularised by Hofer and Kole.

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

Primary indication

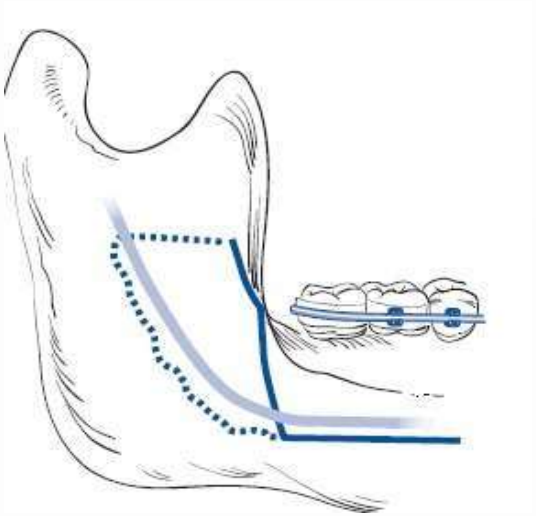
Malocclusion caused by Mandibular Dentoalveolar deformity with normally positioned Maxilla and Mandibular skeletal bases

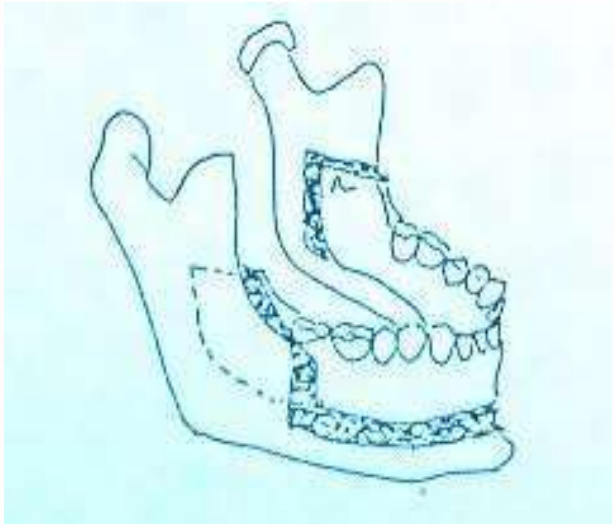
- To increase the height of the mandible
- To level the occlusal plane



Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

Modification by Booth et al





Booth et al suggested a variation of the total mandibular subapical osteotomy that combines the sagittal split osteotomy of the vertical ramus with the total mandibular alveolar osteotomy.

Advantages :osteotomy is made below the inferior alveolar nerve, thereby decreasing the risk of damaging the inferior alveolar nerve and the apices of the teeth, at the same time preserving much of the vascular supply to the mobile segment. Also the sagittal part of the osteotomy allows a larger bone contact area to assist in healing

Booth DF, Dietz V, Gianelly AA. Correction of class III malocclusion by combined sagittal ramus and subapical body osteotomy J Oral Surg 1976; 34:630

HORIZONTAL OSTEOTOMY OF THE SYMPHYSIS

- Facial features often form a basis for stereotyping of personality characteristics

- Chin is most prominent facial feature

- Chin deformities can manifest in 3 dimensions but majority are in the horizontal direction

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

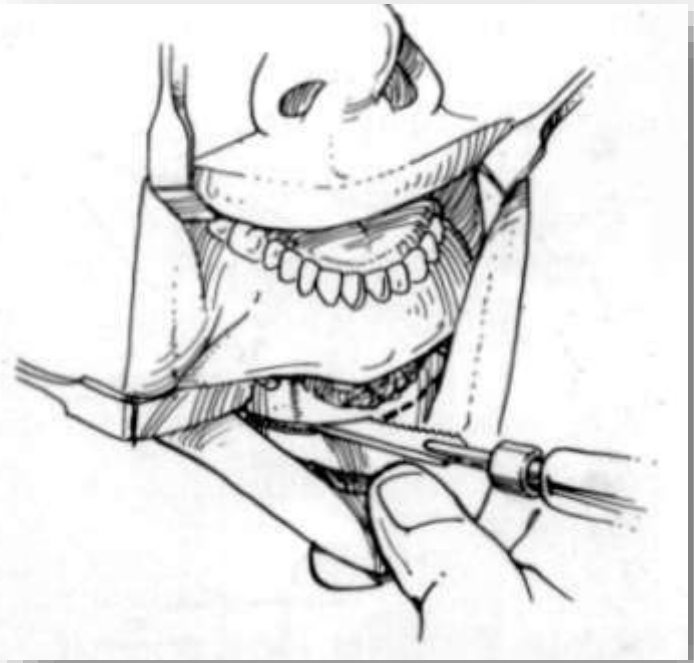
Horizontal sliding osteotomy-first described by Hofer in 1942- through extra oral approach.

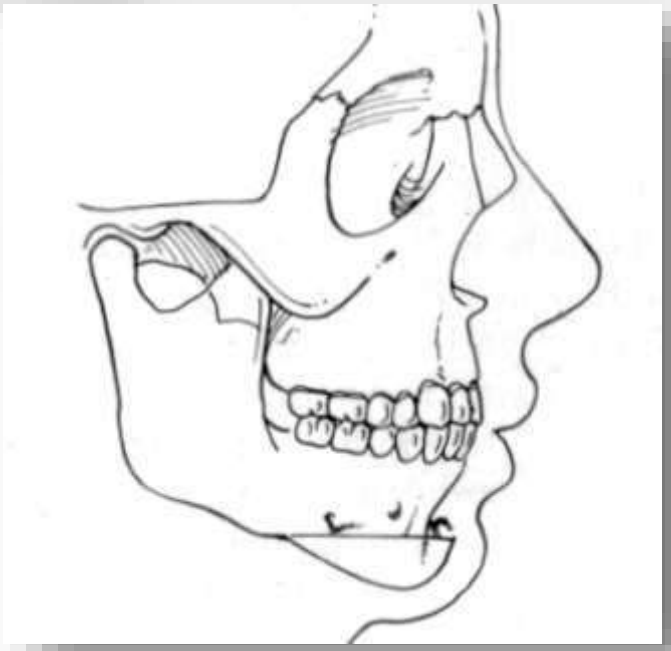
Converse 1950- fesibility of bone graft by intra oral approach

Trauner and Obwegeser-1957- horizontal osteotomy through an intra oral incision.

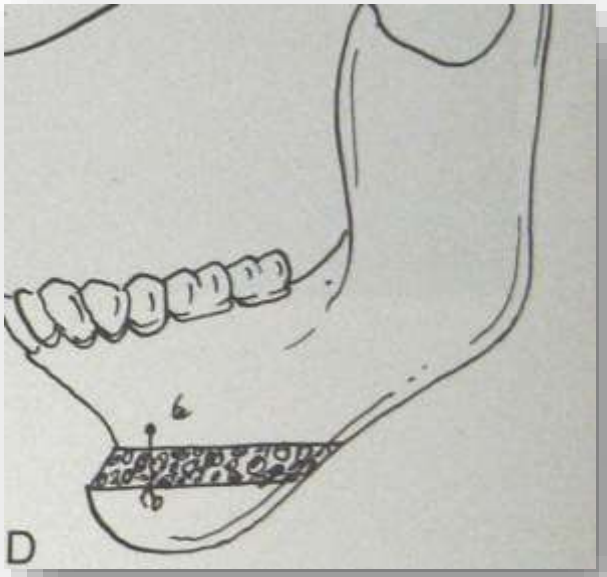
Reichenbach-1965-wedge osteotomy and vertical shortening of the chin.

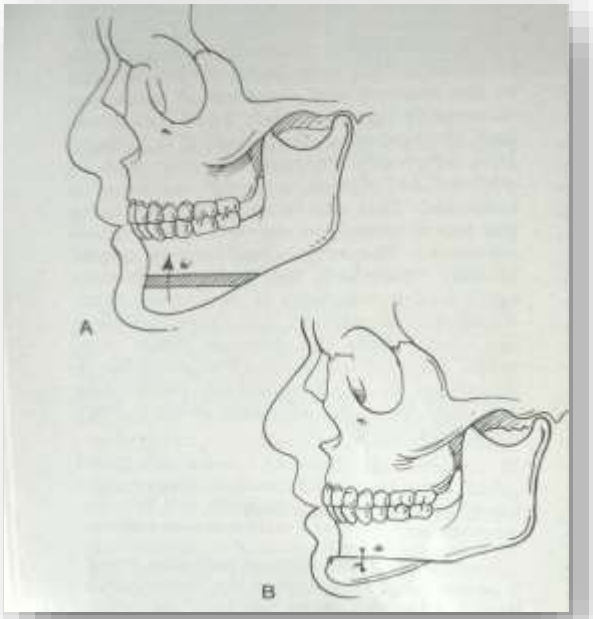
Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

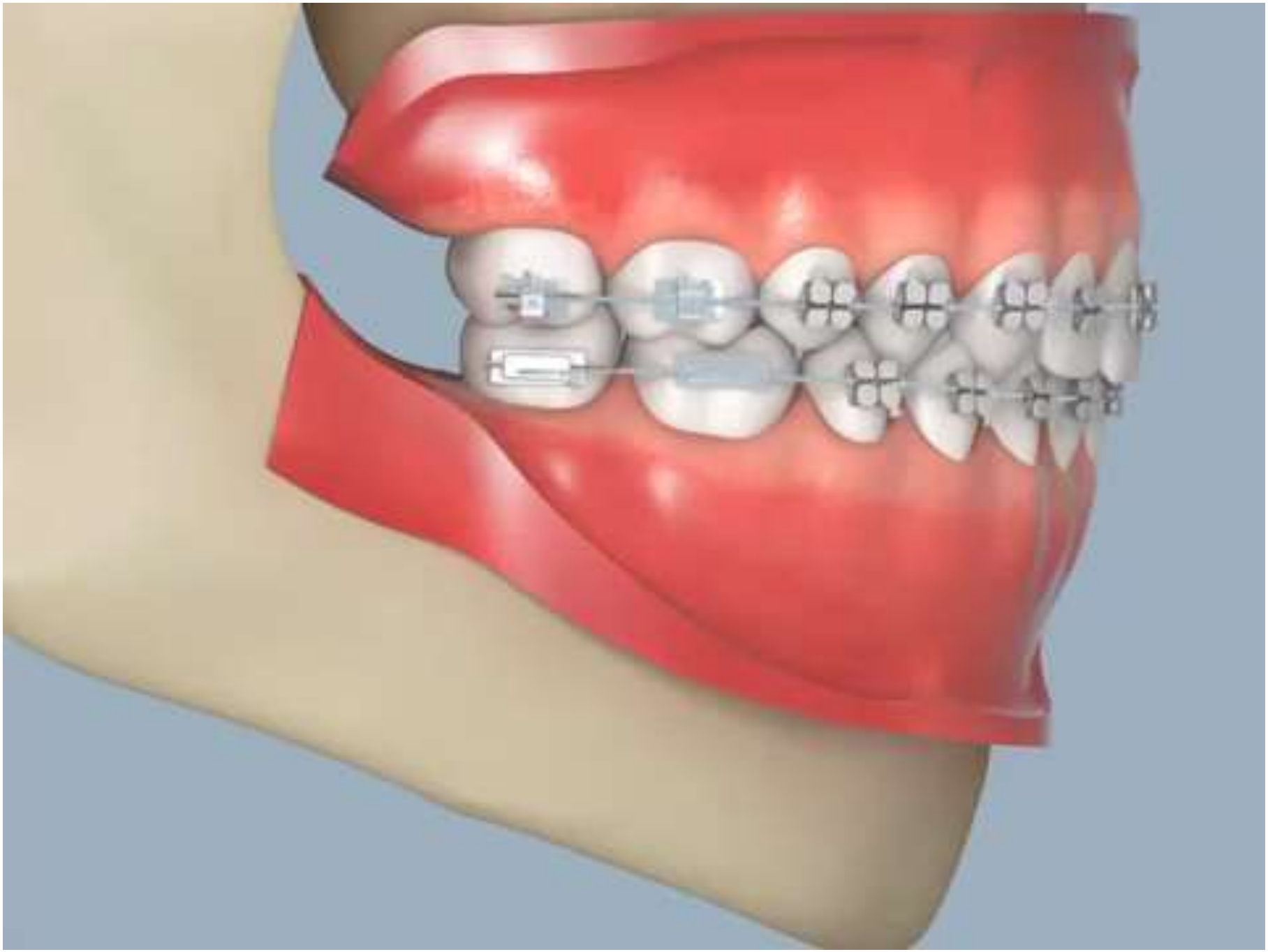




TYPES OF GENIOPLASTIES







HORIZONTAL OSTEOTOMY WITH ADVANCEMENT

Incision halfway between the depth of the vestibule extended upto canine B/L

Reflection of periosteum by keeping periosteum intact in inferior border

Maintain 5-10 mm of periosteum in the midpoint of symphysis region so that soft tissue support and blood supply are maintained

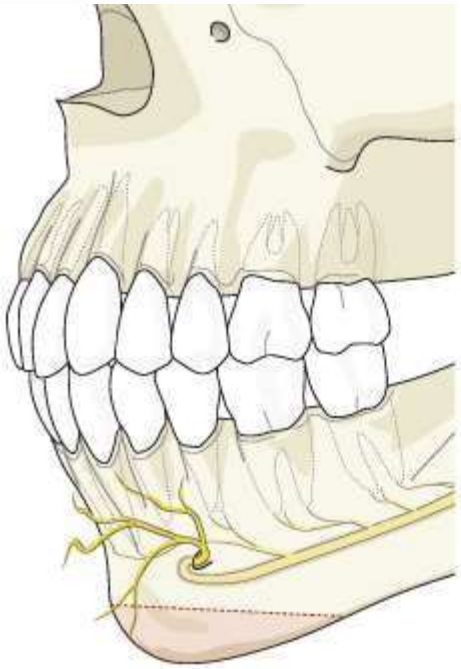
Osteotomy cut should be 5 mm below the canine tooth root and 10-15 mm above the inferior border.and 4-5 mm below lowest mental foramen

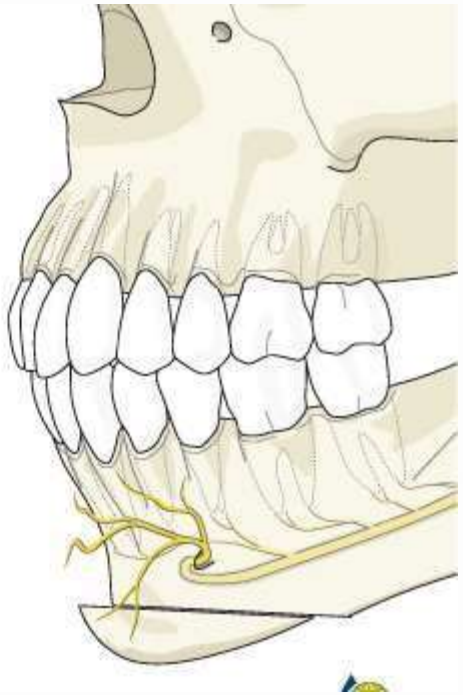
The more parallel the osteotomy cut with the occlusal plane and the mandibular plane , more easy AP movement

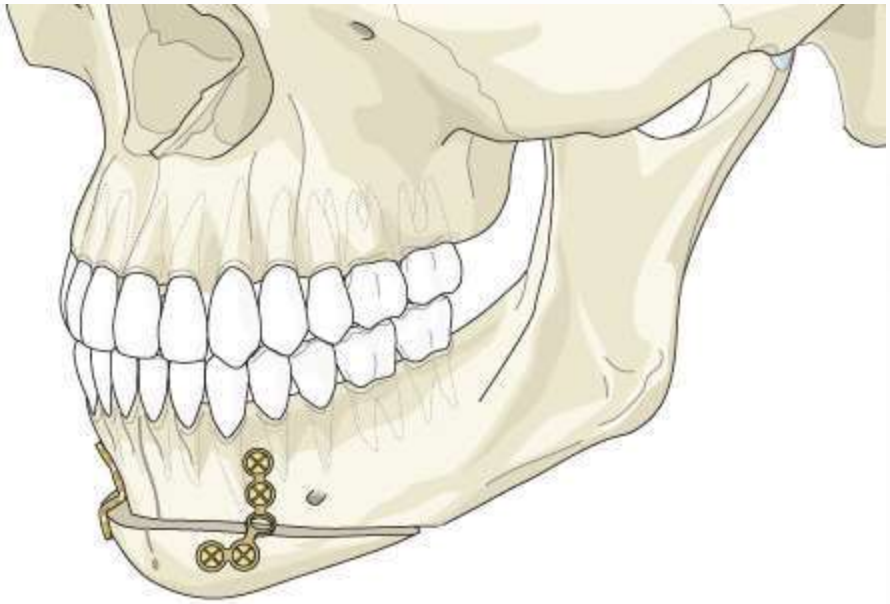
Buccal and lingual cortical cuts be complete on proximal region.- reciprocating saw

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

HORIZONTAL OSTEOTOMY WITH ADVANCEMENT







HORIZONTAL OSTEOTOMY WITH A-P REDUCTION

Same as advancement

Reduced proximal tips of mobilised segments to ensure smooth transition along inferior border and avoid palpable wings

Plus take ant vertical height of mandible into consideration

TENON TECHNIQUE

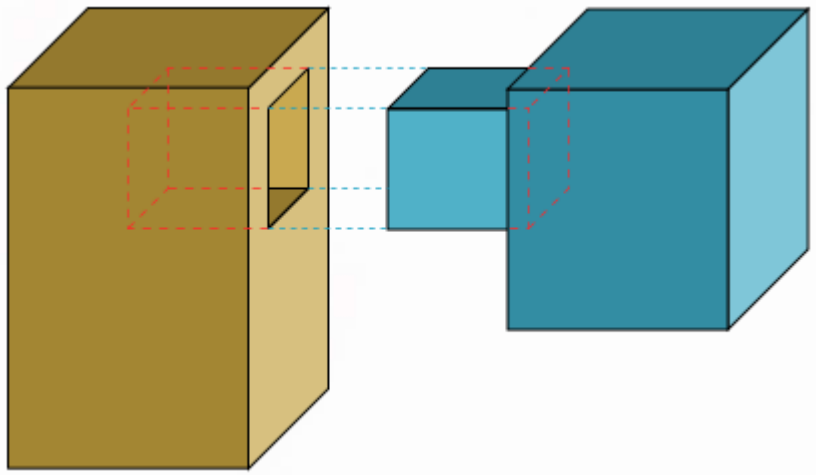
Michelet 1974

Adv-

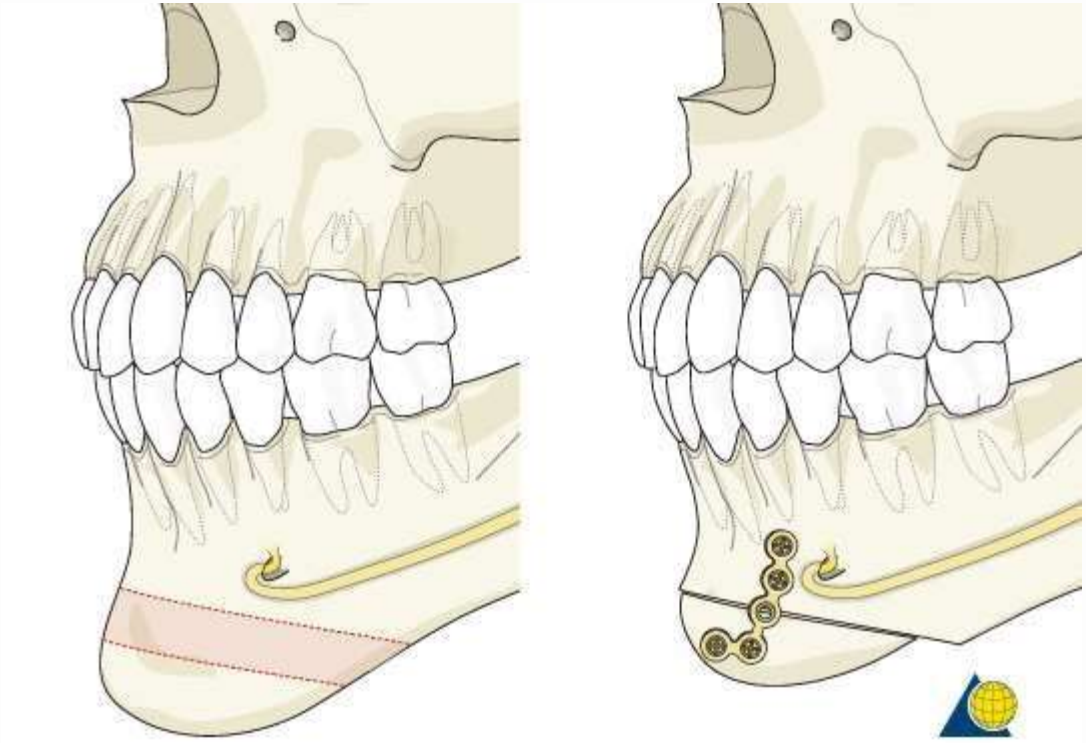
Symmetry is ensured by tenon and visual inspection of proximal extention

Single lag screw required

Disadvantage- amount of advancement is limited by oerall thickness of ant mandible.



DOUBLE SLIDING HORIZONTAL OSTEOTOMY



Wedge vertical reduction osteotomy allows for anteroposterior repositioning in addition to vertical shortening

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

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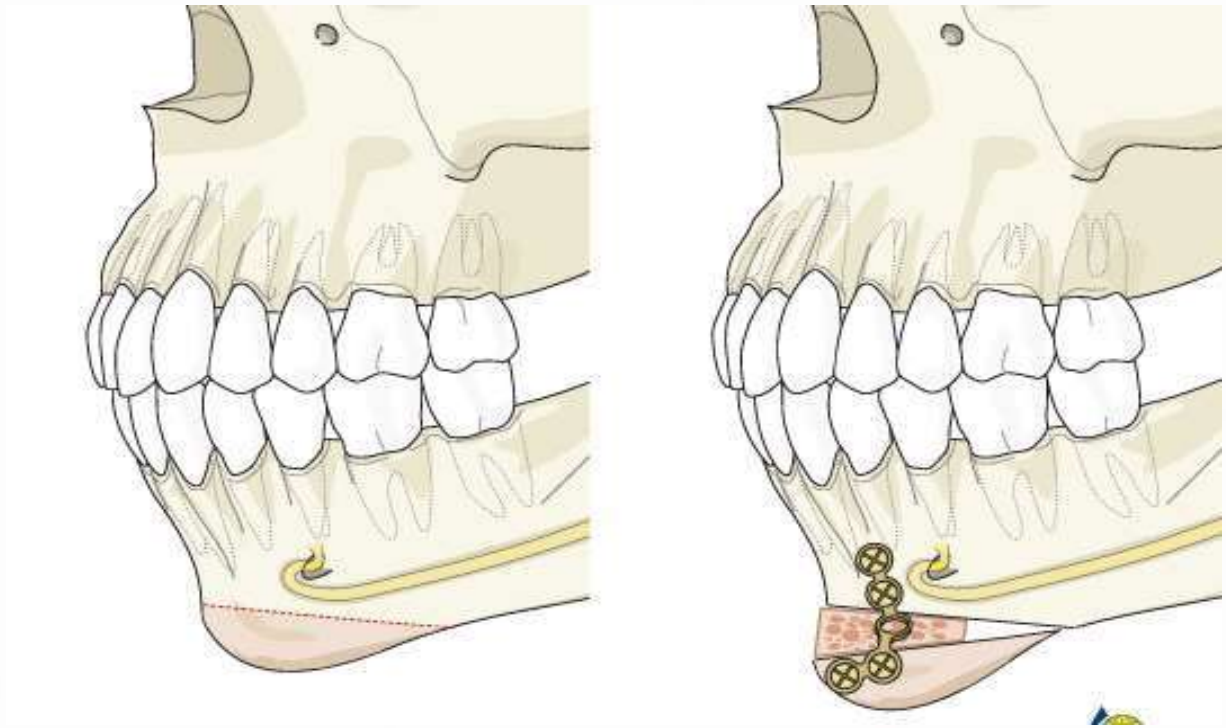
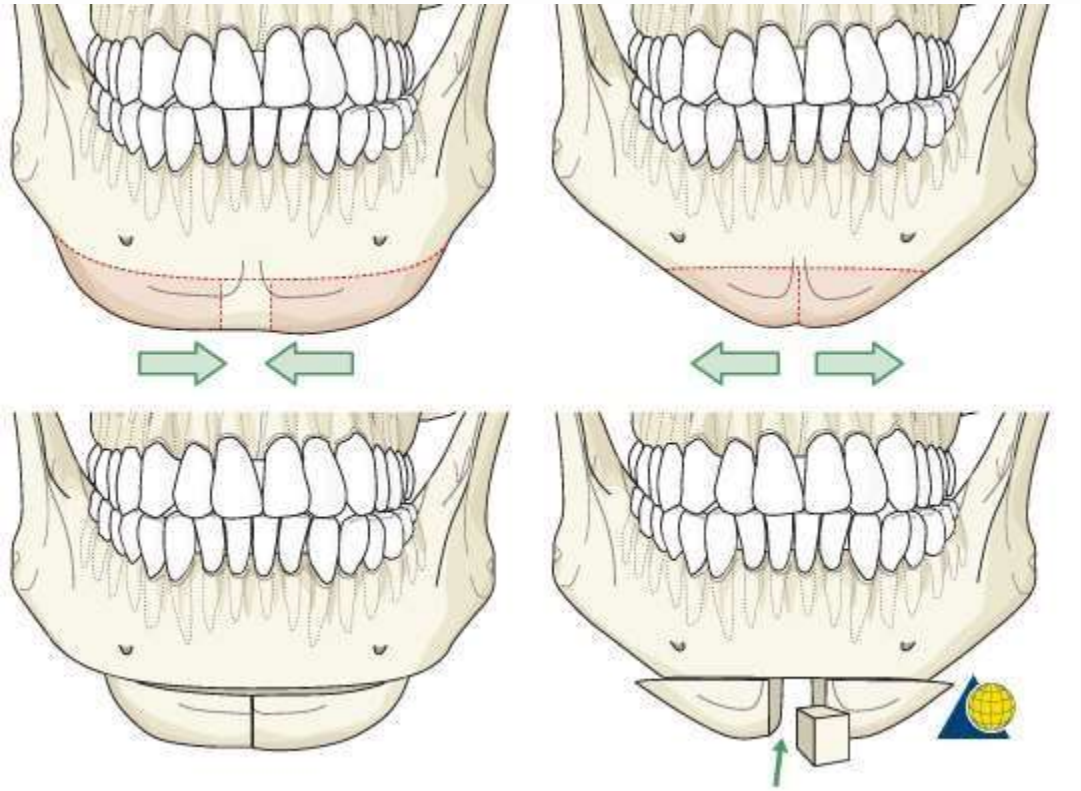


Downward movements are associated with gap formation.
This gap needs to be filled with either autogenous bone or a bone substitute, to ensure a predictable contour

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

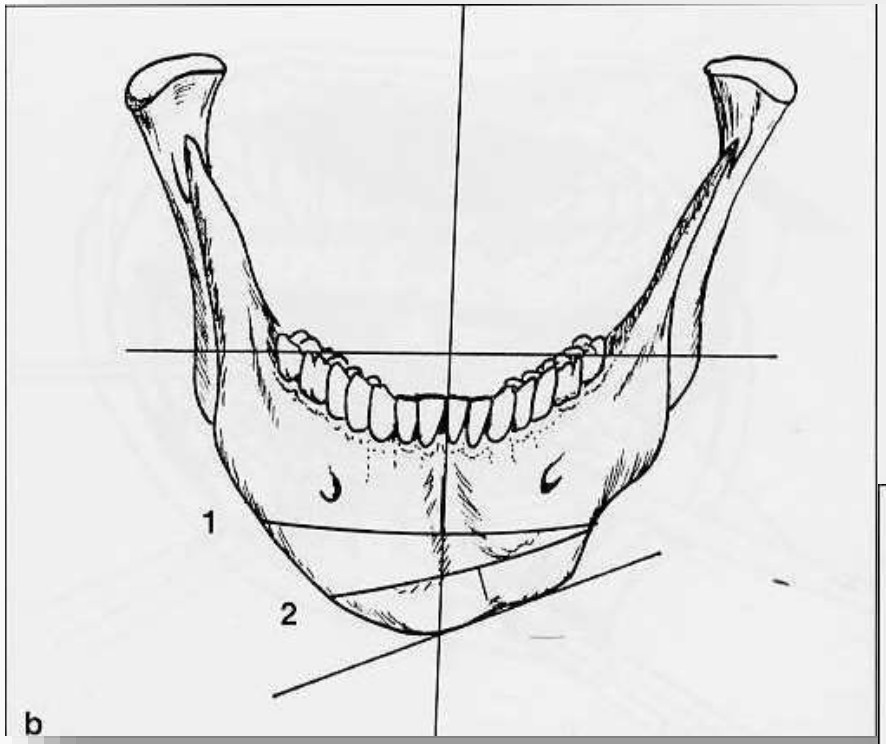
vertical osteotomies/ostectomies

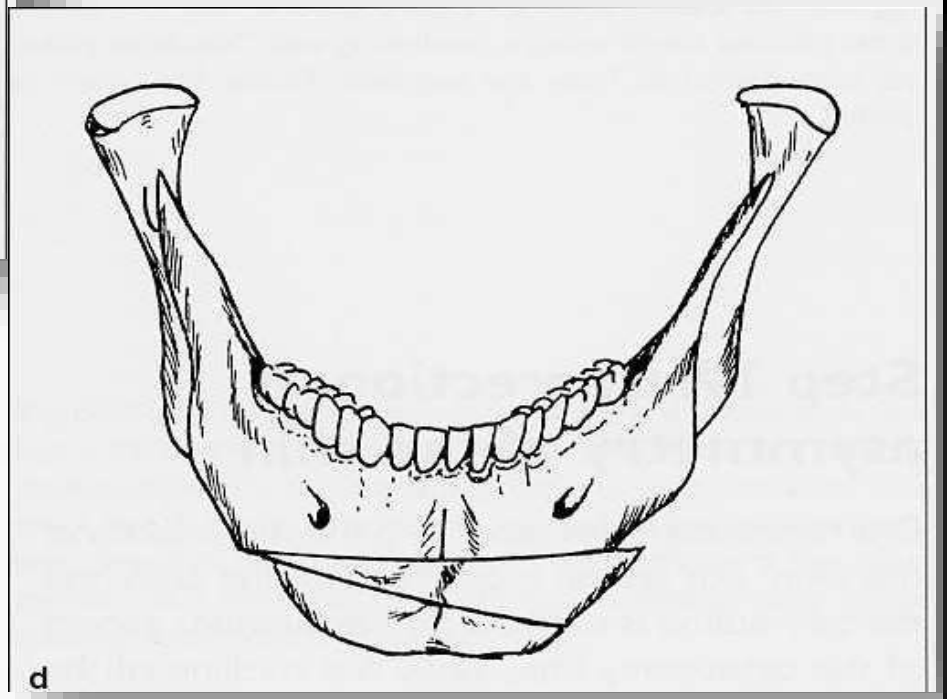


For transverse genial deformities, **vertical osteotomies/ostectomies** can also be performed.

This allows widening or narrowing of the chin. In case of widening, additional bone grafts or alloplastic implants (eg, ceramic blocks) are needed

PROPELLAR GENIOPLASTY





COMPLICATIONS

UNFAVOURABLE OSTEOTOMY

- Inadvertent # of body and ramus
- Damage to teeth roots

NERVE INJURY

Mental nerve is commonly injured

- incision, reflection and retraction, osteotomies, plating or closure

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

BLEEDING

Damage to lingual soft tissues

- Injury to genioglossus, geniohyoid muscles
- Laceration of sublingual and submental arteries

Usually not life threatening

Managed by local measures

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

POST-OPERATIVE PHASE
EARLY POST OPERATIVE COMPLICATION

Excessive swelling

Haemorrhage & Haematoma

PONV

Neurological dysfunction

Mandibular dysfunction

- Hypomobility, reduction in bite force, TMJ dysfunction

Relapse

- Genioplasty
  - Neurological dysfunction
  - Chin asymmetry
  - Uneven mentalis muscle contraction
  - Chin ptosis

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

LATE POST-OPERATIVE COMPLICATIONS

- Long term neurological dysfunction
- TMJ dysfunction
- Dental and periodontal problems

Fonseca RJ, Marciani RD. Oral and Maxillofacial Surgery: Orthognathic surgery, esthetic surgery, cleft and craniofacial surgery. Turvey TA, editor. Saunders; 2009.

CONCLUSION

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THANK YOU….