

SLEEP SURGERY | CADAVER DISSECTION MANUAL

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# FOREWORD



Sleep apnoea surgery has come a long way from the early days of tracheotomy and first-generation uvulopalatopharyngoplasty. Contemporary surgical treatment for sleep apnoea takes an anatomically directed and functionally based approach to maximize effect and minimize morbidity. This Sleep Surgery Cadaver Dissection Manual beautifully depicts several contemporary sleep surgery techniques with clear photographs of each step and labels of key structures. This Manual is a wonderful resource itself for both new and experienced sleep surgeons, and it is a perfect complement to hands-on learning in a cadaver course on contemporary sleep surgery.

**EDWARD M WEAVER**

Professor  
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I am very pleased to endorse the development of this manual, for a dissection based approach to the anatomy of modern variations utilised in airway reconstruction surgery. Development of dissection manuals targeting surgical specialties will be significant in the maturation of the academic and clinical development profiles of our University of Wollongong anatomy group and of The Wollongong Hospital as the central teaching and training hospital of the ISLHD. This manual is particularly significant in that it has arisen principally from the efforts of one of our Illawarra ENT/Head and Neck surgeons, committed to provision of leading edge clinical service and development of advanced medicine and surgery methodology appropriate to a university hospital based surgical service.

**NOEL TAIT**

MBBS(Hons), MEd, FRACS(Gen) General Surgeon / Professor of Surgery  
University of Wollongong

With thanks to Niall Jefferson, Marco Raftopoulos,  
Murray Thompson, Arj Ananda

*This manual is dedicated to my wife and children, for their patience and support, and to the late, great Sam Robinson for his teaching.*

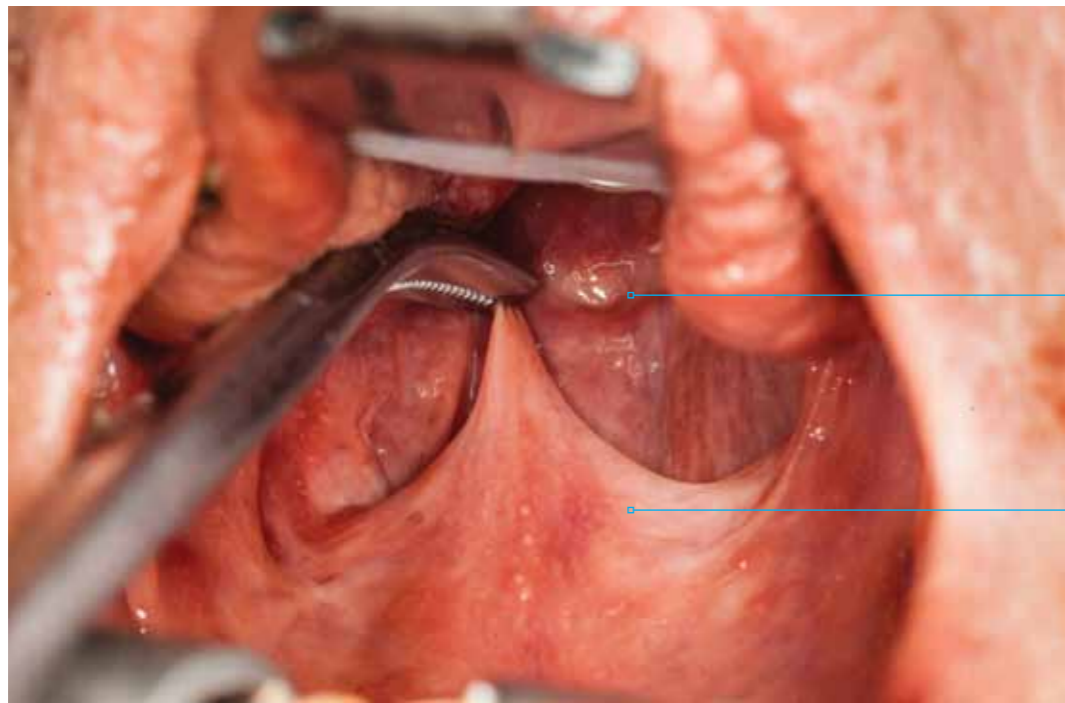
**STUART MACKAY**

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# BILATERAL TONSILLECTOMY & MODIFIED UPPP



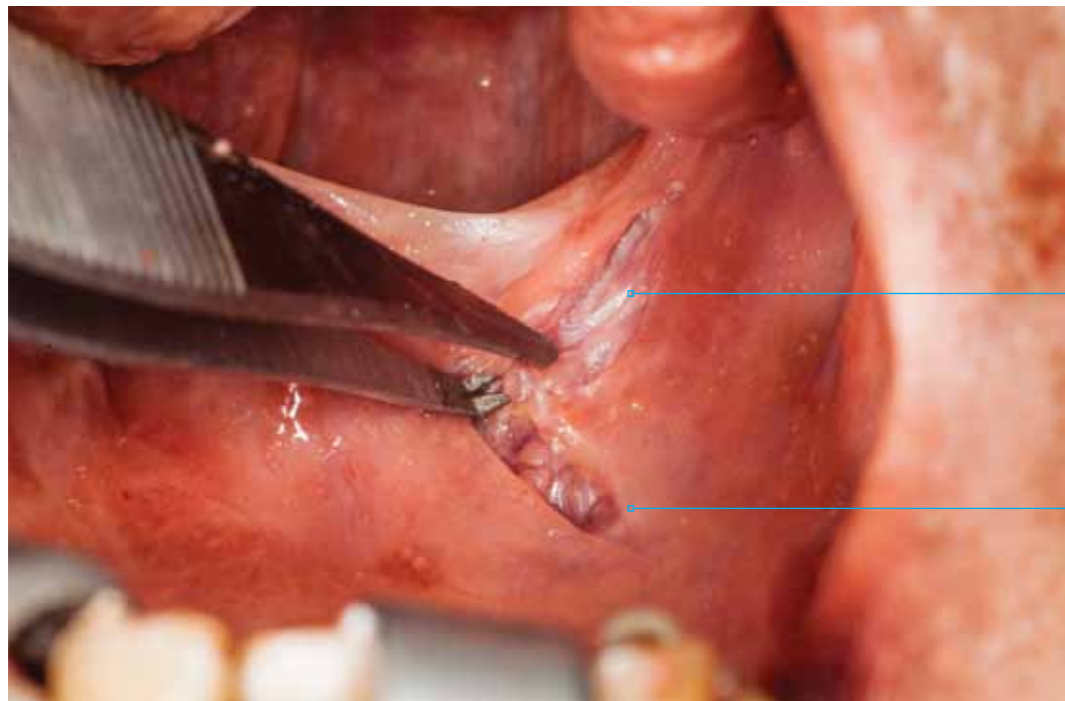
posterior pharyngeal wall

junction between posterior pillar and uvula

Caudal traction on the uvula towards the contralateral (left) foot



The triangular flap of mucosa is elevated to display the supratonsillar fat



lower limb of flap

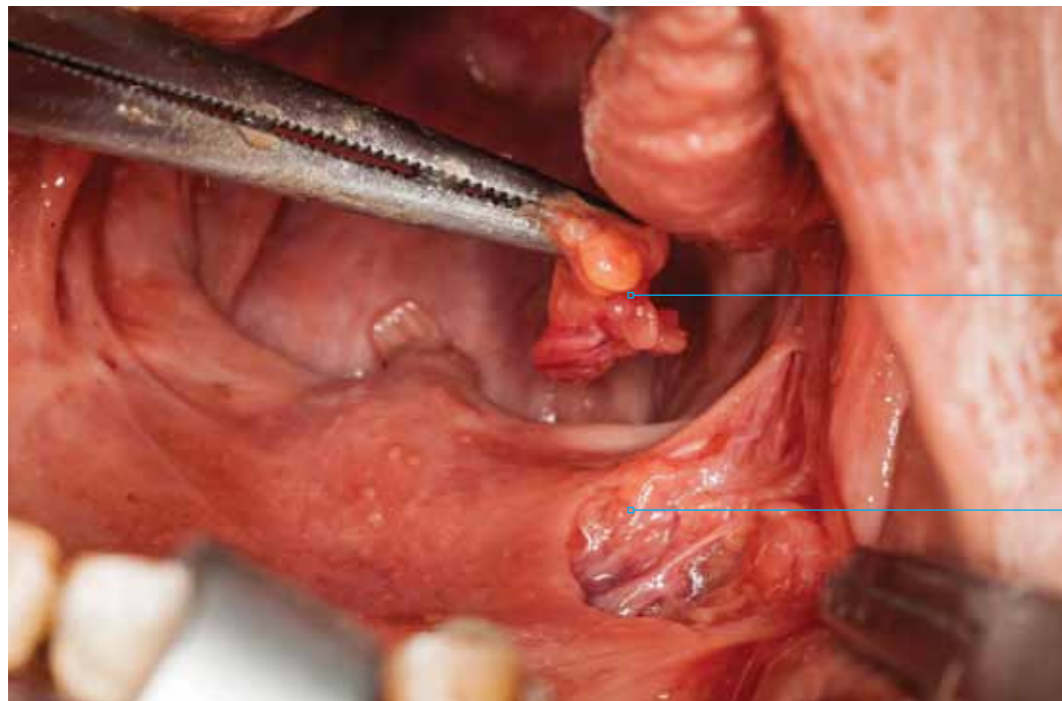
upper limb of flap

Whilst maintaining the caudal traction a triangular flap of mucosa is elevated  
 The upper limb of the triangle angles towards the maxillary tuberosity  
 The lower limb follows the line of the anterior pillar



The supratonsillar fat is grasped with toothed forceps

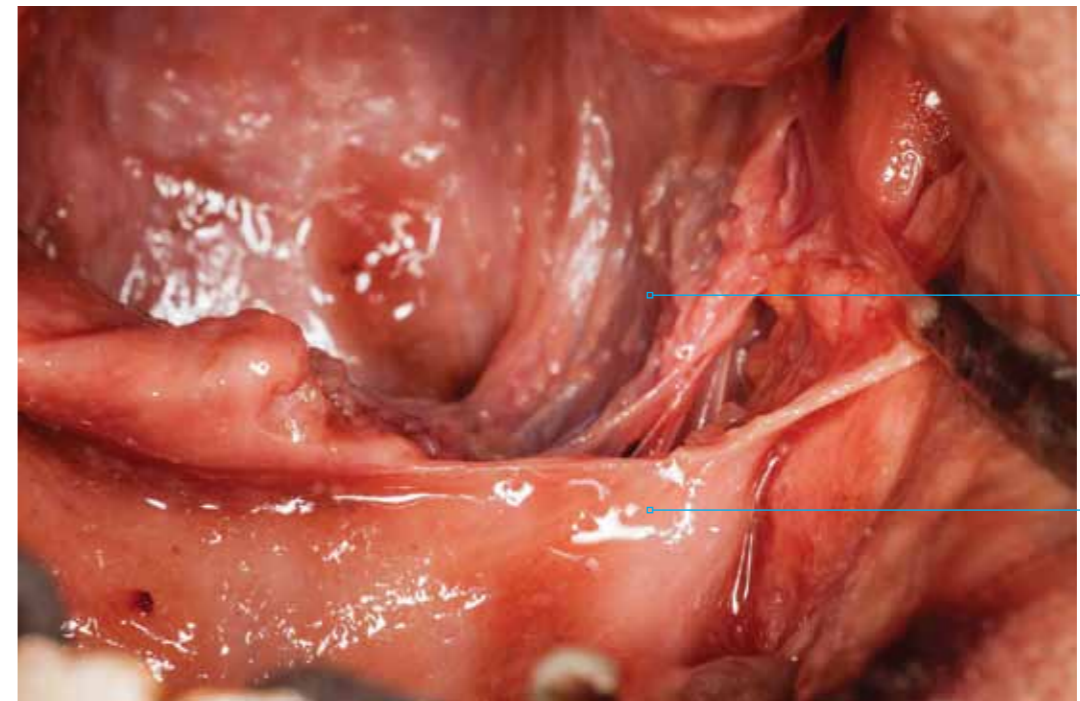




Supratonsillar fat

Arching muscle fibres

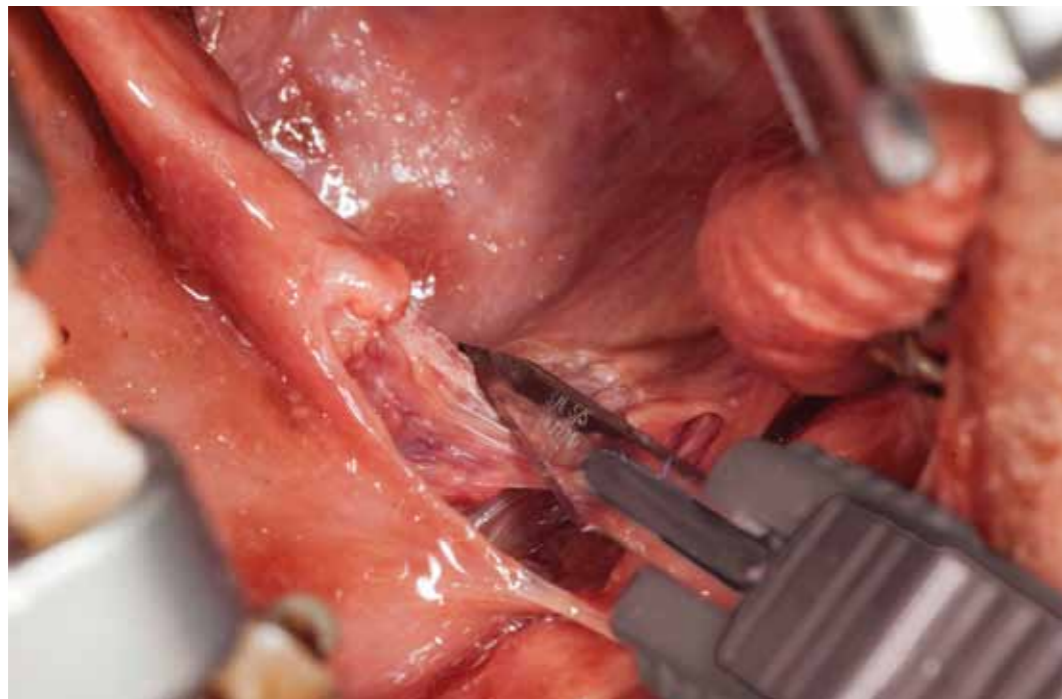
The supratonsillar fat is removed from the underlying arching muscular fibres



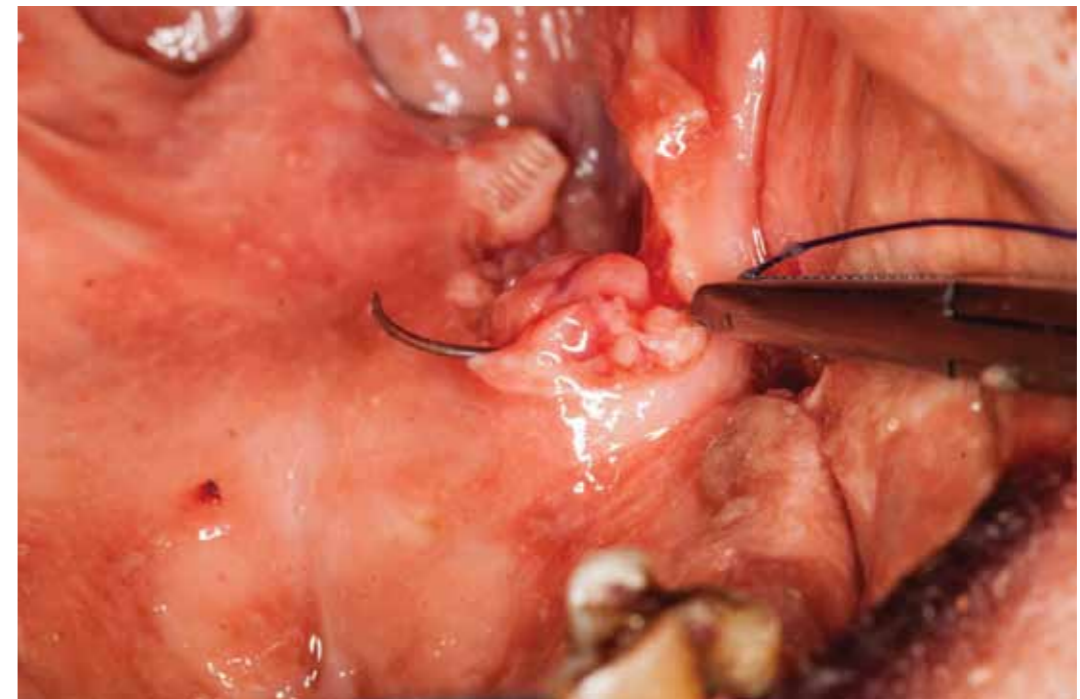
posterior pillar muscle fibres

soft palate

The completed division of the posterior tonsillar pillar is shown

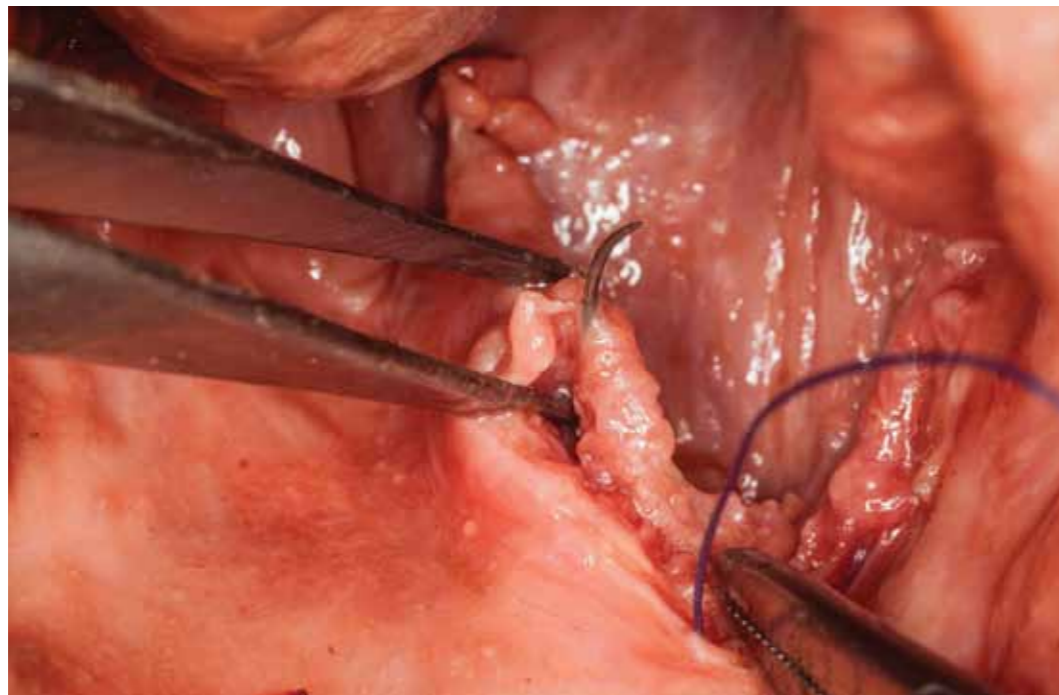


The posterior pillar mucosa and muscle is divided at the junction of the upper third and lower two thirds



A 3-0 vicryl suture is passed with a large bite through the upper arching muscle fibres

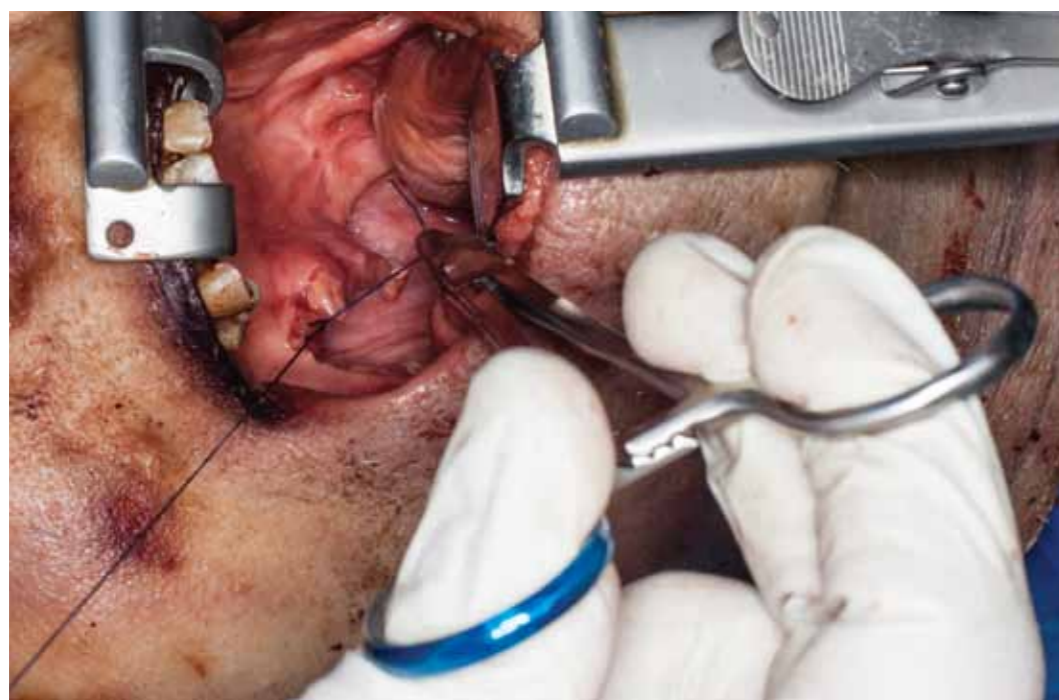




The suture is then passed through the muscle of the upper third of the divided posterior pillar tissue



After muscle apposition is achieved the mucosal flaps are closed to reduce post operative pain

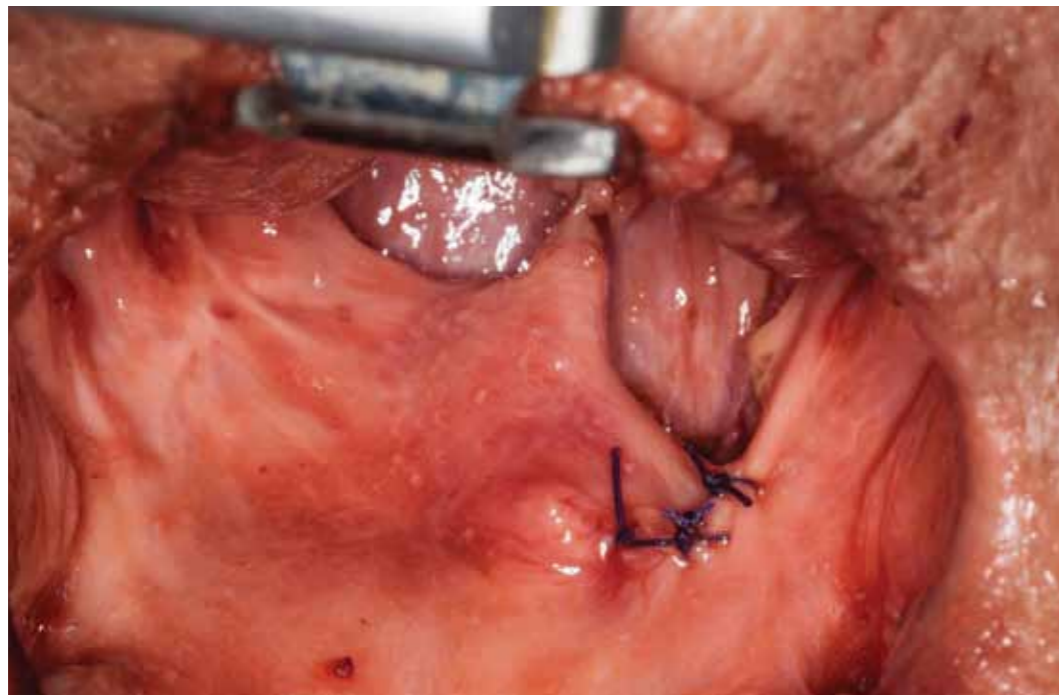


The needle holder is grasped in the orientation shown in order to secure the knot of the suture

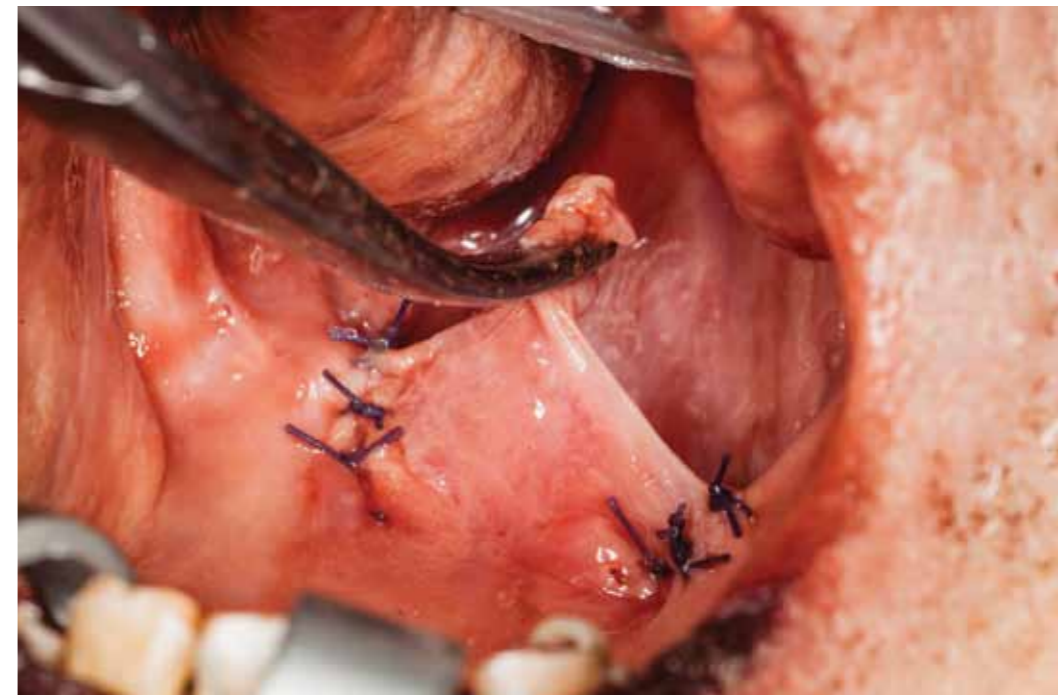


The mucosa may be closed in a pseudo z-plasty configuration

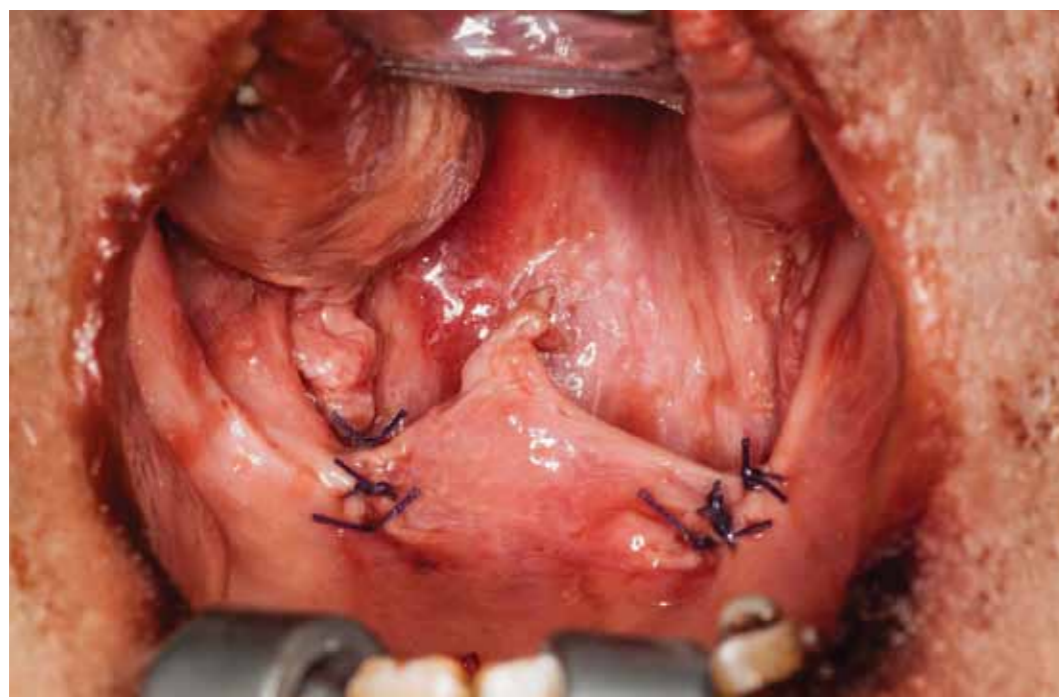




The right hemi-operation is complete

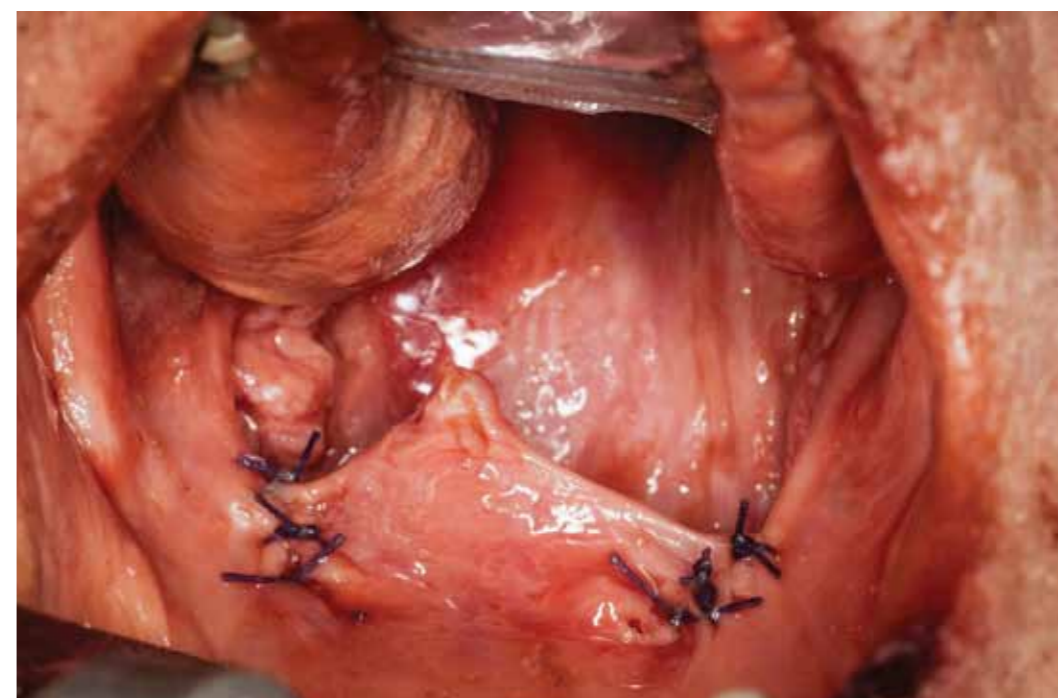


A small neo-uvula is fashioned in a beveled plane, leaving a slightly greater amount of the posterior uvula mucosa



The same steps are repeated on the left

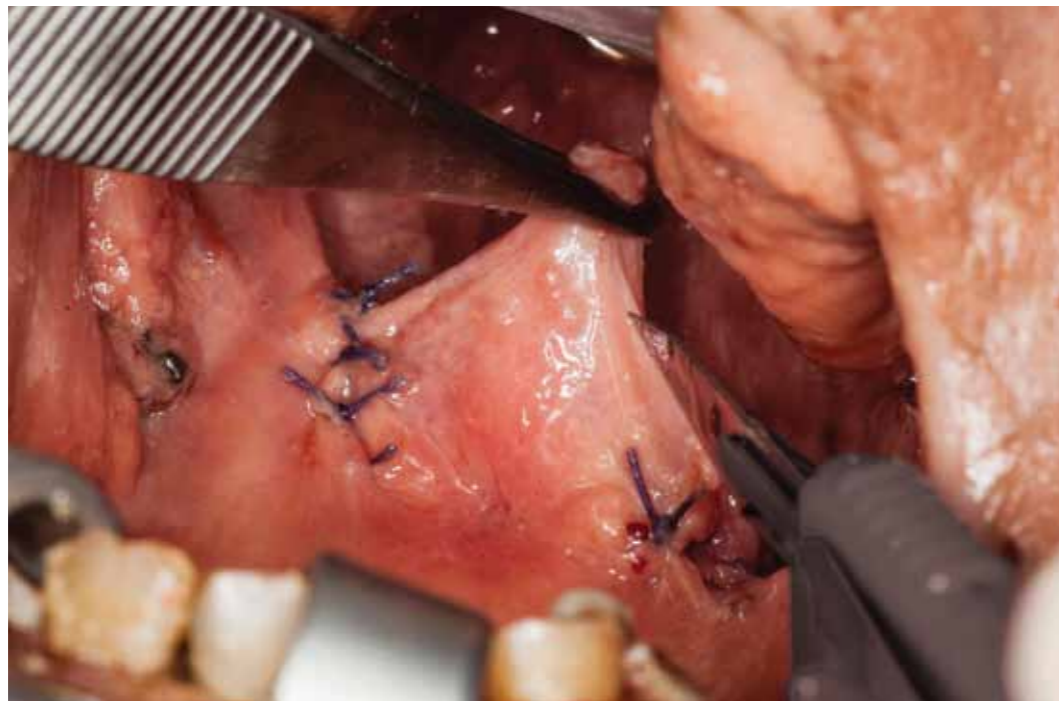
Superolateral velopharyngeal port openings, as well as increased anterior posterior dimension are achieved



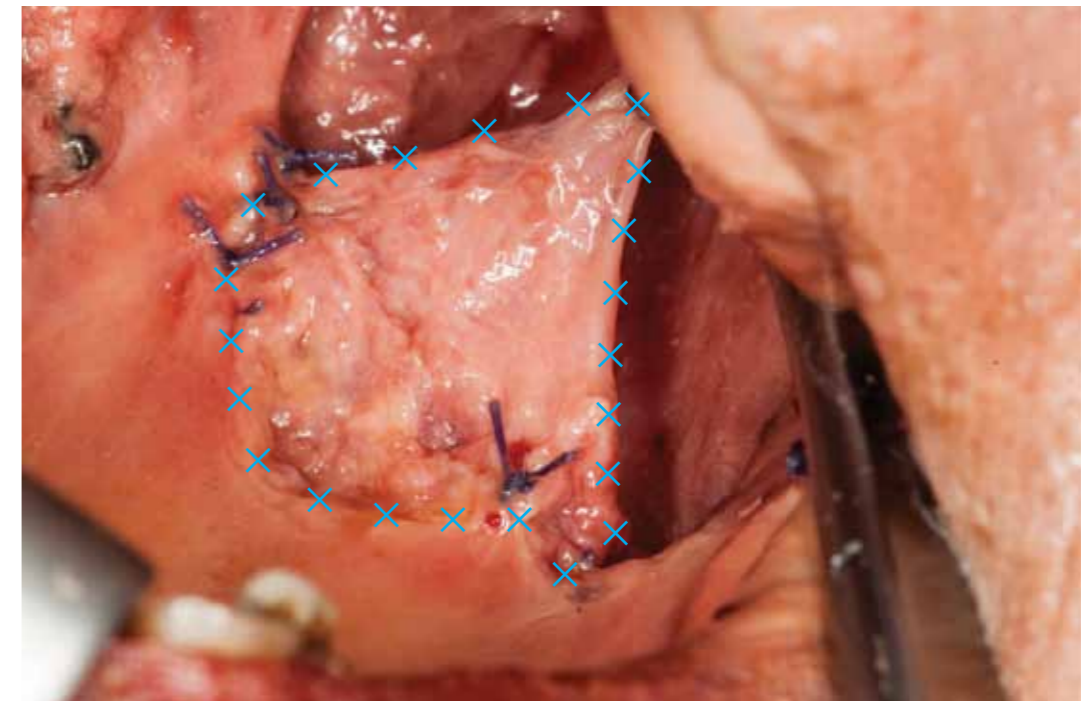
The completed operative view is shown



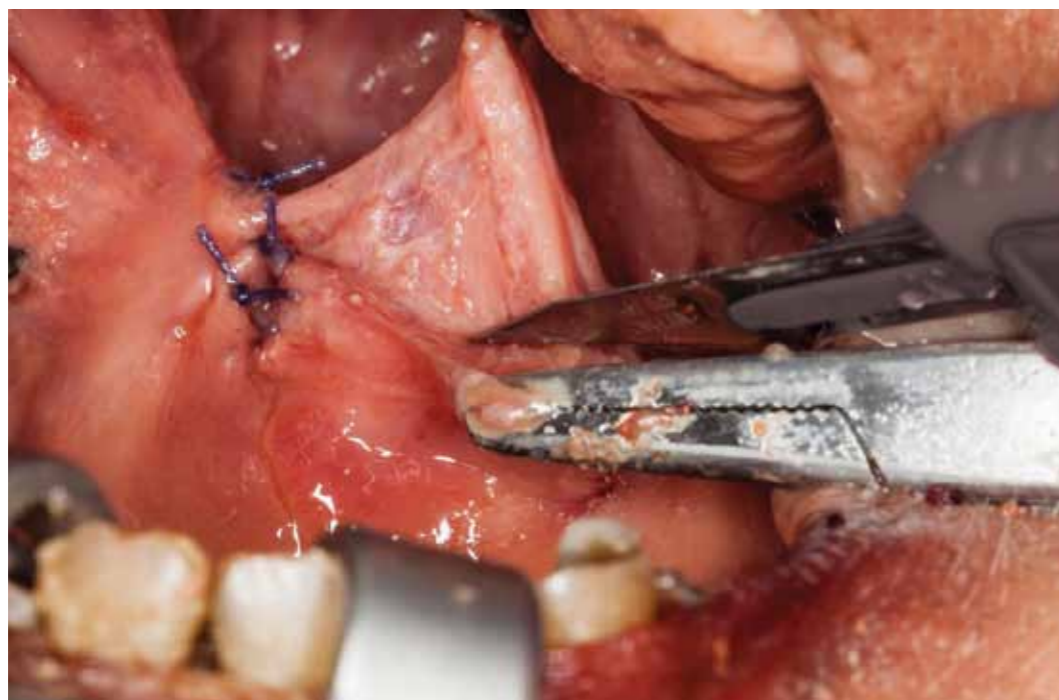
## UVULOPALATAL FLAP



In the instance of the neo uvula being projected too far anteriorly, the uvulopalatal flap becomes an option



The demucosalised surfaces are outlined in crosses

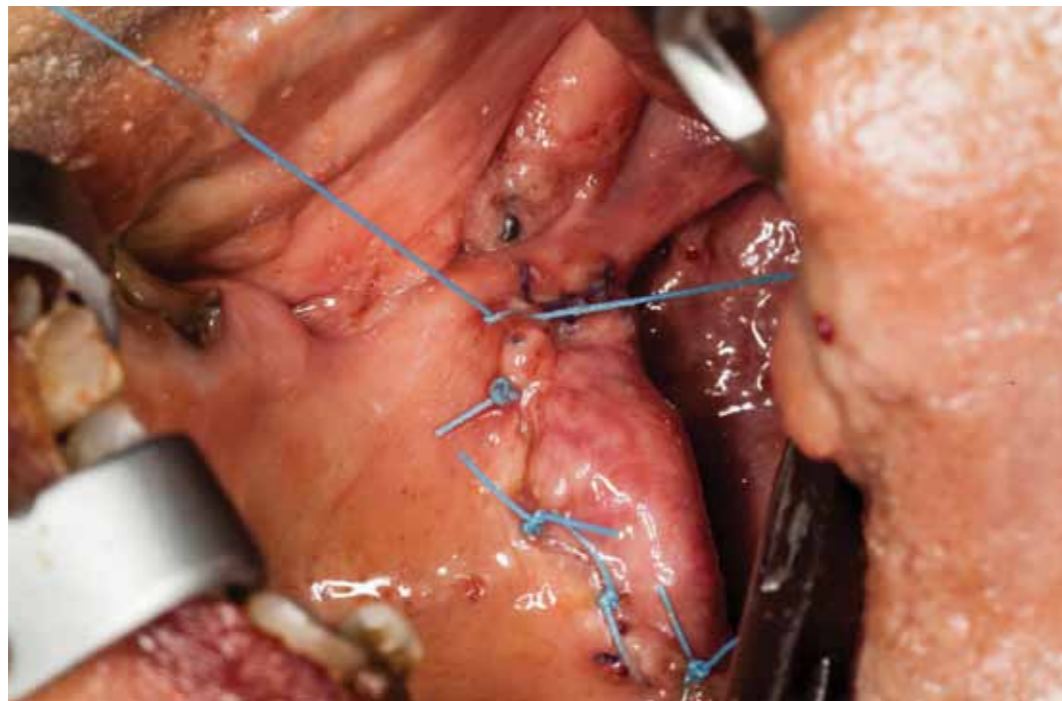


Two diametrically opposed flaps are 'de-mucosalised'



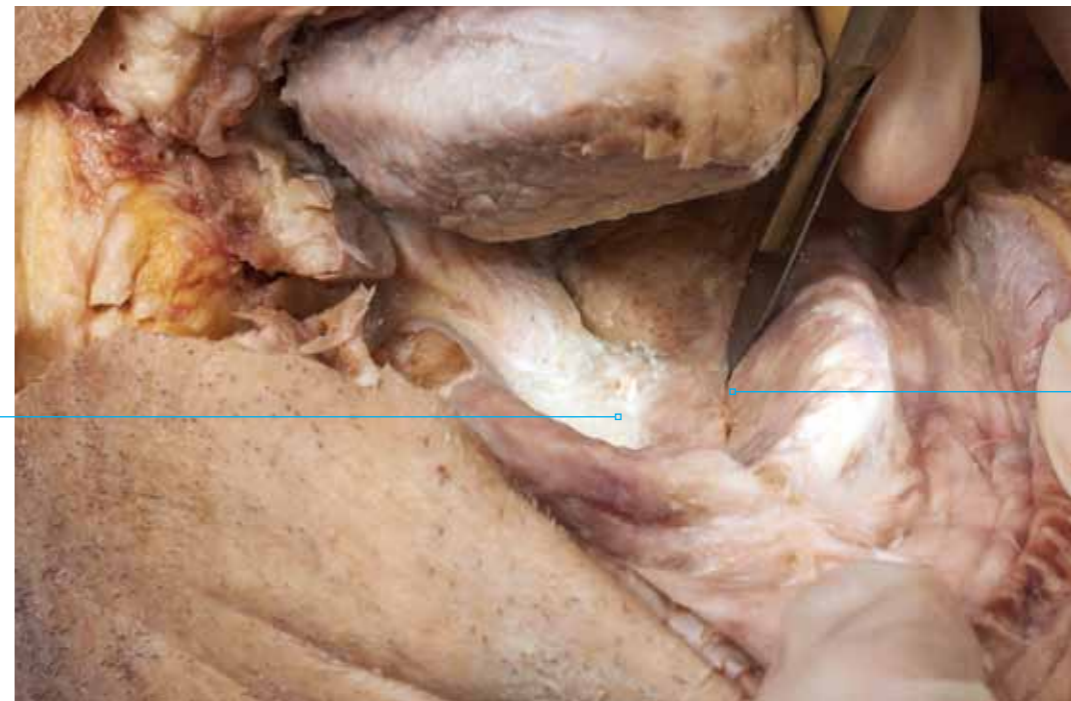
The inferior demucosalised surface is opposed to the superior surface





The flaps are sutured in place with 3-0 vicryl  
 In the event of a breakdown of the modified UPPP or significant post operative globus,  
 the uvulopalatal flap becomes a valid option

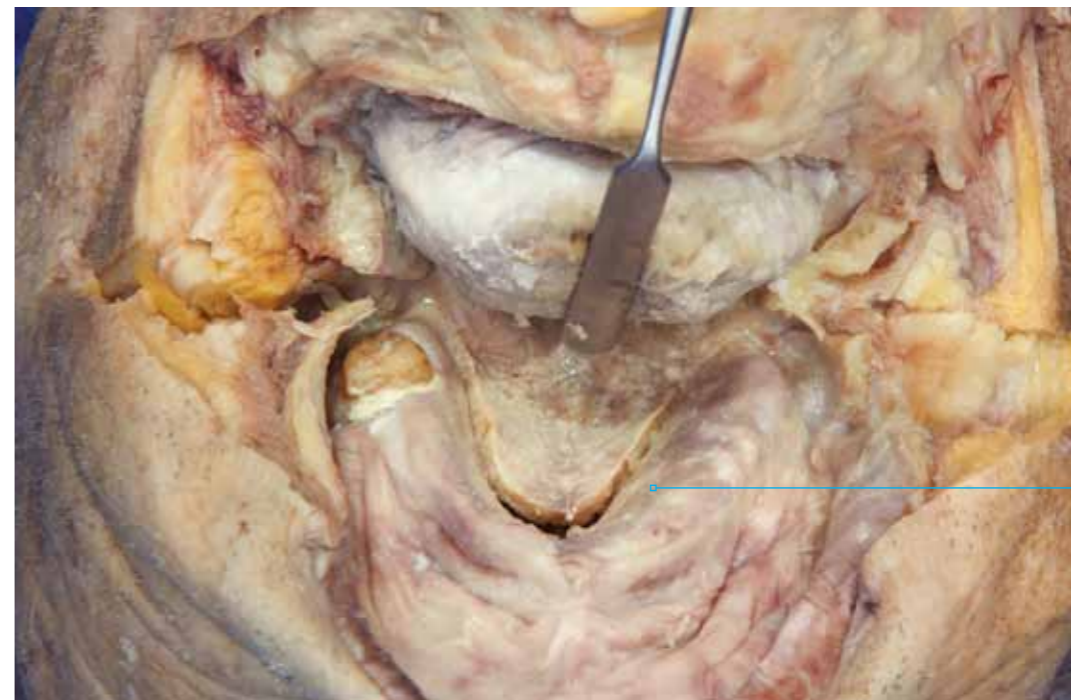
## PALATAL ADVANCEMENT



Central hard  
 palate

Right limb of  
 gothic arch  
 incision3

A gothic arch (or propeller) incision is performed with bovie diathermy  
 This is carried medial and posterior to the greater palatine foramen flaring laterally to the  
 hamulus



completed  
 gothic arch  
 incision

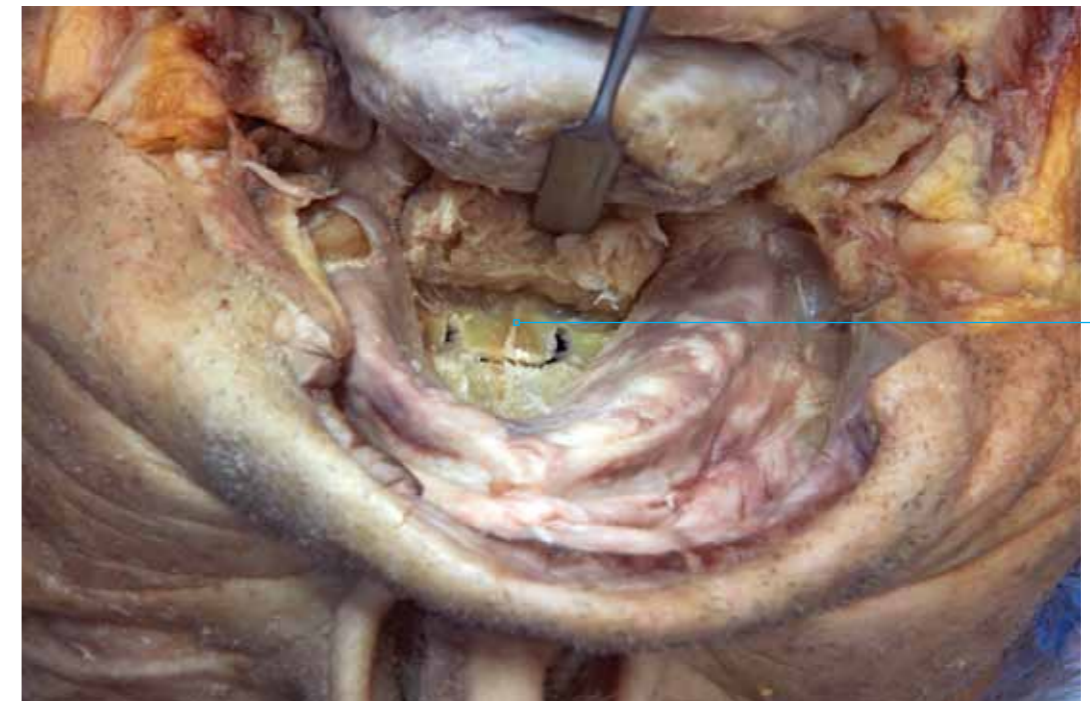




The flap is elevated off the bone with a periosteal elevator  
It is important to stay hard on the bone at this point to preserve the integrity of the flap



The flap is carried back until 1cm of the palatine aponeurosis is exposed



Bony Island

A fisher burr is used to create a 2cm width by 3-7mm length bony island  
This remains attached to the palatine aponeurosis in the midline  
In the operative setting care must be taken to avoid damaging the nasotracheal tube

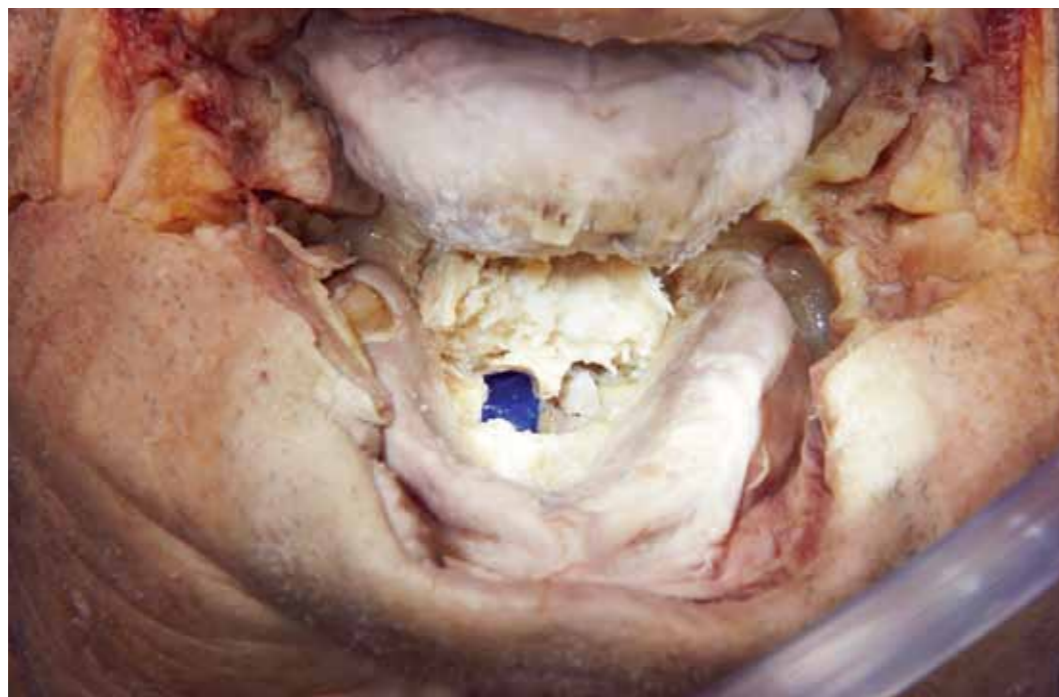


The bony island is sharply dissected off the posterior nasal septal (vomere) attachment  
At this point it is common to note some bleeding from the septal mucosa





Further freeing of the bony island is carried out



In this picture blue colouration is utilised to identify the anticipated position of the nasotracheal tube, in this instance in the left nasal airway



tensor  
tendon

Exposure of the tensor veli palatini tendon is carried out laterally, by dissecting off overlying mucosa and soft tissue on each side

Minor vessels are often encountered in the fat and soft tissue. These are dealt with by bipolar cautery

The tensor veli palatini tendon is then divided



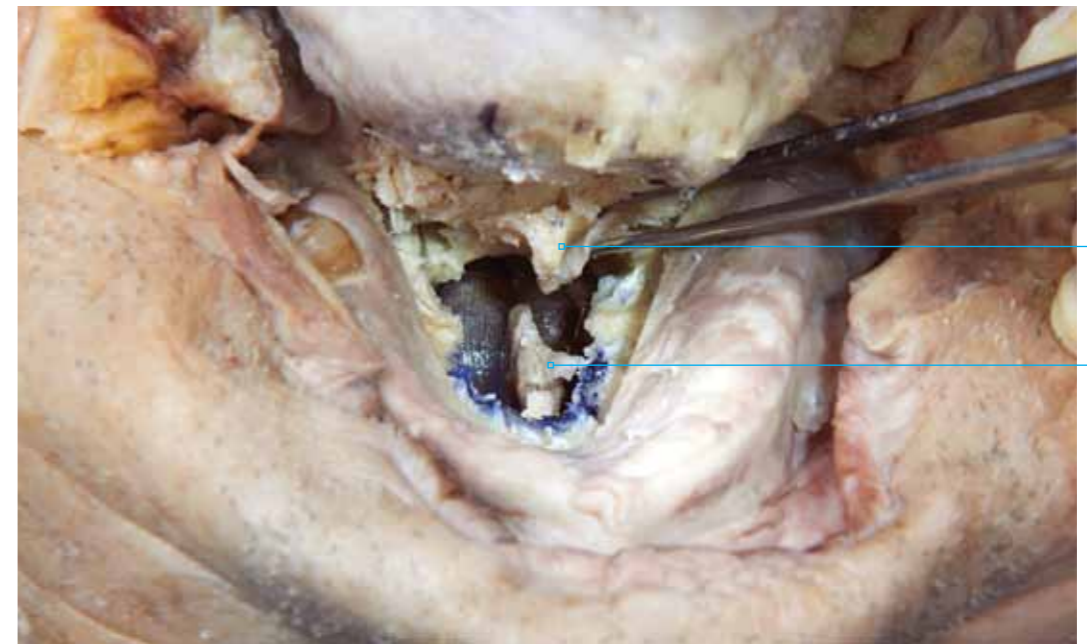
Fascial attachments lying medially and anteriorly are divided in order to increase mobility of the bony island and free edge of the palate

BT Woodson has described these fibers' as the 'prelevator fascia'





A curved obwegeser or bent Woodson's elevator is utilised to raise the mucosa off the nasal side of the hard palate over a short length of about 1 cm



bony island

nasal septum



The bone is then removed using a bony punch such as a Kerrisons  
It is important to preserve the nasal mucosa where possible

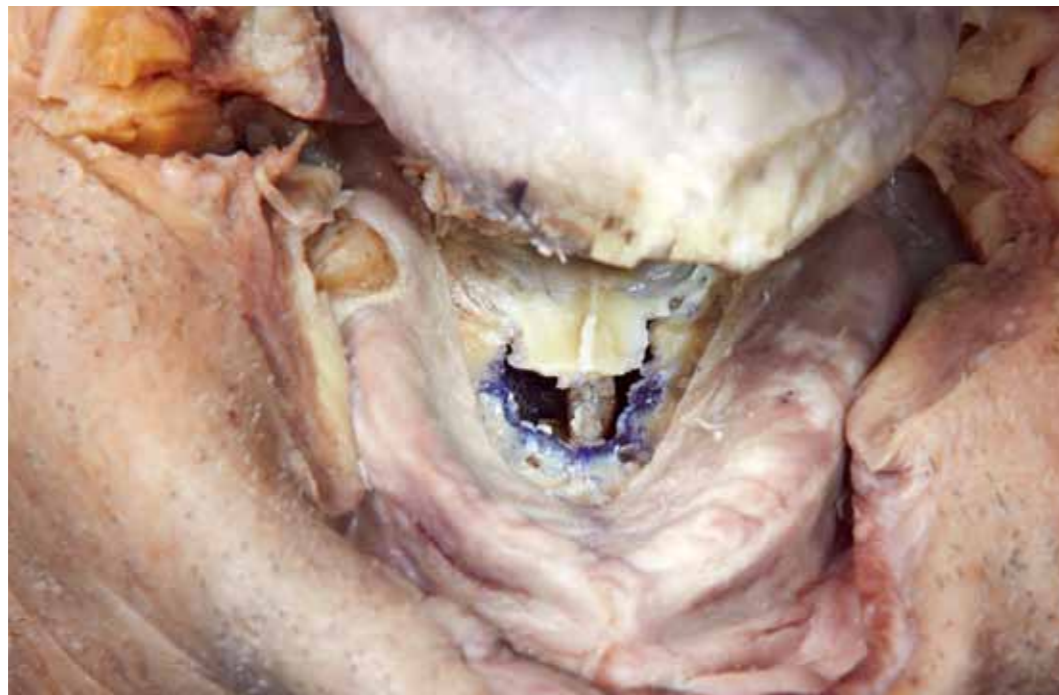


bony island

bone to be removed

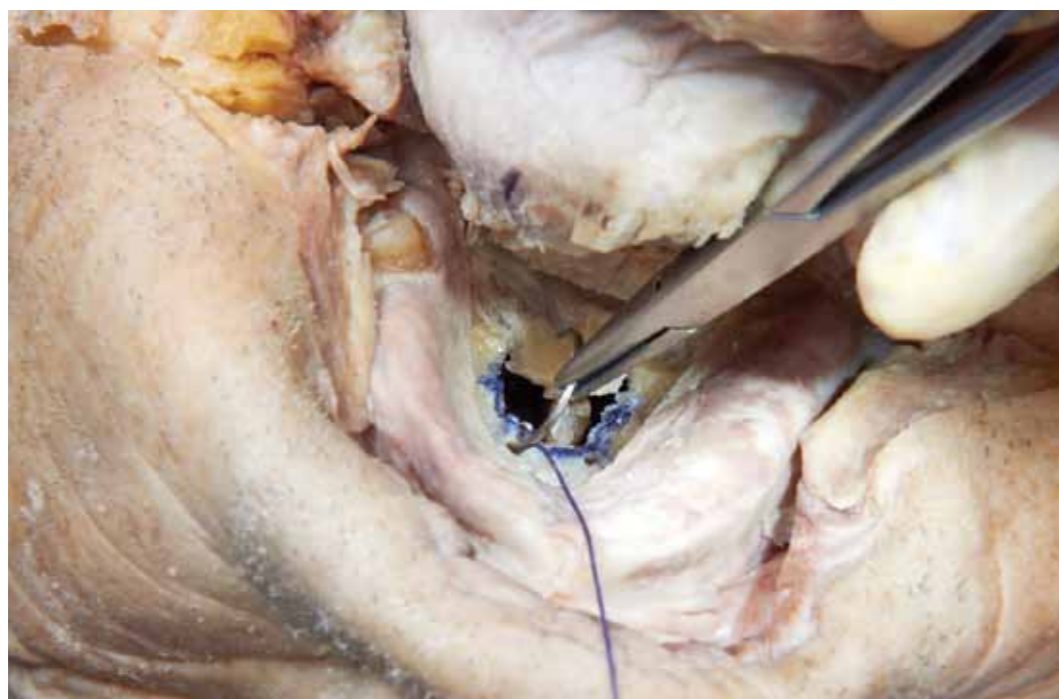
The required bony removal is mapped out and usually ranges from a minimum of 0.5cm to a maximum of 2cm



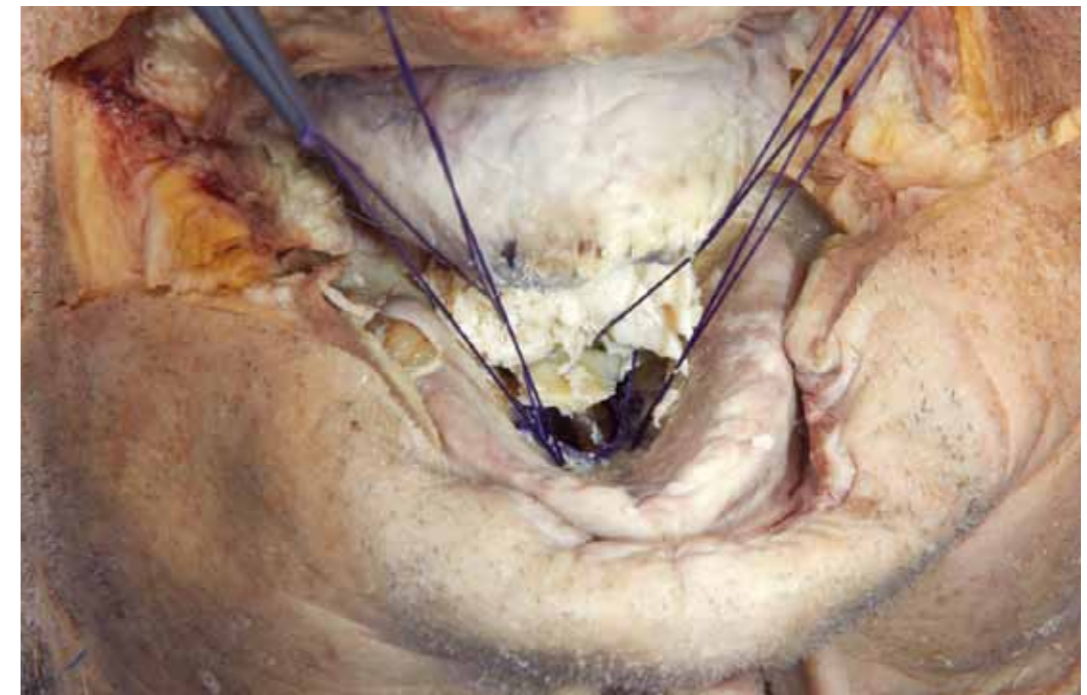


Two holes the width of the fisher burr are created just anterior to the limit of the resected bone

Ensure the underlying mucosa and nasal structures are protected by using a right angled instrument to act as a boundary for the burr



An 0 vicryl on a 5/8th needle is passed retrogradely through the drill hole and around the bony island



This suture is repeated around the lateral soft tissue and musculature (i.e. two sutures on each side, total of four sutures)



The knots are secured using the surgeon's dominant hand or the Negus knot pusher





The palatal soft tissue flap is sutured in place with 2-0 vicryl on a 5/8th needle, starting posteriorly and working anteriorly

Submucosal fat and mucosa from the tip of the flap is trimmed judiciously to inset the closure



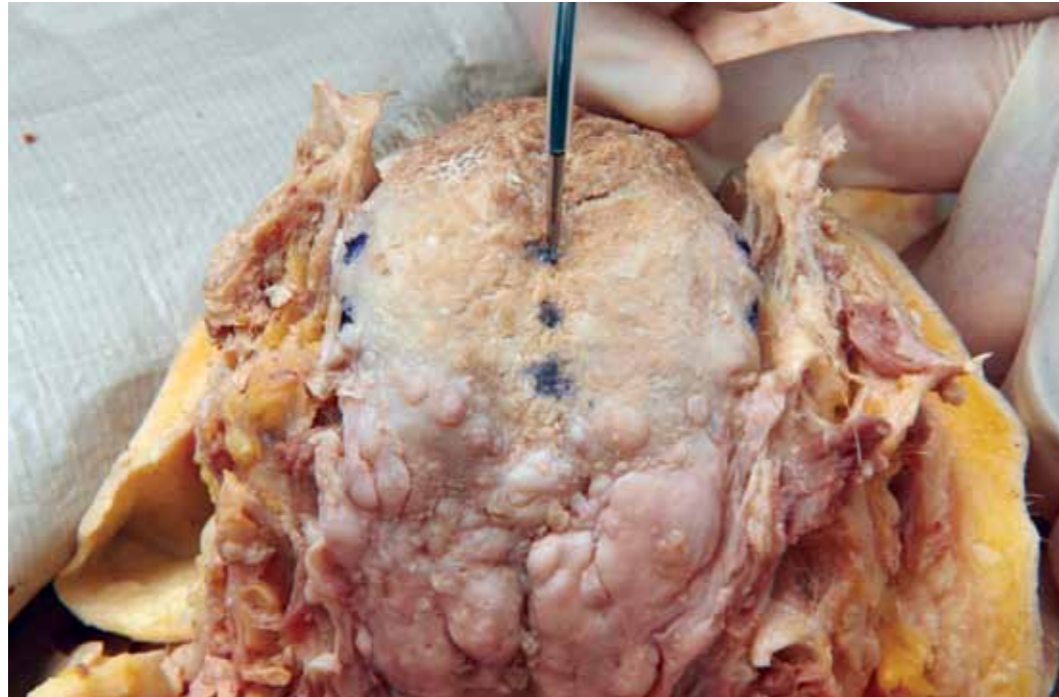
Radiofrequency systems can be utilised to perform low morbidity reduction of macroglossia

In this instance we are utilising a ReFlex Ultra® SP coblation wand which has a distal ablative electrode and a proximal thermal electrode. This provides the dual therapy that results in both immediate and sustained tissue reduction

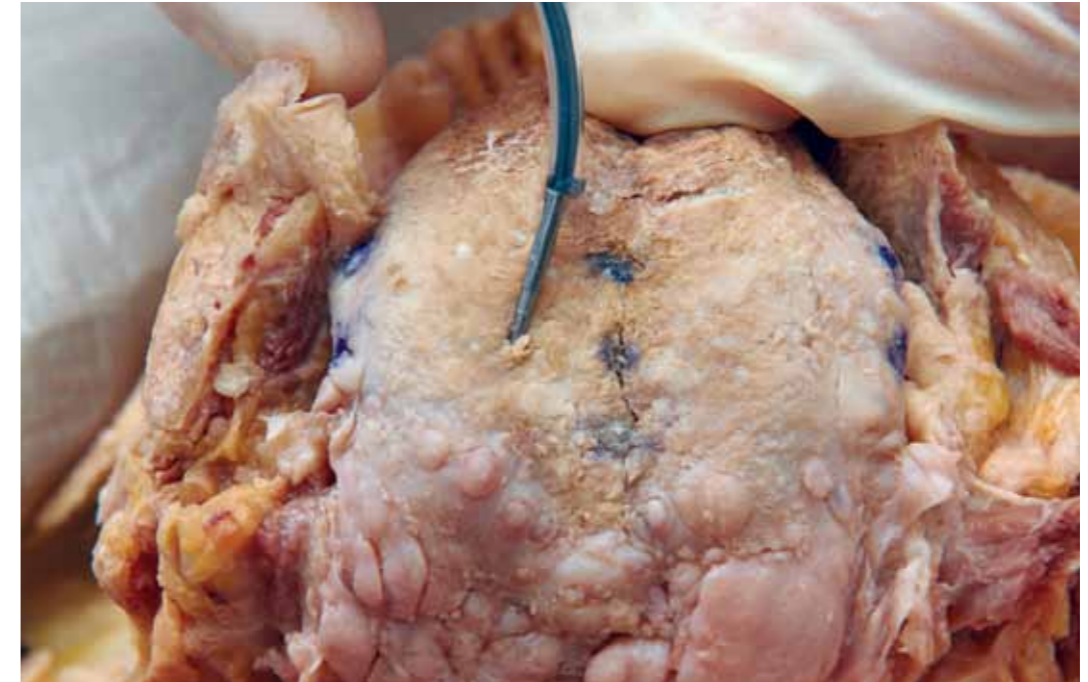


The probe can be passed into seven or nine anatomically safe channels preserving the integrity of the major neurovascular bundles



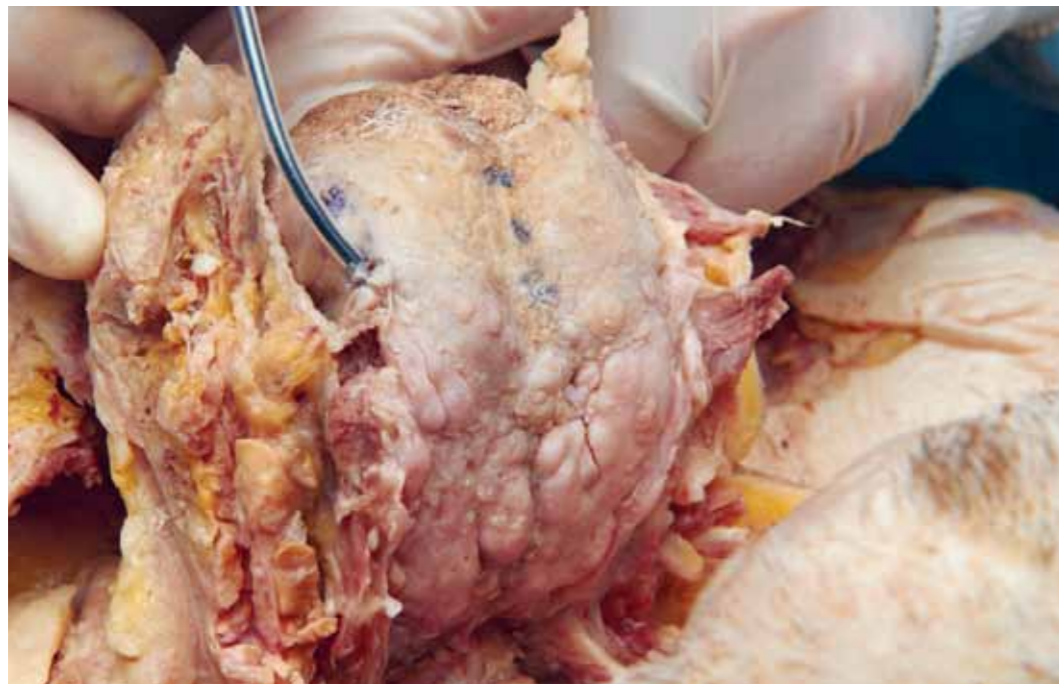


The first three channels should be in the midline, directing the probe posteriorly on an angle, starting from no closer than 3cm from the tip of the tongue and ending no closer than 0.5cm from the most anterior part of the circumvallate papillae



Two additional channels may be carried out by passing the probe midway between the midline and lateral tongue orientating the probe towards the postero-lateral tongue

Ensure delivery is performed superficially so as to preserve the integrity of the neurovascular bundle



Two lateral channels on each side are performed introducing the probe at the junction of the dorsal and lateral tongue mucosa

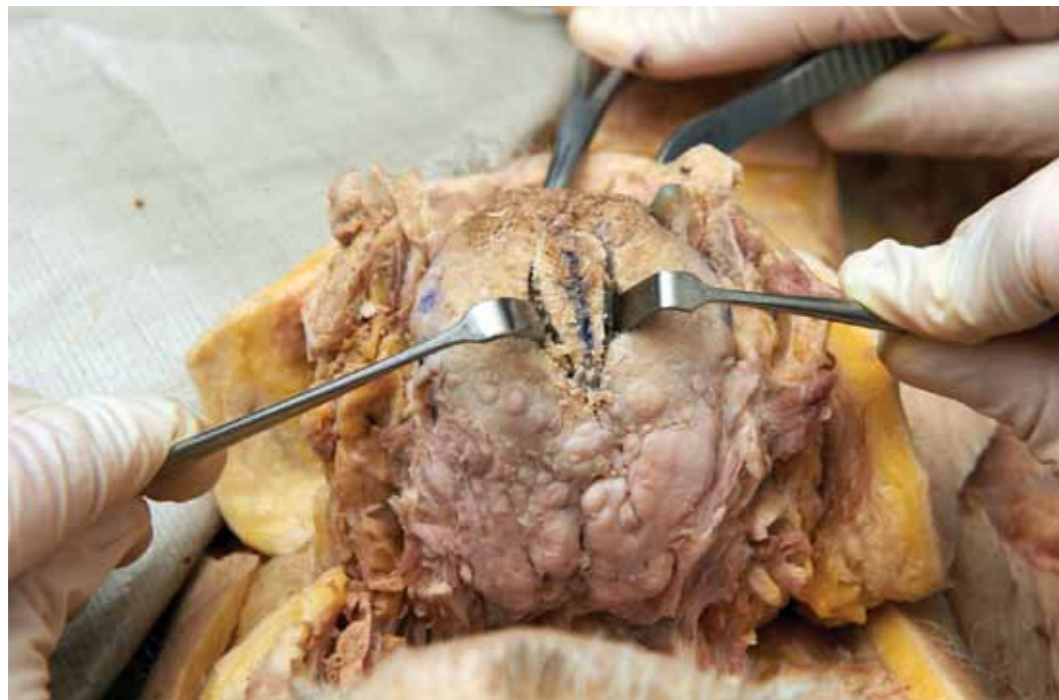
The probe is orientated towards the circumvallate papillae without angulation cranially or caudally



## MIDLINE GLOSSECTOMY



A midline glossectomy can be performed as a prelude to comprehensive combined lateral dissection (submucosal lingualplasty) OR with limited combined lateral dissection (cobLAMO)

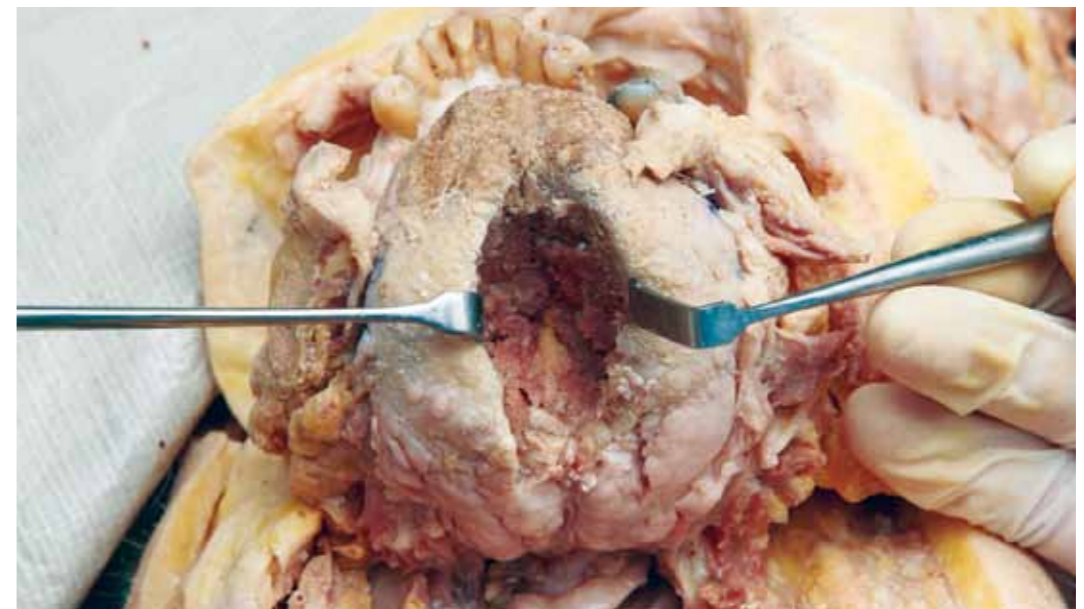


Dissection spans from the junction of the anterior and middle 1/3 of the tongue to the circumvallate papillae (anteroposterior), 0.5cm either side of the midline (mediolateral) and (initially) to the depth of the midline raphe



Options for dissection include: – Needle point diathermy – Coblation with Evac\* 70 Xtra HP – Harmonic focus wand – Argon coagulator

Harmonic focus results in limited stimulation of tongue musculature



After removal of the initial mucosal specimen, further stay sutures can be inserted in the operative setting to retract the lateral tissue, and deliver the posterior tissue

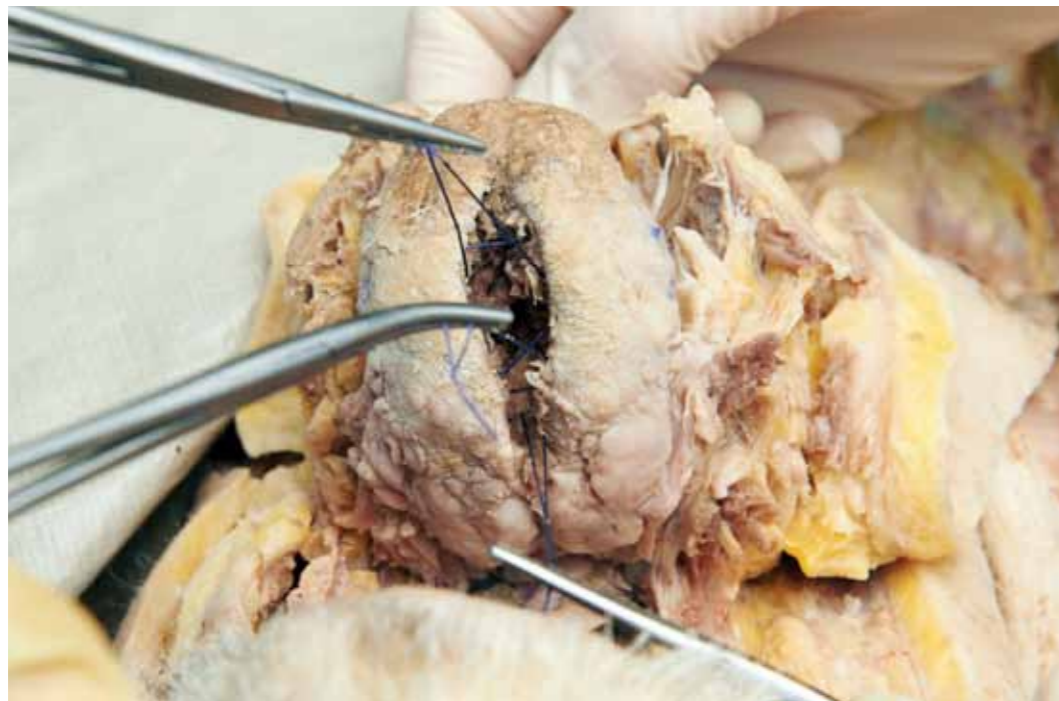
The latter allows further base of tongue dissection via the midline opening

Submucosal midline dissection can continue until the surgeon's palpating finger can feel the epiglottis through the mucosa of the base of tongue

During the dissection, venous bleeding can be dealt with by bipolar devices or the Harmonic focus

Arterial bleeders in the midline are rare but should be liga-clipped

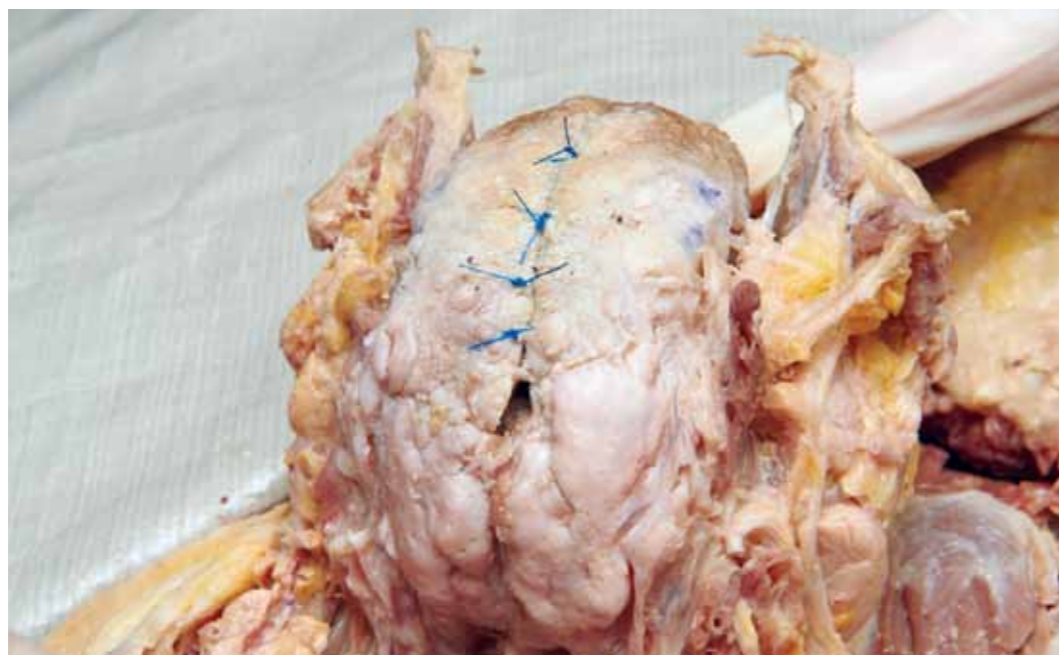




A combination of 0 and 2-0 vicryl or biosyn is used to close dead space and mucosa to decrease post operative pain and achieve optimal contouring of the tongue



Longest tooth root measurements are obtained from the preoperative CT mandible



A small drainage hole can be left posteriorly

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When as a part of cobLAMO, no drain is required

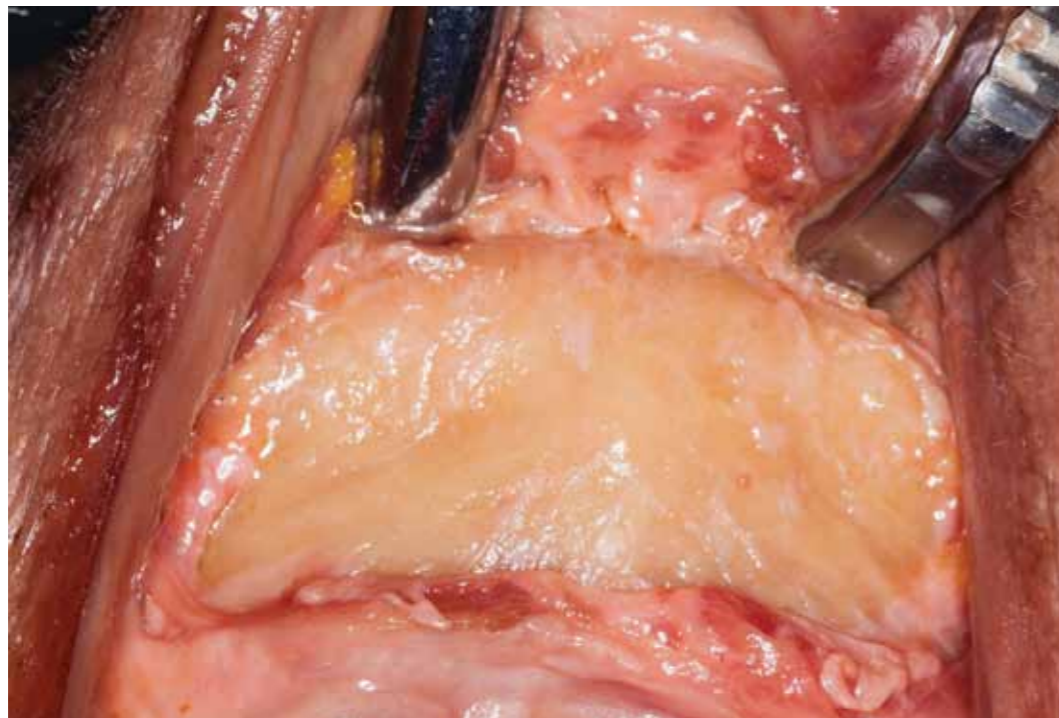
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When as a part of submucosal lingulaplasty a drain is required and inserted via a suprahyoid incision and trouser-legged into each hemi- tongue



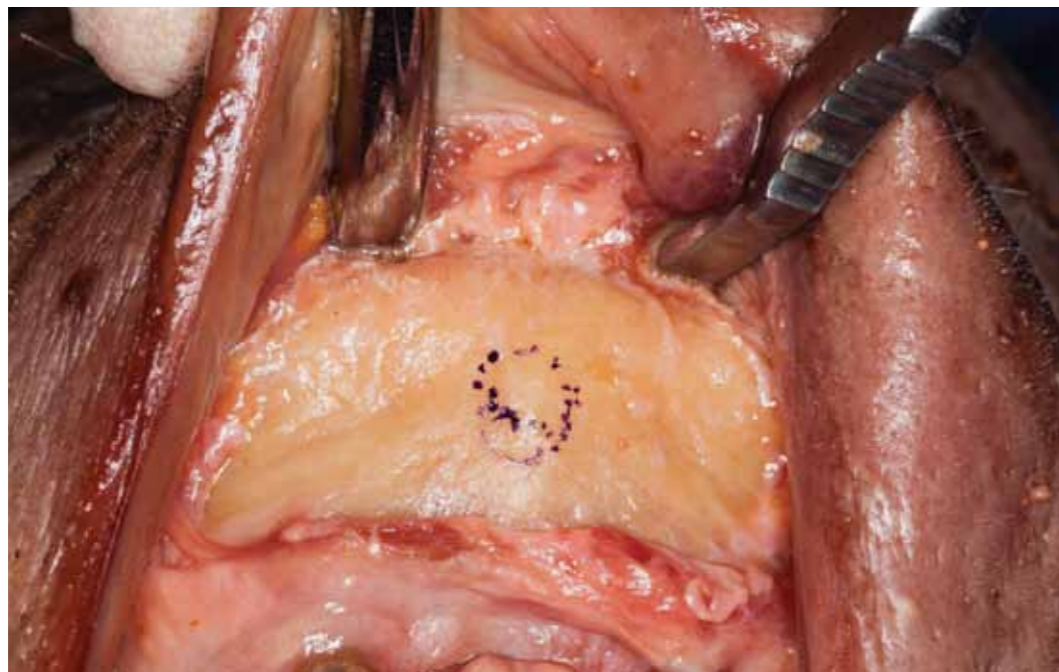
A mucosal incision is made in the labi gingival sulcus from first premolar to the first premolar





Using a periosteal elevator, the mucosa is elevated to expose the inferior margin of the mandible

Temporomandibular joint retractors are then used to retract the soft tissue



An external protuberance is often suggestive of the location of the genial tubercle internally

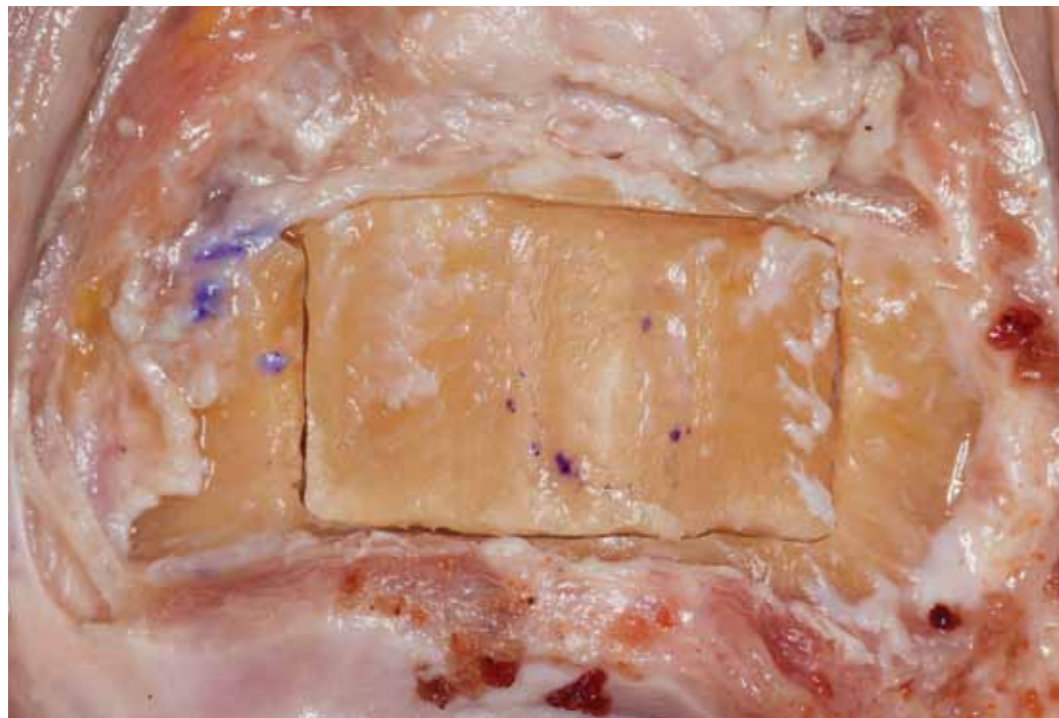


Calipers are set at the length of the preoperatively determined longest tooth root, with the addition of 1-2mm margin of error

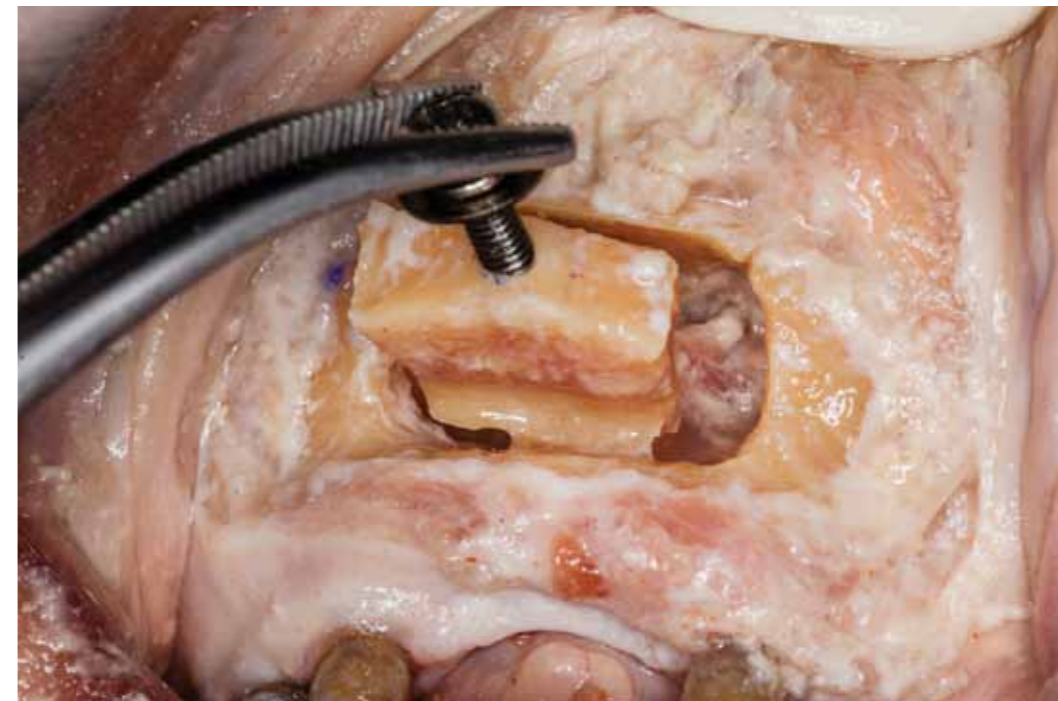


A box osteotomy is mapped out spanning the gap between second incisor and canine bilaterally and from 1-2mm below the longest tooth root to several mm above the inferior border of the mandible





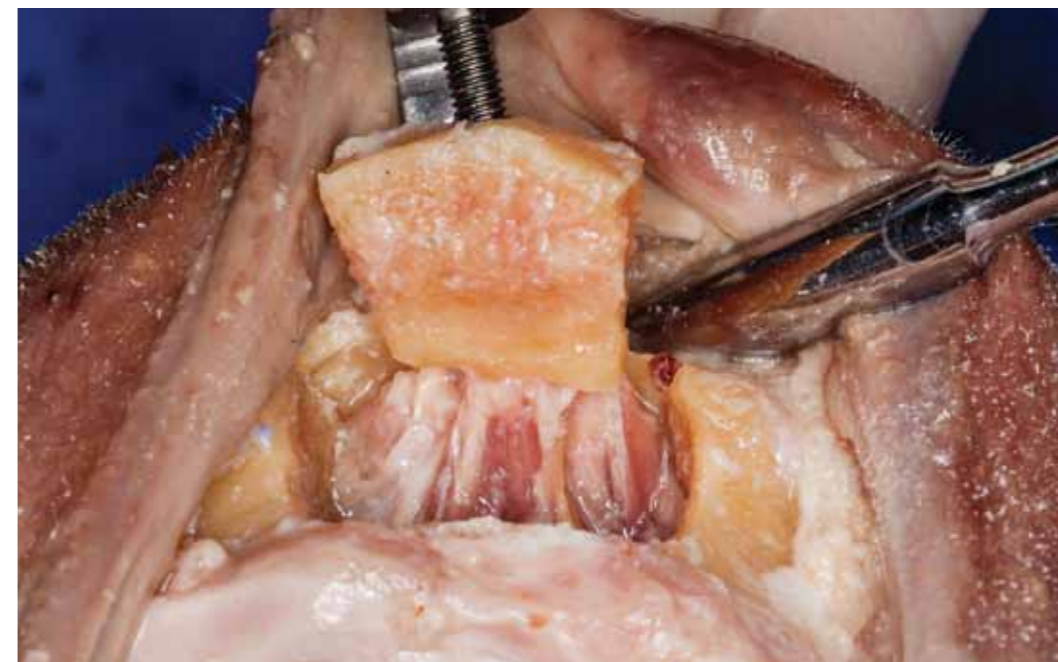
The box osteotomy is performed using a sagittal saw with strictly parallel borders and copious irrigation  
 A reciprocating saw is used to complete the corners, cross hatching is to be avoided



A clamp is used to mobilise the fragment attached to the lag screw  
 The fragment can be pushed through into the floor of mouth, in order to obtain haemostasis in the intraoperative setting

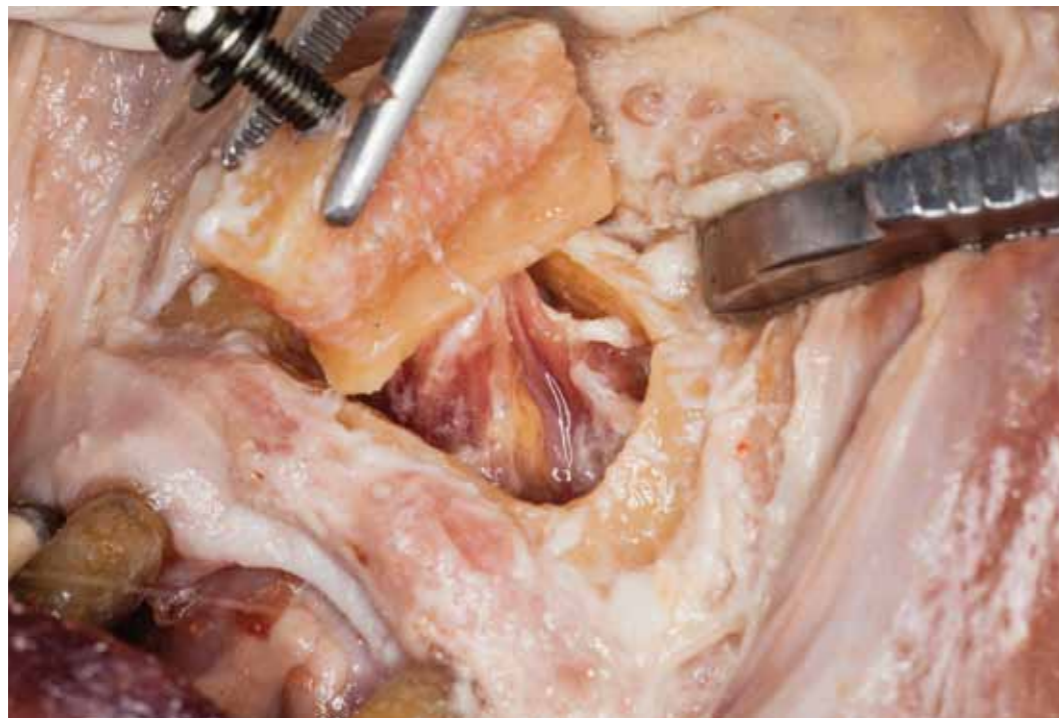


A lag screw, 2x7mm, is inserted into the central portion of the bony fragment

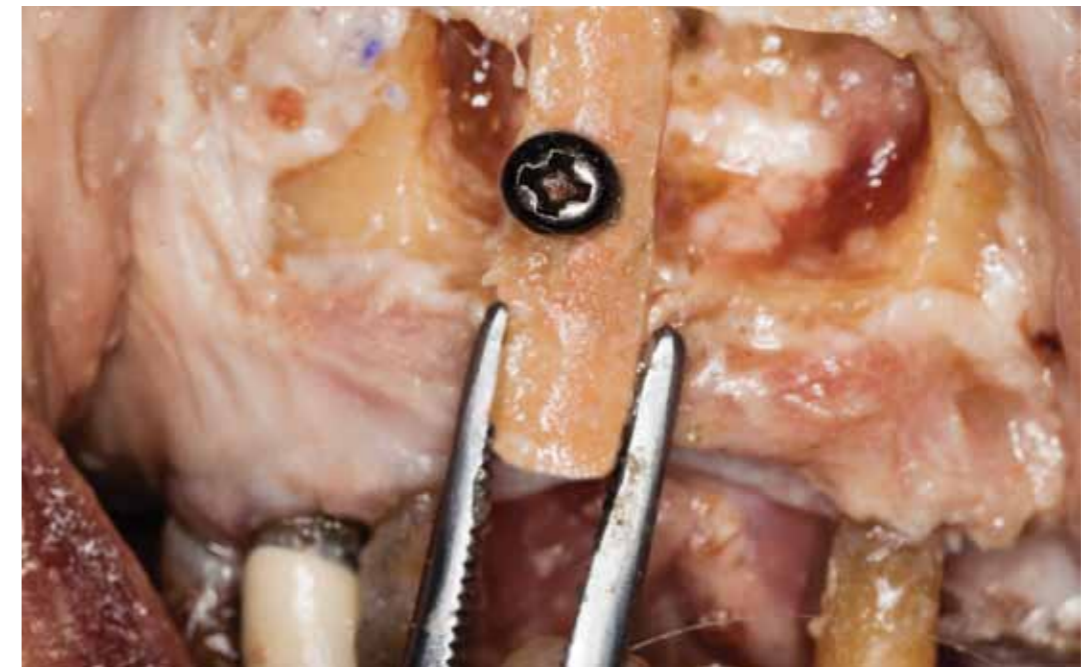


The fragment is then pulled externally, demonstrating the genioglossus fibres attaching to the genial tubercle on the inner table of the bony fragment

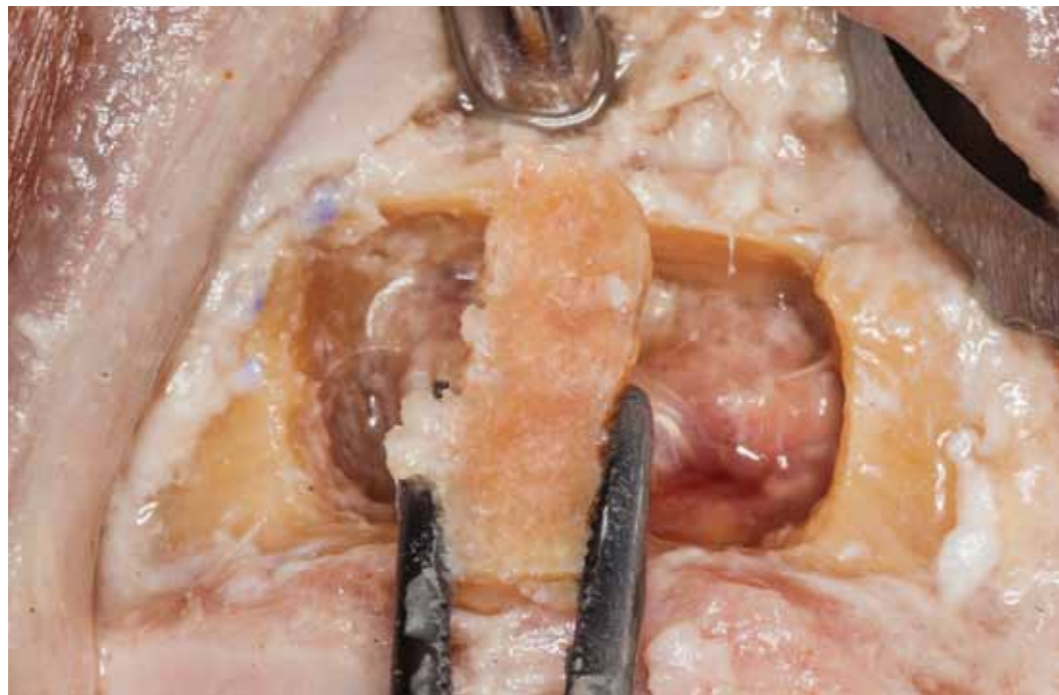




Rotation is used up to 90 degrees  
 If the fragment is tight only rotate to 30-45 degrees



The fragment is secured to the inferior mandible (preferred) or superior mandible (as demonstrated) or both  
 A lag screw technique is employed and a compression screw introduced (the outer hole should be wider than then inner hole to allow securement of the screw)



This picture demonstrates removal of the outer cortex of bone (using a drill whilst grasping the fragment with artery forceps) to reduce protrusion of the lower midline jaw



A two-layered closure of mentalis and mucosa technique is performed  
 An adhesive dressing may be used on the external skin



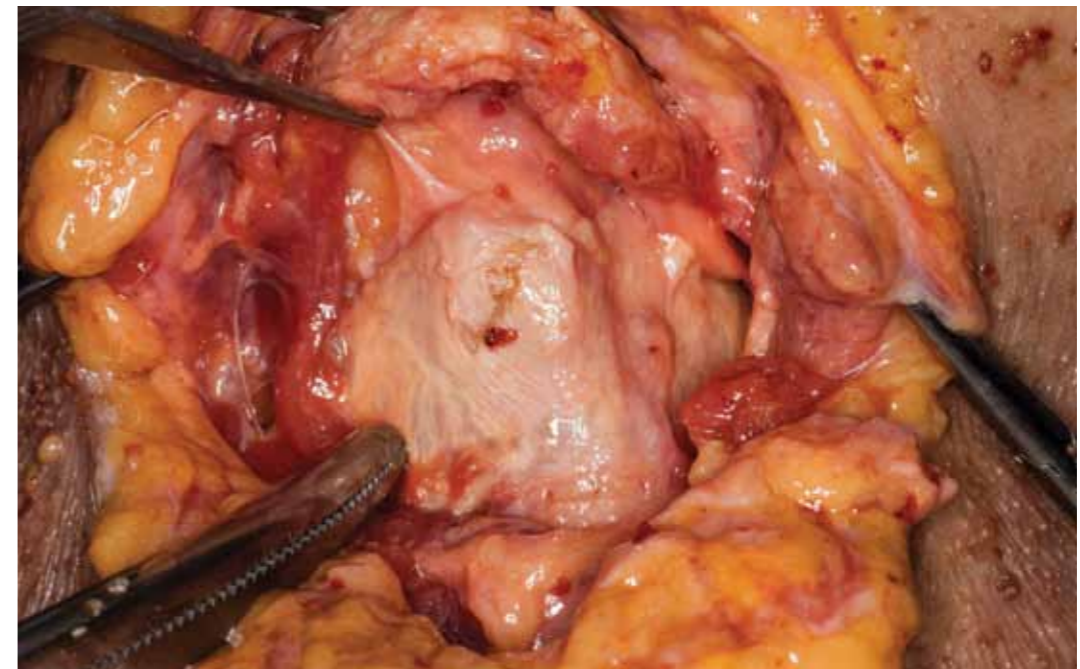
## HYOID SUSPENSION



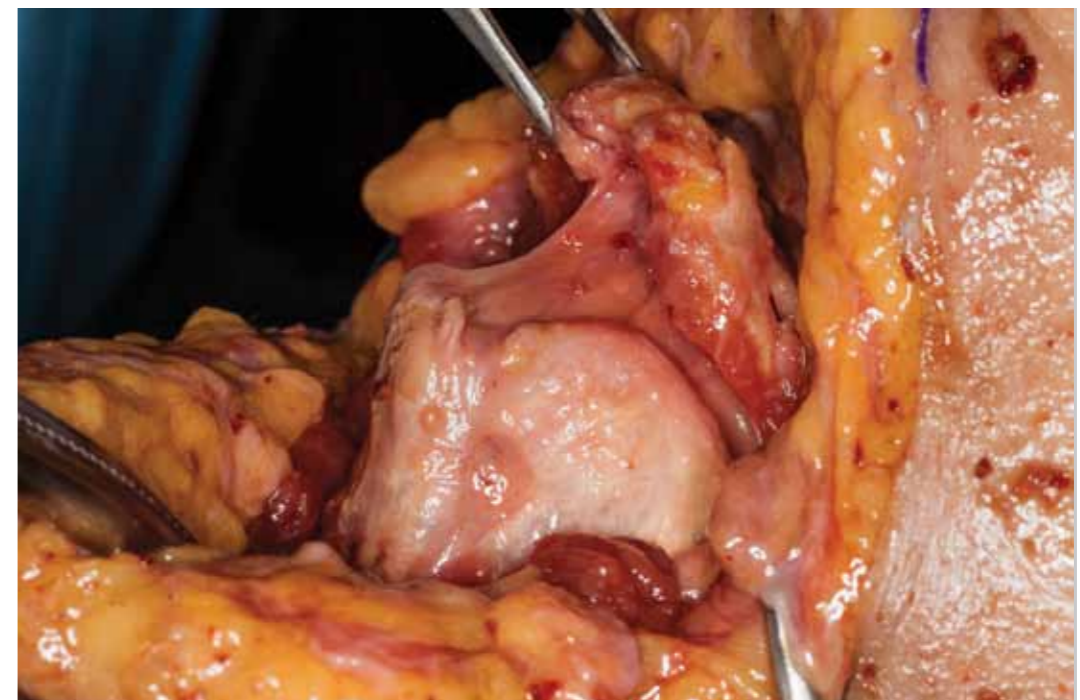
A skin crease incision is made between the inferior body of the hyoid bone and the thyroid notch



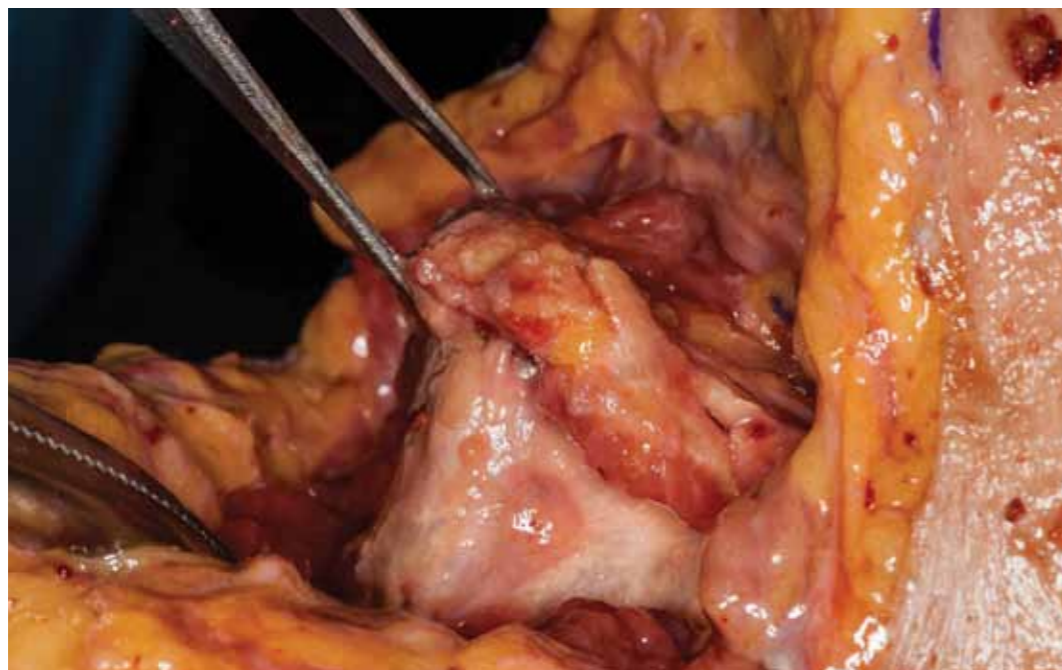
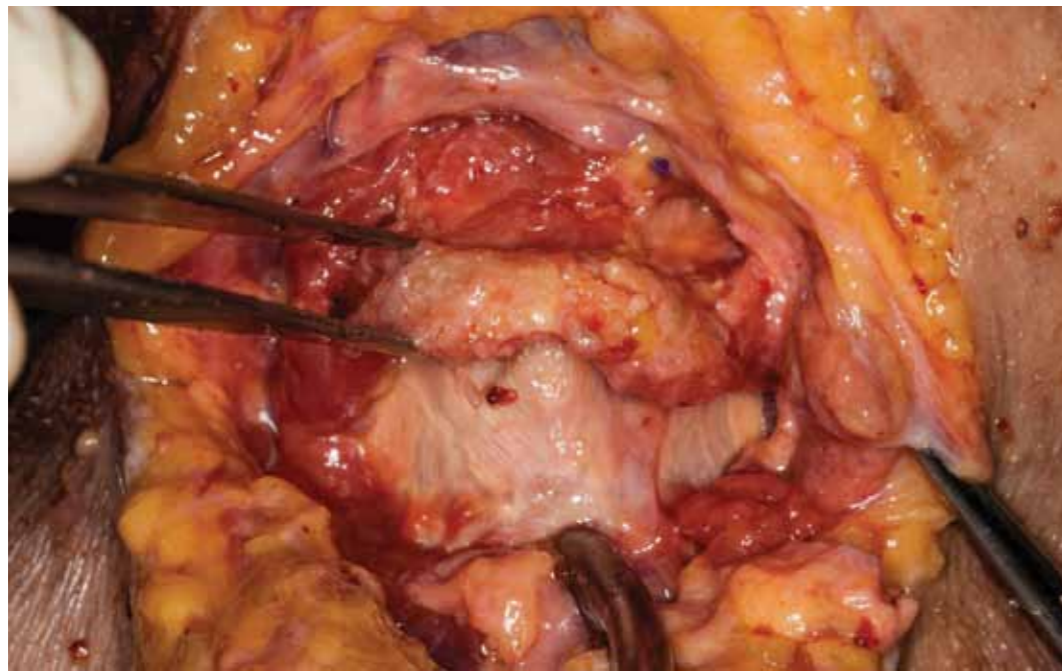
Layered dissection is carried out to expose the hyoid (metal pointer)



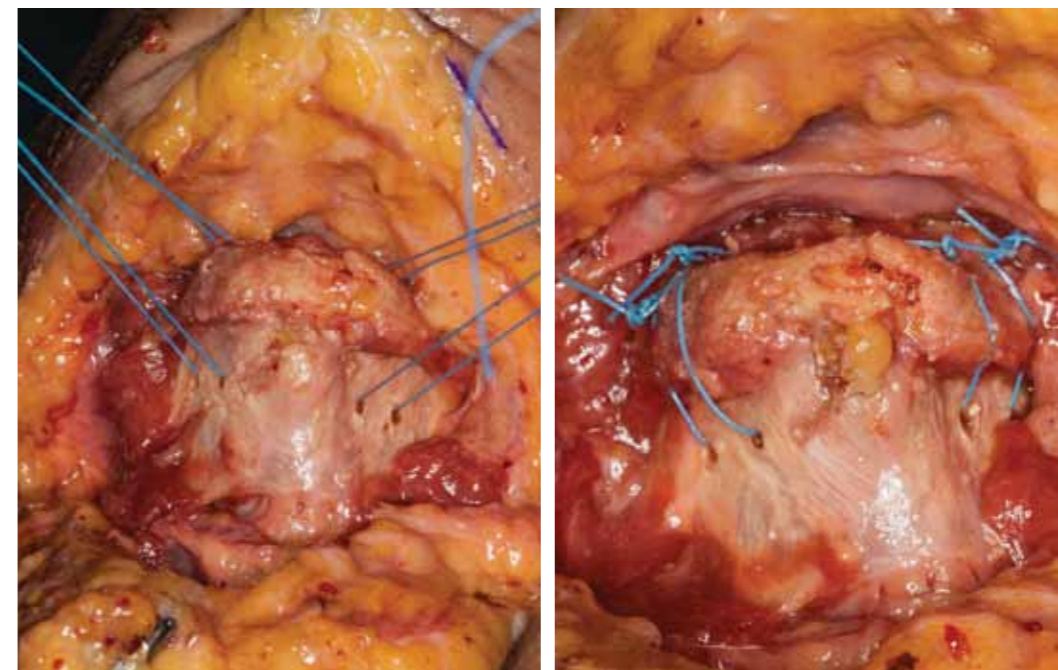
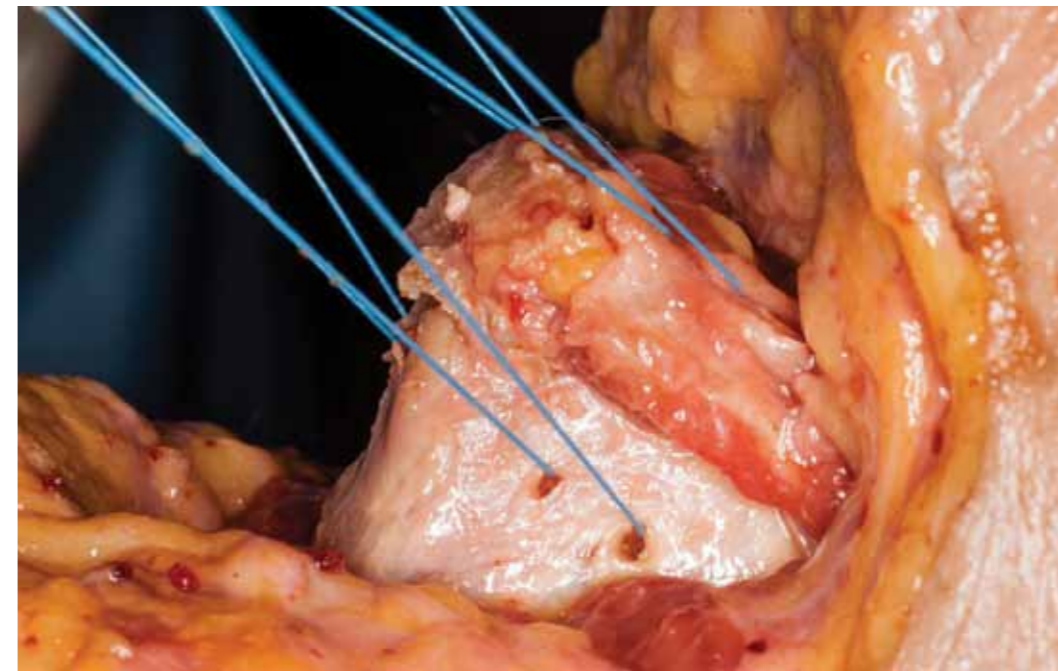
The hyoid bone is exposed and grasped with a babcock  
The thyroid notch and superior border of thyroid lamina is also exposed







The babcock delivers the hyoid over the upper portion of the thyroid laminae



Four drill holes through the thyroid lamina are used as access points to pass 4x 0-Tycron sutures to permit suspension. The soft tissue and skin are closed in layers. Typically, no drain is required.



SUGGESTED READING - EVIDENCE		
REFERENCE	LEVEL OF EVIDENCE	SUMMARY OF CONTENT
<b>Browaldh et al.</b> SKUP <sup>3</sup> randomised controlled trial: uvulopalatopharyngoplasty in selected patients with obstructive sleep apnoea. <i>Thorax</i> 2013;00:1-8	RCT	Randomised evidence showing treatment effect for modified UPPP
<b>Woodson BT et al.</b> A randomized trial of temperature-controlled radiofrequency, continuous positive airway pressure, and placebo for obstructive sleep apnea syndrome. <i>Otolaryngology Head and Neck Surgery</i> 2003;128(6):848-61	RCT	Randomised placebo controlled trial on radiofrequency showing improvement in function, sleepiness and QOL
<b>Robinson et al.</b> Upper airway reconstructive surgery long-term quality of life outcomes compared with CPAP for adult obstructive sleep apnea. <i>Otolaryngology Head and Neck Surgery</i> 2009;141:257-263	Cohort	Matched surgery and CPAP cohorts showing equivalent outcomes in ESS, snoring and QOL
<b>Peker et al.</b> Increased incidence of cardiovascular disease in middle-aged men with obstructive sleep apnea. <i>Am J Respir Crit Care Med</i> 2002;166:159-165	Cohort	Treatment (surgery or device) reduces cardiovascular risk
<b>Marti et al.</b> Mortality in severe sleep apnoea/hypopnoea syndrome patients: impact of treatment. <i>European Respiratory Journal</i> 2002;20:1511-1518	Cohort	Treatment (surgery, device or weight loss) reduces the mortality
<b>Weaver et al.</b> Survival of veterans with sleep apnea: continuous positive airway pressure versus surgery. <i>Otolaryngology-Head and Neck Surgery</i> 2004;130(6):659-665	Cohort	Study of 20,000 veterans showing reduced mortality in surgical group
<b>Haraldsson et al.</b> Does uvulopalatopharyngoplasty inhibit automobile accidents. <i>Laryngoscope</i> 1995;105:657-661	Cohort	Reduction in MVA risk with surgery for OSA

SUGGESTED READING - PHILOSOPHY		
REFERENCE	LEVEL OF EVIDENCE	SUMMARY OF CONTENT
<b>Weaver E.</b> Judging sleep apnea surgery. <i>Sleep Medicine Reviews</i> . 2010;14:283-285	Perspective/analysis	Provides valid argument for the role of surgery in adult OSA
<b>MacKay S, Weaver E.</b> Surgery for obstructive sleep apnoea. <i>Medical Journal of Australia</i> (pending publication Sept 2013)	Perspective/analysis	Provides valid argument for the role of surgery in adult OSA
<b>MacKay S.</b> Treatments for snoring in adults. <i>Australian Prescriber</i> 2011;34(3):77-79	Review	Discusses the different treatment options for snoring in the adult population
<b>Ruehland et al.</b> The new AASM criteria for scoring hypopneas: impact on the apnea hypopnea index. <i>Sleep</i> 2009;32(2):150-157	Perspective/analysis	Understanding different PSG scoring systems
<b>Hobson et al.</b> What is "success" following surgery for obstructive sleep apnea? The effect of different polysomnographic scoring systems. <i>Laryngoscope</i> 2012;122:1878-1881	Perspective/analysis	Understanding different PSG criteria for "success" in surgery

SUGGESTED READING - TECHNIQUES	
<b>MacKay et al.</b> Modified uvulopalatopharyngoplasty and coblation channeling of the tongue for obstructive sleep apnea: a multi-centre Australian trial. <i>Journal of Clinical Sleep Medicine</i> 2013;9(7):117-124	Description of technique for both <b>modified modified UPPP</b> and <b>coblation channeling of tongue</b> . Clinical and PSG outcomes included.
<b>Woodson T.</b> Transpalatal advancement pharyngoplasty. <i>Operative techniques in otolaryngology-head and neck surgery</i> . 2007;18(1):11-16	<b>Transpalatal advancement</b>
<b>MacKay S, et al.</b> JLO 2013 Pending publication	<b>cobLAMO</b>
<b>Gunawardena I. et al.</b> Submucosal lingualplasty for adult obstructive sleep apnoea. <i>Otolaryngology Head and Neck Surgery</i> . 2013;148(1):157-65	<b>Submucosal lingualplasty</b>
<b>Li K.</b> Hypopharyngeal airway surgery. <i>Otolaryngology Clinics of North America</i> . 2007;40(4):845-853	<b>Geniotubercle advancement</b>
<b>Krepsi et al.</b> Hyoid suspension for obstructive sleep apnea. <i>Operative Techniques in otolaryngology-head and neck surgery</i> . 2002;13(2):144-149	<b>Hyoid suspension</b>



## A/PROF STUART MACKAY

Dr MacKay completed his training in Otolaryngology Head and Neck surgery in 2006 and then undertook 12 months of training in Contemporary airway reconstruction techniques for OSA with Dr Sam Robinson, and Prof Simon Carney, in Adelaide. Since returning to Wollongong in 2008, he has established a Sleep Multidisciplinary Team which meets for regular patient reviews in the Illawarra.

He has delivered national and international lectures on Surgery for OSA, including invited keynote addresses as far afield as India, published papers on new techniques and philosophies and coauthored multiple peer reviewed papers on different aspects of sleep medicine. He is currently the only surgeon on the Australasian Sleep Association Clinical and Conference committees.

Dr MacKay resides in Wollongong, New South Wales with his wife and 3 children.



## DR JULIA CRAWFORD

Dr Crawford completed her Otolaryngology Head and Neck surgery fellowship in 2012 and joined A/Prof MacKay for 6 months of training in Sleep Surgery in the first half of 2013. She is currently undertaking an Advanced Head and Neck fellowship featuring both robotic surgery and microvascular reconstruction in the U.S.A at Florida Hospital Celebration Health under Dr J Scott Magnuson, Medical Director of Robotic Head and Neck Surgery at Florida Hospital Nicholson Center, and Dr Hilliary White. She will become one of the first New South Wales Otolaryngologists to receive formal fellowship training in transoral robotic surgery.



