RESEARCH ARTICLE

A Step by Step Guide to Performing a Tension Palatoplasty (Ahern Procedure) and a Maximum Tension Palatoplasty

Tom Ahern

Abstract

The surgical procedure referred to as a Tension Palatoplasty, Oral Palatopharyngoplasty or Ahern Procedure was conceived in the late 1980's. Since then variations in instrumentation, suture patterns and materials have been explored. In addition a two stage Maximum Tension Palatoplasty approach had been developed. Exploration of its use as an adjunct to other upper airways procedures had also been explored.

The procedure had however not been popularised, due to reports of high wound breakdown rates, technical difficulties experienced operating in a confined and relatively distant space and the possibility of creating an oronasal fistula.

This article presents numerous aides and a detailed account of the process, to assist surgeons who wish to attempt the procedure. It also contains suggestions that can hopefully reduce wound breakdown rates and unwanted iatrogenic defects including oronasal fistulas.

Key words: Soft palate, surgery, palatal instability, dorsal displacement

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Introduction

The Tension Palatoplasty TPP procedure [Ahern, 1992; Ahern, 2018] was developed to reduce the incidence of palatal instability PI [Allen et al., 2013] with or without progression to dorsal displacement of the soft palate DDSP [Holcombe, 1999]. Studies into PI were based on the theory that a seal was created between the tongue and the soft palate SP during respiratory exercise. This seal, referred to as the oropharyngeal seal OPS, was postulated to be the primary mechanism that maintained the SP in a ventral position within the nasopharynx during respiratory exercise [Ahern, 1993a]. The epiglottis was a secondary stabilising structure which assumed a primary role when the OPS was disrupted [Ahern, 2024c].

A TPP increased tension in the SP in the region acted upon by the palatine aponeurosis. It did not alter tension in the caudal SP. Tension was increased in both the superficial tissues (mucosal) and the deep glandular and connective tissues down to, but not including the aponeurosis. Thermocautery of the soft plate performed in the same region acted only upon the superficial tissues [Ordidge, 2001].

Maintaining this functional seal reduced the likelihood of horses acquiring orally inspired air during periods of PI [Ahern, 2021; Ahern, 2019], which could potentially lead to contamination of the airways with oral matter (feed, saliva, bacteria).

More recently, case studies involving sleep deprived horses that subsequently underwent TPP procedures, suggested that both oesophageal reflux associated with upper oesophageal sphincter UOS aplasia [Ahern 2024a; Ahern, 2021] and an equine form of obstructive sleep apnea were linked [Ahern, 2018; Ahern 2024b]. The ability to achieve recumbent (paradoxical) sleep was attained following surgery in all cases.

Reports on postoperative race performance with these procedures were few and varied [Ahern, 1993; Reardon et al., 2007].

The procedure had however a poor uptake rate amongst surgeons, who reported technical difficulties in operating in the confined space, high rates of wound breakdown and infrequent iatrogenic defects in the form of oronasal fistulas.

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Materials

Scissors - 37cm curved, blunt dissecting scissors. It is extremely important to examine the tips which are often hand fashioned and can approach a sharp rather than blunt contour.

These are used for,

(i) dissection in both the primary operative site and tension release incisions.

(ii) as a tongue depressor to improve visibility when placing sutures.

(iii) as a tool for assessing palatine range of movement ROM.

Care should betaken to not over sharpen the tips of the blades as blunt dissection is key to not creating a fistula.

Needle holders - 37cm for suturing and as tongue depressor (similar to the scissors) whilst performing the resection.

Allis tissue forceps - 13.5 cm to grasp the rostral palatine mucosa to assist in creating the initial incision and to hold and elevate the tissues while performing the resection. A length of heavy suture can be attached to the handle so as to allow the surgeon or an assistant to hold and apply tension from outside the buccal cavity.

Mouth gag - recommended for best exposure, a 'Standard Full Mouth Speculum [#93830, Promax equine dental,Scottsdale, Arizona, USA]. This must be opened to 4 or 5 notches for surgical access.

Head light - 3500 lumen approximately. Weaker lamps will not provide clear distinction between blood and tissues.

Head rest/pillow - horse in lateral recumbency with muzzle elevated to 45 - 60 degrees.

Suture needles - Size 8 half circle cutting preferred. Size 10 may be easier initially.

Suture material - Absorbable. Vicryl 0 [VCP616H, Ethicon Inc. Rarity, New Jersey, USA]. A less flexible needle with swaged on suture may be required if scar tissue is particularly dense when performing a repair or Max TPP. Vicryl [VCP364H, Ethicon Inc. Rarity, New Jersey, USA]. Importantly experience has shown that the needle attached to the latter, being less flexible, is more likely to penetrate the aponeurosis and potentially the nasal mucosa. Care should be taken when placing these. Intraoperative endoscopy mat be required to confirm one way or the other.

Method

Tension Palatoplasty

Preoperative feeding:

Small particle feed (no hay or grass) is fed as it is easier to rinse out. All feed is removed thirty minutes before anaesthesia and surgery.

Mouth wash:

The mouth must be throughly hosed out to ensure no feed matter remains in the buccal cavity.

Anaesthesia:

Intravenous anaesthesia only. Nasotracheal intubation will result in distortion of the palate at the operative site. Anaesthetic time with an experienced surgeon should be around 30-40 minutes.

Patient position:

Lateral recumbency. Right side down for a right handed surgeon and left for a left handed. The muzzle is then elevated (after the mouth gag is fitted) such that the head is at 45 to 60 degrees to the ground or operating table.

Mouth gag:

This must be opened maximally to allow the surgeon to best visualise the operative field and manipulate their instruments. Occasionally a temporo-mandibular joint becomes dislocated. These should be checked when the gag is removed and the joint mobilised and relocated.

Mouth prep:

Once anaesthetised any remaining particulate (feed) matter is removed. Antiseptics are not used as these can irritate airways.

Visual assessment:

An assessment of the width and depth of the mid and rostral soft plate should be made. The depth of the sagittal folds is a reliable guide to the thickness of the SP [Fig.1]. Very shallow folds are a warning to take more than usual care during the resection phase.Thin palates present more of an opportunity to breach the broad tendon and thence nasal mucosa than do thick palates when suturing [Figs 2,3].

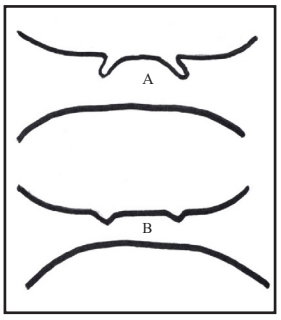

Fig. 1: Thick palate with deep sagittal folds (A). Thin palate with shallow sagittal folds (B).

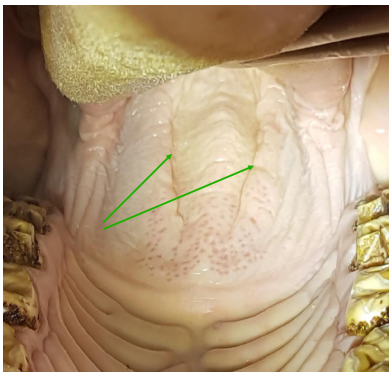

Fig. 2: Shallow sagittal folds associated with a thin palate (green arrows).

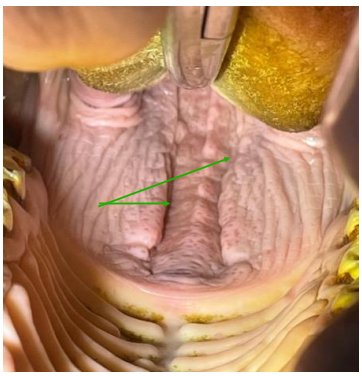

Fig. 3: Deep sagittal folds in a thicker palate (green arrows).

Manual assessment:

The tip of the blunt dissecting scissors should be applied to the SP in the region of the isthmus faucium and dorsoventral ROM should be assessed. This can vary enormously between

patients. The surgeon should then apply, with light pressure, their index finger to the SP and by moving it caudally locate the border of the aponeurosis.

Resection Margins:

The rostral end of the incision is at the level of the caudal margin of the palatine bone which can be palpated. The caudal margin of the incision should be at or just past the caudal border of the aponeurosis [Fig.4] The width can vary greatly dependent on the innate width and ROM of this region of the SP. As a general rule it is best to not over resect. New surgeons should aim to resect approximately 6-8 mm either side of the midline. This should be as far as possible tapered at each end [Fig.5]. Over resection would often result in wound breakdown. If by being conservative during the initial procedure the acquired tension was not clinically adequate, then a Max TPP could be performed. A minimum six week period should be allowed between procedures. This should give the central scar, which will now be attached to the aponeurosis, time to mature and strengthen. As a general rule incisions will be closer to the sagittal folds when operating on thick palates [Fig.6]. This is because the non resected section (lateral component) of the deep fold will often open and flatten once the sutures have dissolved, resulting in reduced postoperative tension.

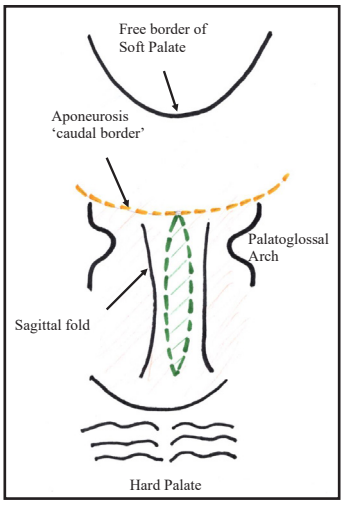

Fig. 4: Surgical incision for a Tension Palatoplasty (green)

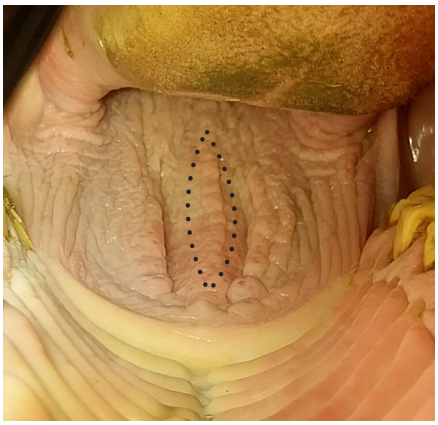

Fig. 5: Bi-elliptical incision margins

Resection:

An assistant holds the tip of the tongue with tension in the midline over and outside the mouth gag. The tissue forceps are then placed at the rostral margin of the resection. A small bite is made in the mucosa on the rostral side of the forceps. One blade of the scissors is then introduced into the wound and the mucosa and with it the submucosal tissues are blunt dissected in an elliptical fashion. It is best to aim at mucosal resection only as in most cases the introduced tip will seperate the deeper tissues without the surgeon actively attempting this. One can always resect more of the underlying glandular tissues later, when visualisation is improved with the resected segment removed [Fig.7]. The forceps are used to both hold and then elevate the section whilst resecting. The rostral and mid section will normally elevate and seperate from the tendon with little effort [Fig.8]. It is the caudal third that can be closely associated with the aponeurosis. It should be first elevated and then teased away from the tendon. It is at this stage of the procedure that an oronasal fistula is most likely to be created. This cannot be overemphasised. Well sharpened scissors can also be more of a liability than an asset when freeing this segment from the tendon.

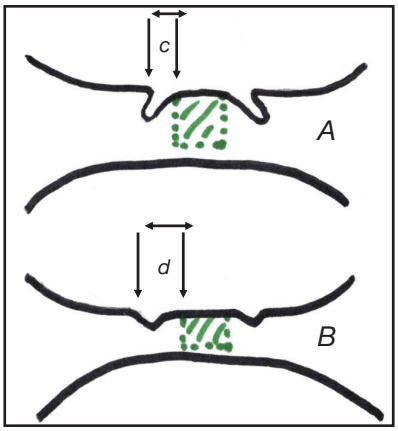

Fig. 6: Resected tissues (Green). Thick palate with deep sagittal folds (A). Thin palate with shallow sagittal folds (B). Relative distances between margin of sagittal fold and margin of resection (c) and (d).

Fig. 7: Once the mucosa and submucosal tissue is removed, further glandular tissues (green arrows) can be carefully removed.

Fig. 8: Resected mucosa and submucosal tissues.

Rule of resection - 'When dissecting always elevate and don't incise what one can't visualise'.

If you have any concerns as to whether you have punctured the palate, the tip of the blunt scissors should be used to explore the tendon prior to closure.

Simple interrupted sutures are used and closure begins at the caudal end of the incision [Fig.9]. The first suture, which is often the most difficult to place, should be at or just past the end of the incision. This should compress the submucosal tissues towards the midline bringing the wound edges to a more central position. This suture should include tissues to the depth of but not including the aponeurosis. If the first suture is placed more rostrally it often lacks sufficient submucosal tissue which will result in less post operative tension. The wound is then progressively closed, again paying attention to including all deeper tissues not including the tendon.

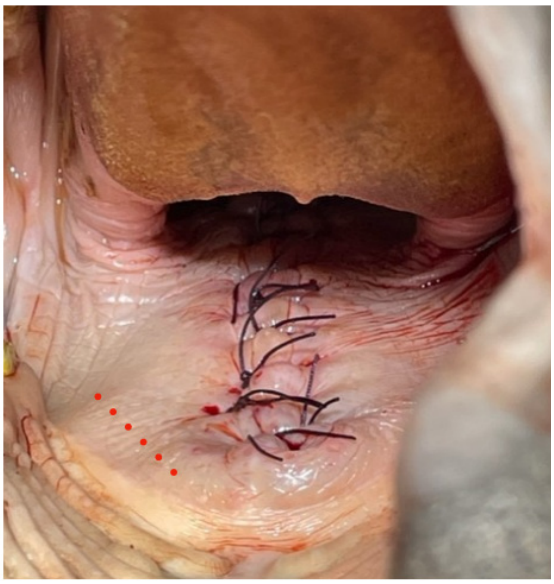

Fig. 9: TPP wound closure (caudal to rostral). Note: A small tension release incision was required (Red line/dots).

In general there are two elements to the surgical compression achieved. Increasing tension at the superficial or mucosal level will directly reduced the circumference at the isthmus and thence create a tighter rostral valve of the OPS. This is a similar response to that achieved with thermocautery of the SP (Ordidge, 2001). It should also indirectly support the action of the aponeurosis.

Tensing the deep glandular and connective tissues that abut the broad tendon should directly support the tensing efforts of the same and indirectly reduce the circumference at the isthmus.

Tension Release Incisions:

Once the wound has been closed tension should again be assessed using the same compression gauge (tip of dissecting scissors) as used preoperatively. If any region of the incision is adjudge to be 'drum tight' or near, then some of this tension needs to be released. The rostral margin is the most common area requiring release [Fig.9]. A 'Mucosal only' incision or incisions are made as laterally as possible in any over tensioned regions. Most often a single incision suffices and less often bilateral [fig.10] are required. These incisions will reduce tension at the mucosal level whilst maintaining tension in the deep tissues that abut and support the action of the aponeurosis. They should reduce the likelihood of suture dehiscence and wound breakdown. If the incisions pass through the isthmus, then there will be a resultant increase in its circumference which can be counter productive when considering OPS function. For this reason these are avoided unless absolutely necessary.

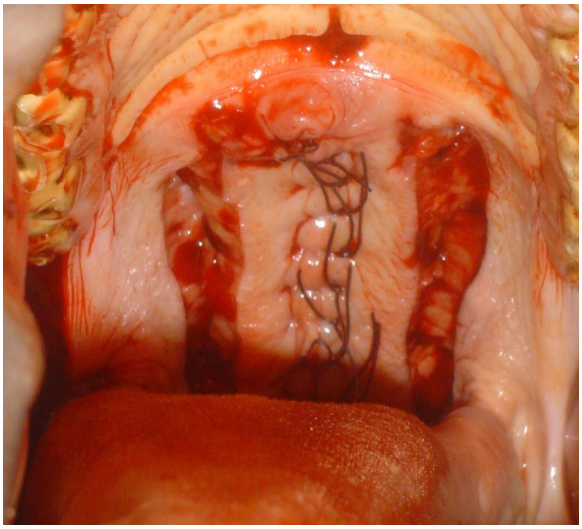

Fig. 10: Bilateral tension release incisions

It is possible to puncture the nasal surface of the SP when performing these, most often in the region of the isthmus and more commonly on the surgeons right side (horses left) so care should be taken to incise 'mucosa only'. Never attempt deeper resection. The space created will normally fill within 2-3 weeks however mucosal covering will take significantly longer.

Post operative care:

Analgesia; A single dose of analgesic pre operatively is usually all that is required. This can be continued if deemed necessary for the first 72 hours.

Antibiotics; 5 days of penicillin LA.

Feed: small particle feed or mash in limited amounts for the first 8 days. The tension placed on the sutures during mastication is considerable therefore limiting the frequency

of this action will lessen the chance of wound breakdown. Water provided immediately. If not eating well in the first 48 hours the patient can be offered small amounts of green feed or hay which they would normally consume.

Stabling; The horse is confined to a stable or small yard (sand permissible) for 8 days.

Turnout; Six weeks turnout is recommended prior to resuming training This to allow for the formation of strong scar tissue and for the mucosa ,where tension release incisions were created, to cover and for any PI associated pulmonary inflammation or hypersensitivity [Van Erck, 2011] to resolve.

Maximum Tension Palatoplasty [11]

It may not be possible with the initial TPP to acquire clinically adequate tension in the mid and rostral SP without risking suture dehiscence. Over resection can result in wound break down as the subcutaneous tissues, made up of loose connective, glandular and fatty tissues, are not strong enough to resist extreme tension. lateral pressures applied during mastication along with direct pressure from the root of the tongue can contribute to surgical failure.

The Max TPP procedure utilises the strong central keel of scar tissue created by the initial TPP to improve suture tolerances.

Applications:

There are a number of reasons why a Max TPP could be performed.

(i) If the primary surgery experienced a significant degree of breakdown. Significant being either total wound breakdown or a loss of sutures and thence tension in the region of the isthmus (caudal third of the incision). Breakdown involving only the rostral third is usually of little clinical consequence.

(ii) If the horse presents with a significant epiglottic issue - small, short, flaccid, injured or missing the tip. In these cases the OPS mechanism needs to maximised as with its failure in the presence of an incompetent epiglottis, DDSP is usually immediate. Indeed, even following a successful Max TPP, DDSP is still often audibly at the conclusion of a gallop or breeze, but importantly not during. In these cases a two stage procedure is often recommended initially.

(iii) Electively, as a two stage procedure. Some trainers/ owners are prepared to spend the extra time acquiring as much tension as possible initially.

(iv) Occasionally patients that had become clinically normal and had performed up to expectations following a TPP, could later (after one or more racing preparations) experience a further loss of form and/or present with some of the original symptoms. Trainer/owners were informed of this possibility. They were advised, if this were to happen, that the extra tension acquired by performing a MaxTPP would in most cases assist in returning the horse to its original clinical state.

Preparation and anaesthesia:

As per a TPP

Manual examination and assessment preoperatively:

The tip of the blunt dissecting scissors are again used to apply pressure to the ventral SP in the surgical region. A comparison with pre-TPP tension and ROM can then be made. At the same time an assessment as to the extent primary union had been attained with the initial TPP can be made. Occasionally tension appears to be full and adequate and no further surgery is recommended.

Additionally an assessment of surgical access to the region just at and caudal to the isthmus faucium should be made. In some cases with smaller buccal cavities (narrow palates) and after the circumference at the isthmus has been reduced by the initial TPP procedure, it can be extremely difficult to place your caudal sutures. Positioning your needle so as to include enough mucosa and subcutaneous tissues before driving through the central scar can be almost impossible. Thus it is important to ensure you have adequate access. Without this a Max TPP should not be attempted.

Resection:

Firstly check your original surgery notes on palate thickness as sagittal folds may longer be apparent and for locations of tension release incisions as scars may not be initially obvious. Then assess the surgical site to ensure that there is enough tissue either side of the scar to include in your closure. Narrow palates, particularly at the isthmus, can result in 'mucosa only' being included with the central scar in your suture. This can then cause rolling or inversion of the wound with resultant breakdowns. The mucosa is then punctured (which may require a sharp tipped scissor) either side of and at the rostral end of the surgical scar [Fig.11,12]. Blunt dissecting scissors are then introduced and driven alongside the edge of the scar (bottom tip dividing the submucosal tissues) terminating 5mm from the caudal end of the scar. Do not manually resect any deeper as it is possible, although rare, to create a fistula at this site. The mucosa covering the now isolated central scar, is stripped away using the dissecting scissors [Fig.13].

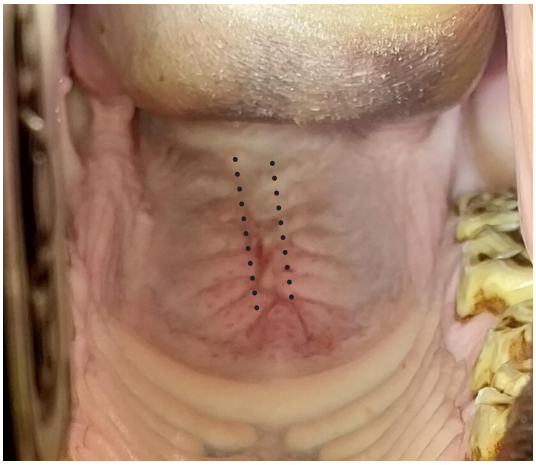

Fig. 11: Max TPP incisions abutting central scar. note suture scars from primary surgery indicating primary union.

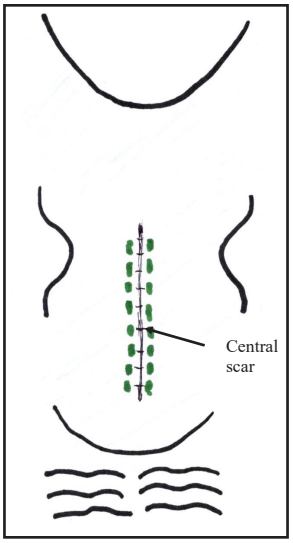

Fig. 12: Collateral incisions abutting the central scar (green) for a Maximum Tension Palatoplasty.

Fig. 13: Strong central scar with covering mucosa resected (Black arrows). Note mucosal edges have retracted laterally exaggerating the extent of the resection.

Suturing:

Simple interrupted sutures beginning at the caudal margin of the wound. A useful amount of glandular tissues to a depth just prior to the tendon is taken on one side, the needle is then driven through the scar and a similar amount of tissue and mucosa from the contralateral side is included [Fig. 14].

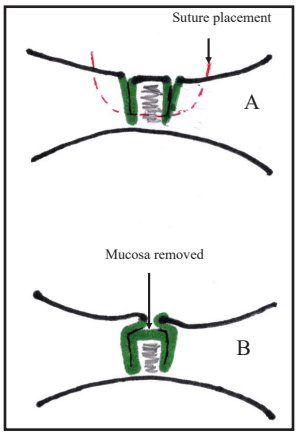

Fig. 14: A, Incisions abutting central scar (green) and suture path (red). B, Mucosa removed from central scar and lateral mucosae being drawn centrally.

Sutures are placed approximately 5mm apart [Fig.15]. Care must be taken to not penetrate the nasal mucosa with your needle . With the initial procedure one cannot visualise the needles path in the midline. This is not the case when performing a Max TPP. If not sure, nasopharyngeal endoscopy carried out by an assistant should determine whether this has occurred and if so the suture can be withdrawn and replaced. Occasionally the scar is particularly tough and the independent cutting needles are unable to penetrate. Here the swaged on needles which are less flexible are utilised. Care must be taken though as these are much more likely to penetrate the nasal mucosa. If resultant tension is extreme, tension release incisions are used reduce this [Fig.16].

Fig. 15: Surgical wound sutured. Sutures all include a substantial amount of scar tissue, taken to a depth just prior to the aponeurosis.

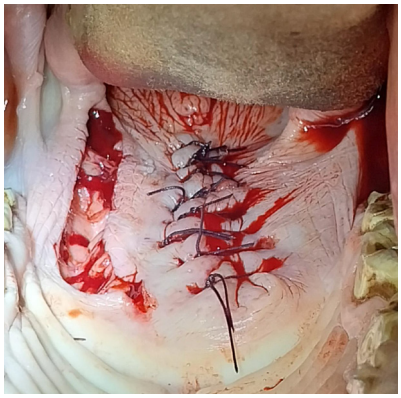

Fig. 16: A tension release incision extending the lull length of the procedure.

Post operative care:

All measures as per a TPP including turnout.

IATROGENIC LESIONS

(i) Suture penetration - Indicated by a clear watery discharge at the nostrils first appearing at about 96 hrs. Occasionally an infection can result within the nasopharynx at the area of penetration. If not noticed and removed intraoperatively, sutures can be safely removed at day 12-14. Occasionally polyps develop at the sites of penetration. If polyps are deemed to be interfering with airflow, laser ablation is recommended. More often suture scars (if not removed) are all that remain once

sutures have dissolved. Suture penetration is not normally associated with wound breakdown.

(ii) Oronasal fistula - These invariably occur in the caudal third of the surgical incision where the resected tissue is very closely associated with, and occasionally attached to the tendon. If the respiratory mucosa has been breached, a nasal discharge is usually apparent around 72 hours post-operatively. If this is detected in the first seven days, the horse should be re-anaesthetised and a horizontal mattress placed to close the defect. Further tension release incisions may be utilised to reduce tension at the breach site. Antibiotics are administered for 8-10 days. In cases where the fistula is not detected early and a mucosal lining has developed, an approach similar to a Max TPP is used. One of the incisions should be through the fistula and as far as possible the fistula's mucosa is ablated. The central scars mucosal covering is again resected. The wound is closed with simple interrupted sutures except in the region of the fistula where a horizontal mattress is placed. 8-10 days of antibiotics are commenced.

If the penetration has occurred within a tension release incision, antibiotic therapy should be extended. In these cases a nasal discharge is usually not evident until day six following the cessation of antibiotic therapy. This lesion should however be expected to heal without any surgical intervention. Laser ablation can be carried out on any polyps or exuberant granulation that may develop on the pharyngeal mucosal surface at the puncture site.

Post Operative Assesment

Secondary intention healing only, following wound breakdown carries with it a poor or guarded prognosis [Ahern,1992].

(i) Wound healing assessment - It is impractical to properly assess healing whilst the horse is standing even when sedated. An examination under anaesthetic is required to visually assess the full length of incision. Where primary intention healing has occurred suture scars will be evident [Fig.17]. An absence of these represents an area of breakdown and secondary intention healing only [Fig.18].

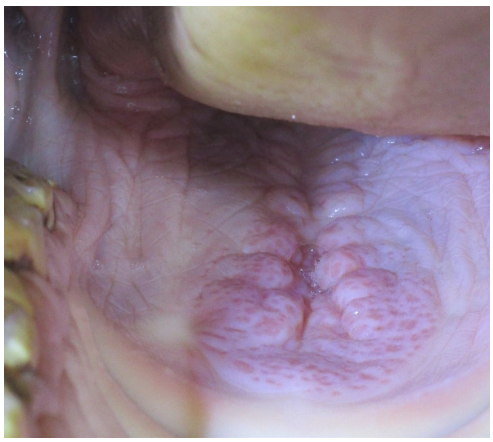

Fig. 17: Full set of suture scars indicating complete primary union.

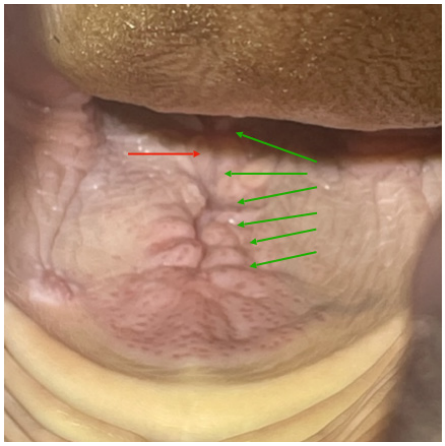

Fig. 18: Primary union suture scars (green arrows). Suture dehiscence (red arrow).

(ii) Tension assessment - The preoperative assessment of ROM of the SP in the region of the aponeurosis is made using the tip of the dissecting scissors. This assessment should be repeated once the surgical procedure is completed. A final and complete assessment can only be made once the wounds are completely healed (6-7 weeks). Assessments made during standing endoscopy using 'degree of dorsal billowing' of the mid and rostral palate within the nasopharynx are at best unreliable.

Wound Breakdown- Surgical Correction

Post operatively, in the standing horse, an oral assessment of wound healing is not adequate as at best only the mid and rostral section of the wound is visible. A full assessment can only be made in the anaesthetised animal. In this state both the extent of primary or secondary healing and the degree to which an increase in tension in the mid and rostral soft palate has been achieved can be assessed.

A clinically significant increase in tension is the primary aim. However small segments of secondary intention healing in the more rostral region are often not significant, whilst the same in the caudal region particularly at the isthmus faucium usually are.

(i) Wound breakdown is most commonly the product of
(ii) Over resection, with tension that cannot be significantly reduced using tension release incisions.
(iii) Poor suture placement, with inadequate amounts of submucosal glandular tissue included in suture.
(iv) Over feeding, as mastication exerts considerable lateral pressures on the sutures. Feed intake should be limited for a full eight days post operatively.
(v) Inadequate antimicrobial cover.

The oral environment can contribute to but is rarely the primary cause of wound breakdown.

Increased tension in the mid and rostral soft palate should improve OPS function whilst also reducing the dorsal ROM

which can contribute to different forms of nasopharyngeal collapse.

If the wound has broken down and increased tension has not been achieved then an approach similar to a Max TPP is performed. The central scar will often be broader and attention to not making incisions to lateral to the midline should be made. If too lateral and a broader central mucosa is stripped, then bring the edges together may require over tensing which could contribute to further breakdowns.

Tension release incisions are usually required and in some cases will be bilateral and coarse the full length of the central surgical incision.

Only occasionally does secondary intention healing provide a clinically adequate increase in tension and this improvement is often short term.

Combination Procedures

TPP with or without a Max TPP has been used to further enhance the functional benefits attained when using other upper airways procedures.

(i) *Laryngeal abductor prosthesis [Spiers et al., 1983];* DDSP and dysphagia following this procedure is not uncommon. Improvements in function can be achieved including a reduction in dysphagia and DDSP as long as these are not of a neurogenic origin (iatrogenic).

(ii) *Epiglottic Entrapment EE;* DDSP and PI have been reported following EE splitting [Lee et al., 2019] or resection. Including a TPP with or without a Max TPP can reduce the incidence of these.

(iii) *Thermocautery of the SP [Audidge, 2001];* Despite operating on what is at times a grossly thickened oral mucosa, useful increases in tension have still been acquired by performing a TPP over the cauterised tissues.

Note: Combining a Laryngeal Tie Forward LTF procedure [Woodie et al., 2004)]which has its effect within the caudal nasopharynx, and TPP surgery which acts in the rostral nasopharynx appeared to be a logical symbiotic combination. However combining these has not produced useful longer term clinical responses.

Discussion

In general surgeons who have been present whilst these procedures were being performed, agreed that there was some logic to reducing dorsal billowing of the mid and rostral SP. In addition the potential enhancement of the function of the OPS, which is central to understanding the concept of PI, was also broadly agreed upon.

However their own experiences, including difficulty working within the operative confines, wound breakdowns, and iatrogenic issues such as the creation of an oronasal fistula, had deterred them from continuing with the procedure.

Clinically beneficial surgical procedures should not however be ignored simply because they prove to be difficult to perform.

It is hoped that the authors experience of the last 40 years can assist in encouraging others to add this skill to their present list and by doing so improve the lives of many of this species.

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