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Anatomical study of the effects of five surgical maneuvers on palate movement☆

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Summary The anatomy of the palate has been extensively described, with a predominant focus on palatal musculature. There are no biomechanical studies investigating the effects of surgical maneuvers on the palate to aid cleft closure. This study aims to describe the soft tissue attachments at different zones and quantify the movement following their release. Fourteen adult cadaver heads were dissected. The palates were split in the midline and five maneuvers described: Step 1, over the hard palate; Step 2, around the greater palatine pedicle; Step 3, over the palatine aponeurosis; Step 4, over the hamulus; and Step 5, resulting in a hamulus fracture. The movements across the midline at the posterior nasal spine following each maneuver were measured.

The age range of the 14 heads was between 60 -75 years. Completion of steps 1 and 2 over the hard palate obtained a mean release of 2.6 and 2.0 mm, respectively. The largest movements occurred at Step 3 (5.7 mm) and Step 4 (3.5 mm), after releasing attachments at the posterior hard palate and palatine aponeurosis. Steps 3 and 4 dissections exhibited cumulative release, with a maximum movement with Step 3 ($p < 0.05$). Isolated fracture of the hamulus (Step 5) yielded a mean movement of 1.4 mm. Individual steps of dissection are described with respect to releasing soft tissue attachments. Medial movement of the oral mucosa is quantified with each step of dissection. The greatest release occurred with dissection overlying the palatine aponeurosis posterior to the hard/soft palate junction. Additional dissection along the hamulus (without fracture) added significantly to this release.

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Introduction

The anatomies of both normal and cleft palates have been extensively described in the literature.[1–5] Millard's Cleft Craft[5] contains a detailed description of dissection studies performed by Dickson,[1] Fara,[2] Kriens,[3] and Latham.[4] Such work has clarified the understanding of the palatal musculature and its role in velar function and speech. Anatomical dissections have additionally emphasized the importance of the levator muscle in a functional cleft palate repair.[6–8] Furthermore, histological studies by Kuehn and colleagues[9–11] have identified the tissue components within each section of the hard and soft palate.

Currently, a variety of palate repair techniques are performed for the repair of clefts: Von Langenbeck,[12] Bardach two-flap palatoplasty,[13] Veau–Wardill–Kilner/V–Y pushback procedure,[14] Furlow double-opposing Z-Plasty,[15] and radical intra-velar veloplasty, as described by Sommerlad.[16] Controversies around the strengths and limitations of each palate repair technique have largely focused on the functional muscle anatomy and issues of long-term maxillary growth. However, the avoidance of a post-operative fistula is an important short-term goal. Losken and colleagues[17] described various surgical maneuvers that can be useful in providing a tension-free palate repair. Having identified higher fistula rates in patients with Veau 3 and Veau 4 cleft palates, the authors recommended a double-opposing Z-plasty for narrow clefts (<8 mm) and two-flap palatoplasty for wider clefts.[17] To date, there have been no objective studies linking surgical technique and tension after repair of a cleft palate.

Regardless of the technique, surgeons have struggled to close, especially, wide cleft palates. In order to do so, a myriad of surgical techniques have become popular to aid in the closure of the most difficult cases. Some have advocated more aggressive dissection of the soft tissue, including subperiosteal release around vascular pedicles and large relaxing incisions. Others have described releases of soft-tissue or muscular attachments, including fracture of the hamulus. To date, the degree of effectiveness of each of these maneuvers is unclear. The aim of this study is to investigate the effects of various surgical steps during dissection on medial movement of the oral mucosa of the palate.

Methods

A total of 14 fresh adult cadaver heads were obtained for study of the palatal anatomy. Dissections were carried out under 2.5× loupe magnification. The temporomandibular joint was disarticulated and the mouth was opened, allowing for the full exposure of the entire hard and soft palate. Careful attention was paid to avoid disrupting the attachments around the lateral oral cavity, pharynx, and tongue. The midline of the palate was identified and marked with ink. Any asymmetries of the palate were specifically ruled out. The posterior nasal spine in the midline was identified. A No# 15 blade was used to incise the midline of the palate from the central incisors to the posterior nasal spine and uvula. Five steps of oral mucosa dissection were identified and described (Figures. 1–6).

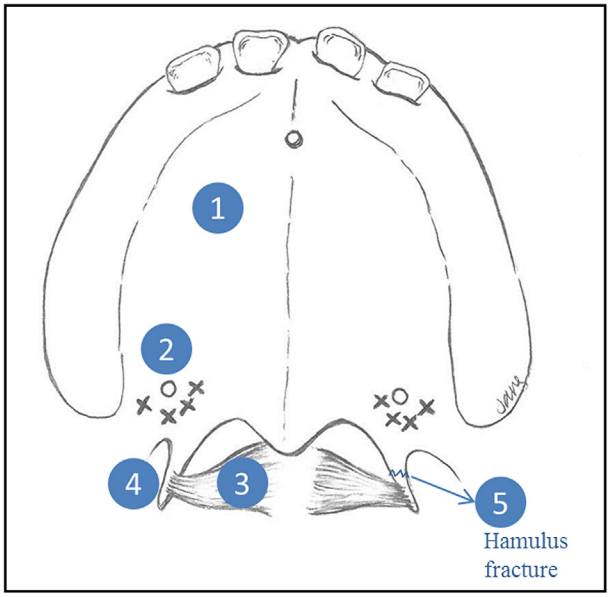

Figure 1 Extent of palatal dissection with each of five surgical steps.

Step 1 involves elevation of all the tissue overlying the hard palate except those immediately surrounding the greater palatine vessels. This was chosen to emulate standard dissection of the hard palate associated with a Bardach two-flap palatoplasty technique. The medial and lateral incisions were incised with the No# 15 blade and the oral mucosa was elevated with sharp dissection using the scalpel. The medial edge of the tissue was pulled medially towards the marked midline with a forceps. The amount of movement beyond the midline was measured with a paper ruler. All the measurements were taken by a single investigator.

Step 2 includes release of all soft-tissue attachments surrounding the greater palatine vessels. Step 3 encompasses the dissection of those tissue attachments associated with the palatine aponeurosis of the tensor veli palatini musculature found just posterior to the posterior edge of the hard palate. Step 4 extends the plane laterally,

Figure 2 Step 1 release over the hard palate.