Visual Demonstration of a Vomerine Flap Healing Over 35 Days using Photographs

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Abstract

Introduction: A single layer vomerine flap is often used in the primary repair of the anterior hard palate in babies with a complete unilateral cleft lip and palate. Little is known about the mechanism of mucosalisation of the exposed vomerine bone and the raw surface of the vomerine mucoperiosteal flap. Animal histological studies have suggested that both scar tissue formation and wound contraction play a role in palatal healing [1]. The aim of this study was to observe the mucosalisation of the vomerine donor site following elevation of a vomerine flap.

Method: This is an observational, single case study. Post-operative photographs of the roof of the mouth using a 120 degree endoscope and camera, were taken daily for 15 days, and then at weekly intervals for a further 3 weeks.

Results: Healing appears to occur in 4 phases. From days 1-9 clot and slough were seen over the wound, making visualisation difficult. On day 10, pink islands were seen emerging through the slough, and palatal mucosalisation was visible, extending from the free palatal edge. On days 10-14, the depth of the base of the flap appeared to advance towards the oral surface. On day 18, mucosalisation of the vomer was seen alongside, bridging to the palatal side.

Conclusion: While little is known of the mechanism of single vomerine flap healing, our study is the first to provide a visual record and establish a timeline of the process.

Keywords
Vomerine flap; Cleft palate; Healing

Introduction
The aim of surgical repair of a cleft palate is to restore anatomical separation of the oral and nasal cavities to facilitate speech and prevent nasal regurgitation. A vomerine flap, facilitates single layer primary closure of the hard palate, using a mucoperiosteal flap and leaving raw bone behind. This was first described by Pichler in 1926 [2]. Many surgeons incorporate this vomerine flap at the same time as completing the cleft lip repair, as popularised by Oslo [3,4]. However, there is little in the literature about the underlying mechanism of the healing of the raw areas and exposed bone.

Animal histological studies suggest two mechanisms of healing. Epithelialisation from the mucosal edge, healing by secondary intention scar contraction or a mixture of both [5,6]. It has also been shown that complete mucosal wound healing of 6 mm lesions in the oral cavity takes 15 days [1].

Several contributory factors explaining the minimal scarring of oral mucosa have been reported, including unique fibroblast phenotypes, reduced inflammation and growth factors present in saliva and the moist environment [7,8]. Animal studies have demonstrated that saliva application can even enhance skin wound healing and reduce inflammation [9-13], a phenomenon which may be attributable to the presence of Epidermal Growth Factor (EGF) [11] Red Duroc pig models resemble human wound healing in both skin and oral mucosa [14-17] and have shown that scar formation in oral mucosa is significantly reduced both clinically and histologically, compared to the scarring in a skin wound [16,17].

Direct visualisation of vomerine healing may enhance our understanding of the mechanism by which the healing occurs. This article documents the healing of a single layer vomerine flap utilised in an anterior hard palate cleft repair using serial intraoral photographs. These photos provide insight into the distinct phases of recovery from surgery in the oral cavity.

**Materials and Methods**

This is an observational, single case study following vomerine flap and lip repair as the first stage of the primary Closure of a complete Unilateral Cleft Lip and Palate in a six month old child (CUCLP). This technique is known as the Oslo sequence [4]. Images were taken, using a 120 degree Karl Storz endoscope (The Karl Storz 7230 EA Hopkins II Rod lens Endoscope 18cm x 4mm), of the roof of the mouth, pre- and postoperatively in the anaesthetised child. Subsequently, photographs were taken daily for 15 days in the outpatient setting. The child had clear liquids for 2 hours prior to the photographs to reduce obscuring the images. Photographs were then taken weekly for a further 3 weeks. Parental consent was obtained for all images.

**Results**

Over 300 images were taken of the healing palate to visualise the healing process. Figure 1 demonstrates the preoperative image of the hard palatal cleft. Having reviewed all the images, healing appears to occur in 4 phases. Within 24 hours, an exudative fibrin clot is present over the central exposed area [Figure 2]. This clot remained until day 9. On day 10, pink islands were seen through the slough, and palatal mucosalisation was noted to extend from the free palatal edge [Figure 3]. On days 10-14, the depth of the base of the flap advanced towards the oral surface with some inflammatory exudate still present [Figure 4]. On day 18, mucosalisation of the...
Discussion

Wound healing is a complex pathophysiological process orchestrated by multiple factors, occurring in several phases; haemostasis, inflammation, tissue formation and remodelling [18-21], which overlap in time. Fibroblasts are pivotal to this process. Fibroblast synthesis is the ground work for regeneration including collagen and ground substances [17-20]. Following this, myofibroblasts mediate wound contraction through small muscle proteins actin and tenascin C [21]. There are various differences between mucosal and cutaneous wound healing. Firstly, mucosal wounds demonstrate accelerated healing with minimal scar formation, with hypertrophic scarring occurring far less frequently than in cutaneous wounds[17]. Another difference between mucosal and cutaneous wound healing is the reduced inflammation seen in oral wounds. They contain lower concentrations of inflammatory cells and cytokines [11,14,17,19], while undergoing the same stages of wound healing. It has been demonstrated that healing mucosal wounds contain fewer macrophages, neutrophils and T cells as well as other inflammatory cytokines when compared to cutaneous wounds [11,20]. Oral wound beds have also been shown to be less vascular than cutaneous wounds, with lower expression of vascular endothelial growth factor [21]. Dog cheek models demonstrated that despite having a muscle base, epithelialisation follows a similar pattern to cutaneous healing from wound edges [22,23]. While little remains known of the mechanism of healing post palate repair, our study is the first to provide a visual record and establish a timeline of the process. The images shown in this study support two mechanisms of vomerine flap mucosalisation. On day 10, pink islands were seen below the slough, which were thought to be islands of mucosa. These images suggest healing by granulation and re-epithelialisation. On days 10-14, the depth of the base of the flap advanced towards the oral surface, suggesting an additional element of secondary intention healing with scar contraction. A randomised controlled trial in CUCLP, comparing soft palate repair first versus hard palate and lip repair first and their effect on the maxillary arch form, three months post-operatively, showed no change in the intertuberosity distance between either method. The anterior first technique had a significant narrowing of the anterior alveolar gap and of the intercanine distance, but not with the soft palate first technique, supporting that contracture may also be involved in the closure mechanism of the raw vomerine flap.
Conclusion

This paper records photographic images of the healing process of a vomerine flap repair. Epithelial ingrowth beneath a fibrin clot starts shortly after the initial operation. While epithelialisation occurs from the palatal edges, the wound also heals three dimensionally by filling and contracting from its base. It is possible that both methods of healing occur in vomerine flap healing in succession, with the images taken supporting theories from previous animal models. The images also support the idea that vomerine wound healing follows the same pattern as cutaneous wound healing, but at a faster rate.

References
