REVIEW ARTICLE

THE MODIFIED FURLOW PALATOPLASTY

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Abstract

The goals of cleft palate surgery are to achieve closure of the palate, separating the oral and nasal cavities, thereby allowing for normal speech and swallowing function, whilst optimizing maxillofacial growth.[1] The timing of surgery and technicalities of procedures employed to achieve anatomic closure of the cleft remains an active area of investigation. This discussion reflects the competing treatment priorities of achieving functional reconstruction whilst optimizing midfacial growth. Earlier surgery with more radical dissection may achieve better re-alignment of structures and speech outcomes; however this can be at the expense of harmonious facial growth as the vascular supply of the growing mid-face is impeded. Cleft surgeons have therefore striven to devise procedures that are able to restore the form and function of the palate whilst minimizing this disruption. The Furlow palatoplasty, first described in 1978,[2] makes innovative use of z-plasties to lengthen and re-orientate the musculature of the soft palate. It has the benefits of elegant simplicity, it is easy to teach and does not require a microscope to perform and good speech outcomes have been reported, however it has been criticized for the non-anatomic repositioning of the velar musculature. The original procedure has been adopted, and modified by multiple centres worldwide. In this paper we review the use of modified Furlow procedures for primary palate repair.

Key words: palatoplasty, modified Furlow, cleft palate

1. Introduction

Cleft lip and palate is the most common congenital craniofacial anomaly affecting children in the United Kingdom; being present in 1 in 700 live births (NHS Choices). A cleft of the palate disrupts the carefully balanced structures that are responsible for speech production. In the normal palate the Levator veli palatini muscle forms a sling by taking a transverse course to suspend the soft palate from the base of the skull. In a cleft palate the Levator veli palatini is positioned sagittally, running anterior - posterior. This prevents the levator from performing its physiological function of forming a competent velopharyngeal sphincter thereby resulting in velopharyngeal incompetence (VPI).[3] This is manifest by characteristic speech abnormalities.

The goals of cleft palate surgery are to achieve closure of the palate, separating the oral and nasal cavities,[1] and to restore velopharyngeal competence.[3] There are several different operations described for this purpose and ongoing debate about which deliver the best outcomes. There is controversy about the timing of surgery, as early surgery allows the development of normal speech but contributes to changes in midface growth. Multiple studies have shown poorer speech outcomes in patients whose cleft palate repairs have been delayed beyond 18 months of age.[4,5] However, delaying surgery to avoid injury to bony structures then affects speech. Conversely, cleft care teams in the developed world have been able to achieve normal cephalometric outcomes in patients having had palate repairs as early as four months of age through the use of orthodontic and orthognathic treatments.[6] Risks associated with palate repair include velopharyngeal insufficiency and oronasal fistulae both of which may require further secondary surgery.[1]

With this in mind there is ongoing effort to develop a procedure that achieves the aims of normal speech and maxillofacial growth. The Furlow palatoplasty was first described in 1978.[2] Double opposing z-plasties are used to lengthen the soft palate and re-orientate the elevator muscle, recreating the elevator sling. This creates a functional soft palate for velopharyngeal competence. Secondly, the hard palate is closed without lateral relaxing incisions, in an attempt to avoid impeding bony growth.

Since the 1980s the Furlow palatoplasty has been adopted by cleft surgeons worldwide. A recent survey of practice found that 42% of surgeons use the Furlow procedure for their palate repairs.[7] It has been highlighted that the Furlow procedure may be challenging in patients with wide clefts, and some centres are carrying out two stage procedures. However this has a number of disadvantages; it is less cost effective, leads to less compliance and more importantly is more traumatic for patients and their families.[8] Furthermore there is concern that there is a higher fistula rate in wider clefts due to the avoidance of relaxing incisions.[4] Various modifications have been proposed to ameliorate these concerns.

2. Methods

A literature search of PubMed, Google Scholar and Ovid databases was performed, using key words "Furlow", "palatoplasty", "modified Furlow". Papers published in English were reviewed by the authors.

3. Literature Review

After hearing Furlow speak at a conference in 1978, Randall returned to the Children's Hospital of Philadelphia and began to utilise the Furlow technique. Kirshner *et al* in 1999 published what was then the largest series of patients managed by this technique.[9] Their modifications varied based on the Veau classification. For Veau II clefts a V-shaped medial incision at the cleft margin was used. For Veau III-IV the medial incision was extended to the alveolus and vomer flaps were used for closure of the nasal side of the hard palate. The majority of clefts also had von Langenbeck-type relaxing incisions. In this paper they only commented on speech outcomes, with 7.2% requiring further surgery for VPI.

Jackson *et al* 2013 then published an update of their experience at the Children's Hospital of Philadelphia.[4] They reported what is the largest cohort of patients undergoing modified Furlow palatoplasty; 869 over a 30-year period from 1980. The oronasal fistula rate was 5.2%. Speech outcomes were available in 559 patients, with 8.1% requiring surgery for VPI.

Bindingnavele *et al* reported on their case series of 500 patients in 2008.[8] They wanted to reduce the tension of closure of the hard palate. To do this they islandize the hemipalate on the greater palatine pedicle, allowing greater movement. 332 patients had a Furlow + islandization and 168 had Furlow alone. Their overall oronasal fistula

rate was 5%, 2.1% in the modified group and 10.6% in the standard Furlow repair.

Yamaguchi *et al* 2009 reported a modification of the Furlow palatoplasty, using smaller double opposing z-plasties in the soft palate and then various relaxing incisions in the hard palate, based on their intraoperative findings.[10] They carried out a retrospective review of 231 cases and reported an oronasal fistula rate of 0.4% and VPI requiring surgery rate of 5.5%.

Chorney *et al* 2017 published a case series of patients operated on by a single surgeon.[1] They included all patients <18 years old with an unrepaired cleft palate +/- lip. 312 patients were included, 289 of which had a modified Furlow procedure. The modifications included a hockey stick extension incision laterally on the oral mucosa side, allowing further advancement of the oral mucosa as it is transposed. Secondly patients had a vertical releasing incision of mucosa along nasopharynx to allow further movement of nasal muscle flap, thereby allowing closure of almost any size of cleft. They reported a rate of pharyngeal flap surgery for VPI insufficiency of 5.1% and oronasal fistula rate of 15.4%.

Funayama *et al* 2014 published a comparison of three types of cleft palate repair and their speech outcomes at 4 and 8 years of age.[11] This included one stage pushback procedure, one stage modified Furlow and two stage modified Furlow. They found no difference in the velopharyngeal function, but significant differences in misarticulation caused by fistulae/unclosed palate (worse in patients who had a two stage modified Furlow procedure). Their modification included intravelar veloplasty (IVVP), z-plasty limbs less than 10mm in length and patients also had preoperative orthodontic treatment.

Only two papers specifically looked at the effect on midface structures. Kim *et al* compared measurements from 36 cleft patients who underwent a modified Furlow palatoplasty with measurements from the normal population (age and gender matched).[12] They included less detail on what their modification was, simply stating vomer flap or lateral relaxing incisions were used as required for tension free closure. They found significant differences in the mandibles of cleft patients compared to the normal population. There was backward inclination of the anterior mandible,

decrease in midface and mandibular length and downward rotation of the mandible.

LaRossa *et al* 2004 reported further information regarding outcomes for the cohort of patients treated at the Children's Hospital of Philadelphia.[13] They conducted anthropomorphic studies in a group of 50 patients who had complete unilateral clefts treated with their modification of the Furlow procedure. They did not note any adverse effects on midface growth. In a second group of 47 patients followed up by the orthodontic team there were no posterior crossbites and anterior crossbites were minimal. However no further detail was give about what measurements were taken or if any comparison was made with an unaffected population.

4. Discussion

Our review shows that the modified Furlow technique is in reality a number of different procedures, all aiming to improve on the original Furlow procedure. Oronasal fistula rate varied from 0.4 - 15.4% and VPI requiring further surgery from 5.1-8.1%. This is comparable to other types of procedure used for cleft palate repair. It is very difficult to directly compare these papers as all used different inclusion criteria, different surgical techniques and different criteria for their outcome measures. Whilst these procedures are achieving the goal of acceptable speech outcomes there is still little evidence for their effect on midface growth. A recent systematic review attempted to compare speech outcomes between Furlow techniques and straight-line intra-velar veloplasty based on published evidence. The authors found significantly reduced rates of secondary speech surgery and fistulation rates in the Furlow groups, as a proxy of speech outcomes.[14] They noted however that outlying papers describing superior results of intravelar veloplasty reflected the operator dependent nature and learning curve required for performing this technique.

One of the benefits of the Furlow technique is that it is possible to perform without the use of an operating microscope. It is also simpler to perform than some other techniques. This means it is potentially more widely applicable across different resource settings. In fact it was noted by Jackson et al that whilst there was a steep learning curve with their modification, there was not a significant difference in fistula rate between surgeons of varying experience.[4] Further supporting its use in a variety of settings.

This review is a narrative analysis of the evolution of the Furlow technique of cleft palate repair. It is consequently limited in scope compared to a meta-analysis of comparative outcomes between cleft repair techniques. However, all authors in the field have reflected that the heterogeneity of techniques, timing of surgery, outcome measures and reporting make such analysis highly challenging.

5. Conclusion

The modified Furlow technique is a broad term encompassing a number of variations on the original Furlow palatoplasty. To enable future comparisons it would be beneficial for uniform reporting of outcome measures to be adopted. In particular more detail regarding maxillofacial growth is required before it is clear that this procedure achieves the goal of normal speech and bone growth.

6. References

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