

# Pros and cons of the Sommerlad and Furlow palate repair techniques

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*Contributions:* (I) Conception and design: JH Grant; (II) Administrative support: JH Grant, E Soto; (III) Provision of study materials or patients: JH Grant; (IV) Collection and assembly of data: AC Braswell; (V) Data analysis and interpretation: None; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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**Abstract:** The Furlow double opposing Z-plasty first introduced by Dr. Leonard Furlow and Sommerlad repair with intravelar veloplasty (IVVP) initially described by Dr. Brian Sommerlad have both grown in popularity since their conception and are now the two most popular techniques for cleft palate repair. Both have been demonstrated to be safe and effective techniques for cleft palate repair, and while many surgeons have a strong preference for either the Furlow or Sommerlad technique, no definitive study exists demonstrating superiority of one over the other as each method of repair is accompanied by its own unique list of pros and cons. For example, though the Furlow repair is known for its profound ability to lengthen the soft palate, this type of repair is not as effective when utilized in the context of a wide cleft palate. Likewise, while the Sommerlad IVVP fully repairs the velar muscular sling and potentially reduces velopharyngeal insufficiency (VPI), the straight midline scar produced can limit palatal movement. This manuscript will review the introductory and existing literature for each technique, discuss anatomic differences between the two approaches, and point out particular strengths and weaknesses of both repair methodologies. This is a level 4 clinical evidence expert summary based on non-systematic reviews of the literature.

**Keywords:** Cleft palate; hard palate; Furlow Z-plasty; Sommerlad repair; intravelar veloplasty (IVVP)

Received: 22 December 2022; Accepted: 05 June 2023; Published online: 20 June 2023.

doi: 10.21037/fomm-22-72

View this article at: <https://dx.doi.org/10.21037/fomm-22-72>

## Furlow double opposing Z-plasty technique for cleft palate repair

The Furlow double opposing palatoplasty was first introduced by Dr. Leonard Furlow in 1986 (1). His initial paper was a small series with limited follow-up and an unquantified speech outcome evaluation. Despite these apparent shortcomings, the technique immediately gained popularity and has since become the mainstay of many surgeons, particularly in the United States. The initial appeal of the double opposing Z-plasty technique likely

results from its application of tried-and-true plastic surgery principles. The Z-plasty has long been used to add length to any surgical incision by borrowing from the transverse width (2). With that said, a longer palate and a slightly narrowed nasopharynx would appeal to the goals of both optimizing palatal mobility and potentially increasing nasal airway resistance. Another potential strength of the Furlow method includes the fact that the non-overlapping suture lines afforded by the double opposing nature of the repair should in theory result in a decreased risk of fistula.

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Should one incision have difficulty healing, it should be less likely to propagate to the next layer since the incisions do not directly align with one another. A Furlow cleft repair also involves moving the muscles of the palate in concert with the nasal and oral mucosal flaps respectively. Since the muscles always travel with the posteriorly based mucosal flap, the surgeon is able to construct a variation of a levator sling. Additionally, this method can be applied to both primary repairs and to secondary revisions to address velopharyngeal insufficiency (VPI) (3). For these reasons, the Furlow repair had an immediate appeal and has soared in popularity becoming one of the most used techniques in the United States.

The Furlow repair does suffer from a few known and theoretical weaknesses. The greatest identified weakness is the lack of strength afforded by the anterior mucosal flaps (4). The nasal lining flap in particular is quite thin and friable. Surgeons have noted the difficulty of achieving primary nasal lining closure laterally, if the nasal myomucosal flap is fully released. This known liability has led surgeons to make various modifications over the years since the initial description by Furlow. These modifications include augmenting the nasal lining with biologic alloplastic materials such as AlloDerm (5) as well as modifying the flap design by either moving it further posteriorly in the palate or limiting its size (6-8). Furthermore, other surgeons have advocated bringing additional tissue into the repair with the buccinator myomucosal flaps, popularized by Dr. Robert Mann being the most notable (9,10). Another consideration notes that while the Furlow palate repair does create a functional levator sling, its very design means that the two levator muscles are never actually brought into direct contact with one another. Since the oral myomucosal flap brings all the soft palate musculature along with it, the levator muscle is on the deepest (most nasal) surface of this flap. The posteriorly based nasal myomucosal flap also has the levator muscle on its deepest surface adjacent to the nasal lining. When these flaps are transposed and overlapped, there is a layer of palatal depressor muscles (palatoglossis and palatopharyngeus) between the two levator muscles which make up the levator sling. This means the two levator muscles are never actually brought into contact with one another. Video fluoroscopy of patients status-post Furlow show a twisting of the palatal musculature that probably reflects this non-anatomic construct (11,12). Lastly, and perhaps most importantly, the degree of levator sling overlap is determined by the initial design of the Z-plasty before the location of the levator

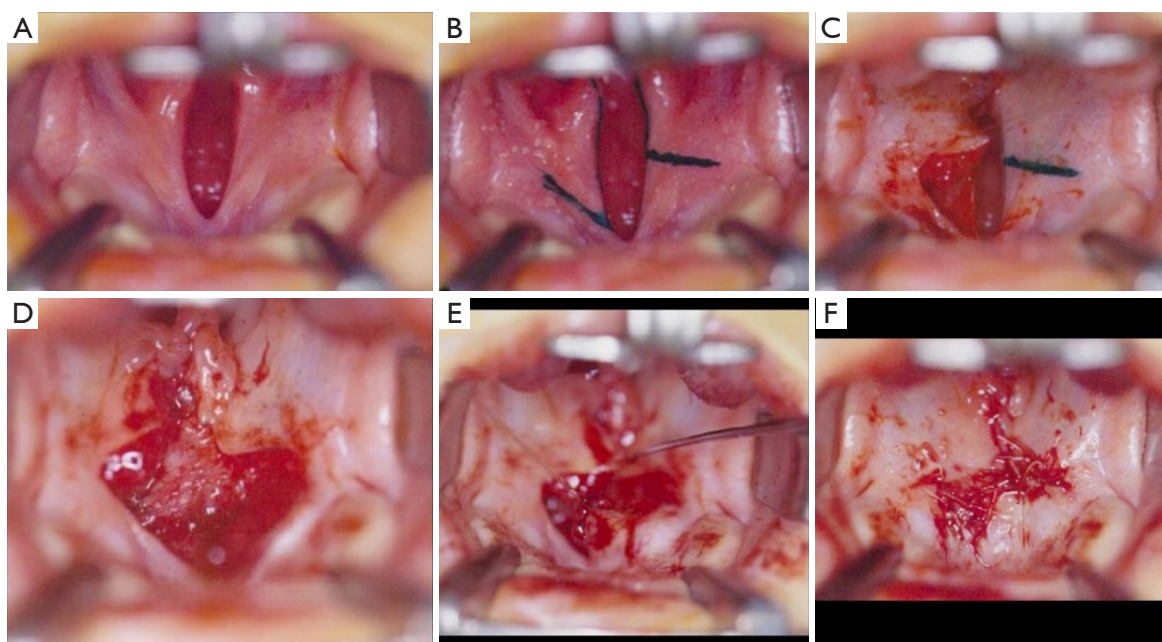
muscles is known for the specific patient. Not all cleft palate anatomy is the same, and there is known variability in the exact levator veli palatini muscle orientation from one patient to another (13). To emphasize, one cannot accurately predict the specific location of the levator muscles in any individual patient since these muscles cannot be seen or palpated from the oral view. The design of the oral mucosal flaps, and this design alone, predetermines the final location of the reconstructed levator sling based on the mucosal flap design and not on the muscles which ultimately determine palatal function. This principle may help explain an apparent trend toward moving the Z-plasty design more posteriorly in the palate (14-16). Because the origin of the muscles on the skull base is fairly constant, a more posterior location of the bases of the myomucosal flaps would tend to favor a more transverse position of the levator sling. However, that could come at the expense of omitting some of the most antero-medially located portions of each levator muscle from the repair. Perhaps the apparent lack of a need to directly repair one levator to the other compensates for this theoretical design flaw.

The advent of MRI imaging of the palate, especially for revision palatoplasties addressing VPI after primary repair, may help ameliorate this problem with anatomic variability by allowing the surgeon to know in advance the exact location of the paired levator muscles prior to designing the incisions (17). This imaging would be especially helpful if paired with augmented reality technology to allow the surgeon to “see” the levator muscles deep within the palate prior to making a surgical plan.

In addition to the Furlow’s popularity in primary cleft palate repair, the method has also shown success in treatment of VPI or inadequate closure of the velopharyngeal valve after primary palatoplasty (*Figure 1*) (16). The secondary Furlow palatoplasty is able to address VPI by lengthening the palate, tightening the velopharyngeal port, and addressing the anatomy of the levator sling (18,19). Additionally, the technique is advantageous in its versatility as it can be used in essentially all VPI patients regardless of the primary palatoplasty technique (20). The potential downfalls of the secondary Furlow are similar to those previously discussed in regard to the primary repair.

### Sommerlad radical IVVP

When Sommerlad first published his research regarding radical IVVP (isolation of the levator muscle pair and anatomic reconstruction of the levator sling) it was in a



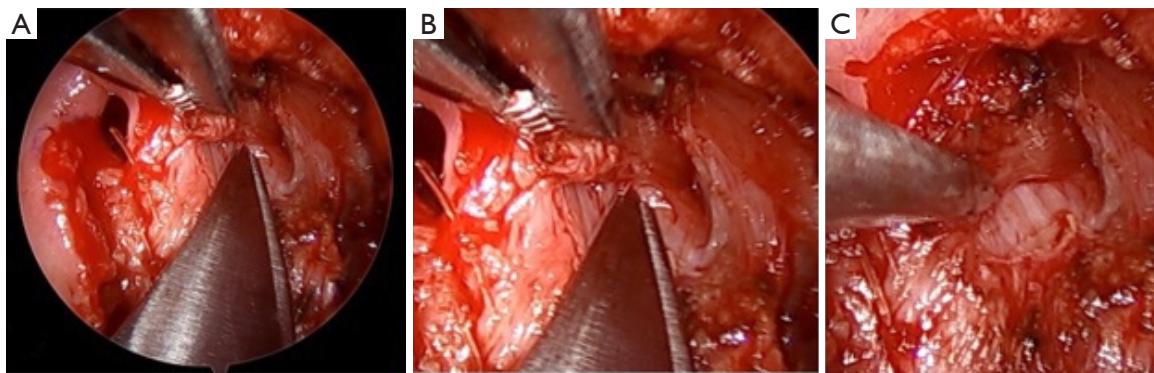
**Figure 1** Furlow palatoplasty. (A) Veau 1 cleft of soft palate; (B) markings; (C) left sided oral myomucosal flap elevated; (D) right sided anteriorly based oral mucosa only flap reflected showing right sided nasal myomucosal flap and left sided nasal lining flaps transposed; (E) demonstrates transposition of oral lining flaps; (F) repair complete.

large series of redo palate repairs (21). His subsequent work applying the technique to primary palate repairs was done after data from the revision series showed such promising results (22). Sommerlad's technique built on work by Liston, Billroth, Kriens, and Cutting (23-26) in order to reconstruct the levator sling to improve the palate's ability to lift upward and backward.

Sommerlad addresses the hard palate cleft at the time of the cleft lip repair with a single layer vomerine flap. This maneuver essentially converts all cleft lip and palate patients to a Veau 1 cleft of the soft palate. Then at a later procedure addressing the soft palate, Sommerlad's technique uses the operating microscope and delicate sharp dissection to individually mobilize the individual levator muscles, separating them from the adjacent palatal depressors as well as from abnormal insertions into the nasal lining (22). This "radical" dissection is not radical in the sense of a radical mastectomy and might instead be termed "extensive". Fully liberating the LVP muscles from the point of their entry to the palate via the levator tunnel all the way to their most antero-medial insertion on the nasal lining allows a tailored, patient-specific reconstruction of the levator sling, and unlike the Furlow procedure, actually attaches levator to levator (*Figure 2*). This direct visualization of the repaired

levator sling appeals to surgeons who want control over that specific anatomy. Another strength of Sommerlad's initial publication was the very careful and neutral evaluations of his speech outcomes (21). The speech evaluation was performed on a series of 106 patients by recording a standardized speech sample and then sending these recordings to a speech language pathologist with whom he was not affiliated, in an effort to minimize any bias. The results were graded on hypernasality, nasal turbulence, nasal emission, hyponasality, and intelligibility parameters and were scored with a color-coded system that is very easy to interpret visually. Sommerlad's initial and subsequent publications regarding this technique provide long term follow-up and even show a progressive improvement in outcomes with surgeon experience.

Theoretical weaknesses of Sommerlad's technique are a straight midline scar which can complicate the repair by forming a linear scar contracture, limiting palatal movement. For this reason, some surgeons add a simple Z-plasty to the oral lining closure, and sometimes both oral and nasal (27). The "Furlad" repair is slang for a combination of the Furlow and Sommerlad techniques. In this particular amalgamation, the Z-plasty flaps are designed, then once exposed, the individual levator muscles



**Figure 2** IVVP. Examples of levator veli palatini dissection. (A) Muscle can be circumferentially dissected allowing patient specific repositioning and tensioning. Laterally as it enters the palate from the levator tunnel, there are no attachments to the mucosa or tensor (there is an intervening fat pad). (B) The abnormal insertions to the nasal lining have been taken down in these images and the muscle is being held in its “new” position. (C) The remainder of the palate repair is standard closure of oral and nasal lining. IVVP, intravelar veloplasty.

are sub-dissected from the flaps to allow for a more controlled repositioning. Another perceived obstacle is Sommerlad’s emphasis in his published work on utilizing the surgical microscope. This has seemed too complicated to many and may have led some surgeons to avoid the technique because of perceived inconvenience or lack of resources. The widespread availability of high-quality loupes has perhaps made the dissection quite feasible without the microscope. Fears that the extensive dissection might lead to increased complications like a higher fistula rate have not been seen in most large series (28,29).

The Sommerlad palatoplasty technique is also used for secondary repair to address VPI. As previously mentioned, the technique itself was initially analyzed in the context of redo palate repairs and continues to be used in such capacity (21). The basis for Sommerlad’s technique is an increase in the functional length of the velum though a combination of extensive dissection and limited scarring that can potentially compromise velar function. The potential downfalls are similar to those previously described.

To conclude, it is also worth noting that there are regional influences that may determine the likelihood that a surgeon will utilize a particular technique. When comparing these techniques, the potential advantage of Furlow’s Z-plasty include: (I) prevention of aberrant maxillary development, (II) transposition of abnormally attached muscles into a more functionally anatomical position, and (III) elongation of the soft palate. However, it may not be feasible for all types of clefts, such as particularly wide cleft palates. Sommerlad’s advantages are (I) limited dissection of the hard palate to prevent scarring and midface hypoplasia,

(II) reduced rate of VPI surgery by fully restoring the velar muscular sling and (III) decreased lateral tension with potential for decreased formation of a fistula. Although a 2014 systematic review reported no difference in fistula rates between techniques, we lack universal metrics to assess speech development and evaluate the impact of technique on different cleft phenotypes. Furthermore, timing of palatoplasty is still debated and lacks high quality evidence. In most series, cleft severity, extent of hypoplasia, and cleft width are highly variable. While surgeons trained in the US are more likely to use the Furlow, those in the UK and much of Europe seem more likely to have trained using a variation of Sommerlad’s technique (30). The CORNET study, currently underway is a prospective multi-institution, multi-year study comparing the Furlow and Sommerlad techniques. The study will assess speech outcomes (blinded analysis of video recordings), complications (fistula, return to operating room, readmission to the hospital etc.), and facial growth. It will hopefully provide information to help surgeons decide upon the best palatoplasty technique to use for their patients.

### Acknowledgments

*Funding:* None.

### Footnote

*Provenance and Peer Review:* This article was commissioned by the Guest Editor (Chung H. Kau) for the series “Managing Craniofacial and Dentofacial Disorders–

Simplified Solutions for Difficult Situations” published in *Frontiers of Oral and Maxillofacial Medicine*. The article has undergone external peer review.

*Peer Review File:* Available at <https://fomm.amegroups.com/article/view/10.21037/fomm-22-72/prf>

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <https://fomm.amegroups.com/article/view/10.21037/fomm-22-72/coif>). The series “Managing Craniofacial and Dentofacial Disorders – Simplified Solutions for Difficult Situations” was commissioned by the editorial office without any funding or sponsorship. The authors have no other conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from the patients for publication of this manuscript and any accompanying images.

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doi: 10.21037/fomm-22-72

**Cite this article as:** Grant JH 3rd, Braswell AC, Soto E. Pros and cons of the Sommerlad and Furlow palate repair techniques. *Front Oral Maxillofac Med* 2023.