

Tissue Rearrangements

The Power of the Z-Plasty

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KEYWORDS

• Burn scar • Contracture • Z-plasty • Adjacent tissue rearrangement

KEY POINTS

- The z-plasty is a highly versatile standard technique of reconstructive burn surgery.
- The z-plasty can elongate tissue along a scar or contracture, narrow a scar in its transverse direction, rearrange the direction of a scar along relaxed skin tension lines, disperse and camouflage scar tissue in favor of cosmesis, and release tension, which ultimately reduces inflammation and hypertrophic scarring.

INTRODUCTION

The z-plasty could be considered one of the oldest tricks in every book of plastic and reconstructive surgery. Its versatility and universal applicability have placed it at the center of various publications over several centuries. Fricke and Horner described single transpositional flaps as early predecessors of the z-plasty as early as 1829.^{1,2} While surgeons such as Serre and Denonvilliers further improved the geometry of the technique and were using it for the correction of facial deformities and lower lid ectropion in the mid 1800s,^{3,4} the earliest publication of what is considered the standard contemporary z-plasty with equal limb dimensions and angles is attributed to French surgeons Berger and Bonset in 1904.⁵ The early 1900s saw a series of articles by Mc Curdy, who first coined the term in use today and introduced the technique to the correction of burn scars.^{6,7} In 1946's first volume and second article in *Plastic and Reconstructive Surgery*, Davis evaluated and

summarized the z-plasty and its variations as indispensable and versatile techniques.⁸ Since then, innumerable variations of the basic surgical concept and new potential applications have been published throughout the century by surgical pioneers such as Morestin, Davis, Limberg, and others.^{9–11}

To think of the z-plasty solely as workhorse of plastic and reconstructive surgery falls short of its actual impact on virtually all surgical specialties:

General surgeons have shown it to be useful in the treatment of sinus pilonidalis.¹²

Oralmaxillofacial surgery uses it regularly in cleft palate repair.^{13,14}

Neurosurgeons have treated myelomeningocele¹⁵ similar to how orthopedic surgeons ameliorated patellar compression syndrome¹⁶ with a variation of the z-plasty

Aesthetic surgeons improve the appearance of both genital¹⁷ and facial¹⁸ labia with this technique.

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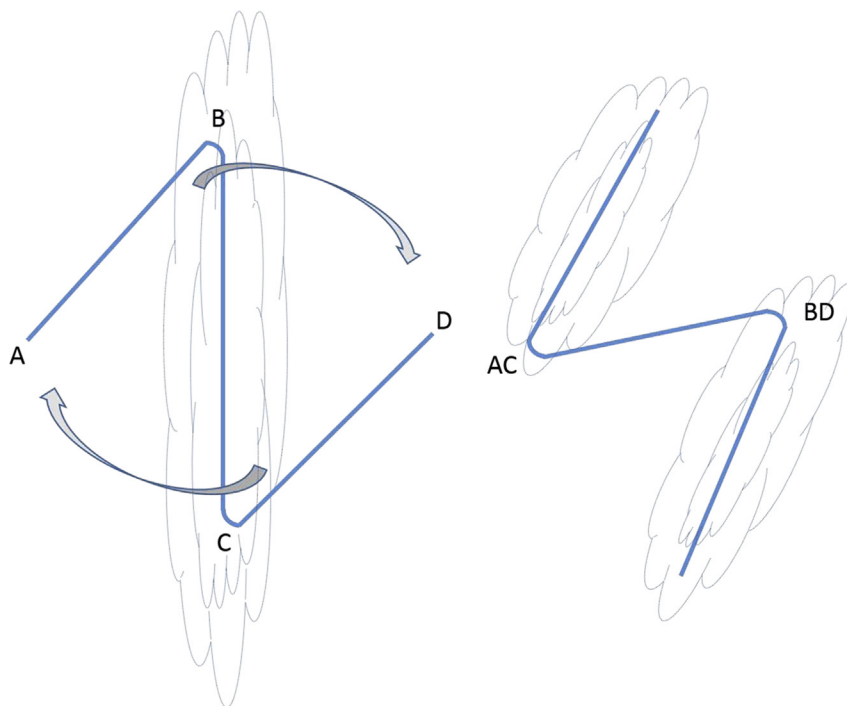


Fig. 1. Basic principle of the z-plasty: 2 opposing triangles of equal angles to a central incision along the line of tension are transposed. The result is a break up and lengthening of scar tissue and redirection of the scar in perpendicular direction.

PRINCIPLES

The basic idea of the z-plasty was best described by Limberg, who highlighted the flap's simultaneous rotational and advancement properties and deduced its versatility from this unique combination.¹¹ The main objectives of the z-plasty are

1. Elongate tissue, usually along a scar or contracture, to release tension and enable mobility
2. Narrow a scar in its transverse direction
3. Rearrange the direction of a scar, favorably along pre-existing relaxed skin tension lines (RSTLs)
4. Disperse scar tissue in favor of cosmesis
5. Soften and thin scar tissue

Technique

Fig. 1 illustrates the concept of rotation and advancement of the classic z-plasty: a central vertical incision is placed in line with the long axis of the scar or line of tension. Two lateral limb incisions of the same length as the central incision are placed at its ends in a 60° angle. Next, the resulting triangular flaps are raised to the desired plane and rotated toward each other so that their tips fall into place in their respective opposite

corners. The former shared sides of the triangles are now located toward flexible skin next to the limb incisions and a new, now horizontal, central limb is formed. The line of tension of the incised tissue is now perpendicular to its original direction. The costs for longitudinal elongation and elimination of 1 prominent scar are relative perpendicular tightening and 3 resulting smaller scars.¹⁹

Although this concept may appear simple and straightforward on the pages of a surgery textbook, its execution under real circumstances can prove to be challenging. Wanzel and colleagues²⁰ demonstrated that the ability of surgery residents to properly execute a z-plasty (which they termed a “spatially complex surgical skill”) correlated with their performance in visual-spatial ability testing. Those who scored lower according to their visual-spatial ability required more supplementary training and feedback to achieve comparable operative results, demonstrating how challenging this seemingly simple procedure can be.

Elongation, Remodeling, and Reorientation

Tissue lengthening in the direction of the scar contracture after z-plasty is a function of the angles of the limbs toward their central incision. Mathematically, an increase in angle will result in increased central elongation (**Table 1**). Likewise,

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