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“No Protractor, No Problem: A different angle on z-plasties.”

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Short Running Head: No Protractor, No Problem

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Z-plasty is a frequently used technique for scar revision and correction of free margin distortions in facial plastic and reconstructive surgery. Several variations of this transposition flap have been developed and described [1] making the z-plasty a versatile tool for elongation of contracted scars, realignment of scars to match relaxed skin tension lines, or to camouflage scars in natural skin creases. Z-plasties also allow the repair of defects near free margins of the face (eyes, nose, lips) without excision of additional tissue [2] following micrographic surgery. Finally, z-plasties are reliable and reproducible repair mechanisms with variable angles of lines drawn to create the transposable triangular flaps correlating to a known degree of central rotation and increase in scar length [2, 3].

Classically, the z-plasty is two triangular flaps created by three incisions. The central limb, or shared side of the triangular flaps, may be a scar to be modified or surgical defect for closure. Lines drawn at various angles from the central limb create the transposable, triangular flaps. The angle of these lines relative to the central limb determines the length gain of the scar and degree of rotation about the central axis, thus determining the overall effectiveness of the z-plasty.

Angles would ideally be measured with a protractor, and tools have been developed for this specific purpose [4]. This is often clinically impractical for small z-plasties. For surgeons desiring improved precision, we describe a method to accurately draw z-plasties at 60° , 45° , and 30° using easily identified clinical parameters and the trigonometric relationships of special right triangles (See **Figure, Supplemental Digital Content 1**, which shows trigonometric proofs of the relationships of special right triangles that allow creation of z-plasties at 60° , 45° , and 30° after measuring only the length of the defect to be repaired, [INSERT HYPERLINK HERE](#)).

First, divide the surgical defect or scar to be modified by drawing a perpendicular bisector (b), creating two equal segments of length x. Next, designate the proximal (a) and distal ends of the scar as pivot points. To create a 60° z-plasty, rotate a line the length of the original scar (2x) from each pivot point away from the scar until it meets the perpendicular bisector (Figure 1). The 60° z-plasty is frequently used as it offers 75% increased scar length and 90° change in direction [2].

To create a 45° z-plasty, measure distance x on each side of the scar along the perpendicular bisector. Connect this point to the pivot points creating an equilateral triangle (Figure 1) for a resulting scar that is 50% longer than the original [2].

Creation of a 30° z-plasty requires building on the 60° z-plasty design. First, draw a 60° z-plasty limb of length 2x as described above. Then draw a line that will create the 30° z-plasty, originating from the pivot point opposite line 2x and terminating at the midpoint of line 2x (Figure 1). Use a 30° z-plasty to achieve 45° of rotation about the central limb and 25% increase in scar length [2].

The availability of sterile rulers and surgical pens makes this a very useful and simple technique for determining accurate angles in z-plasty and other surgical reconstructive flaps.

References:

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Figure legend

Figure 1.

To design the various angles for the z-plasty, divide the surgical defect or scar to be modified by drawing a perpendicular bisector, creating two equal segments designated length x . The proximal and distal aspect of the surgical defect or scar will be designated as the pivot points.

For the 60° z-plasty (α), rotate from each pivot point (a) line $2x$ (length of scar) until it meets the perpendicular bisector.

For the 45° z-plasty (β), measure distance x from the center of scar along the bisector and extend a line from the pivot point to the point distance x on the perpendicular bisector creating an equilateral triangle.

For a 30° angle z-plasty (γ), start by drawing a 60° z-plasty as described above. Next, draw a line originating from the pivot point opposite the 60° z-plasty limb and terminating at the midpoint of the 60° z-plasty limb.

Supplemental Digital Content legend

Figure, Supplemental Digital Content 1.

Trigonometric proofs of the relationships of special right triangles that allow creation of z-plasties at 60° , 45° , and 30° after measuring only the length of the defect to be repaired.

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