

The square flap method

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Summary—We report a method for increasing the distance between two points on the skin surface by using two triangular flaps and a square flap. The theoretical lengthening is excellent when one of the triangular flaps is right-angled. The method has been used successfully in 40 cases of scar contracture, various clefts and cryptotia.

The Z-plasty or methods derived from it are frequently used for increasing the length between two points on the skin surface. We have devised a method with the same purpose which we name the "square flap method" consisting of two triangular flaps and a square flap. A similar method was described by Limberg (1963) which consisted of one square flap and two similar acute-angled triangular flaps (Fig. 1).

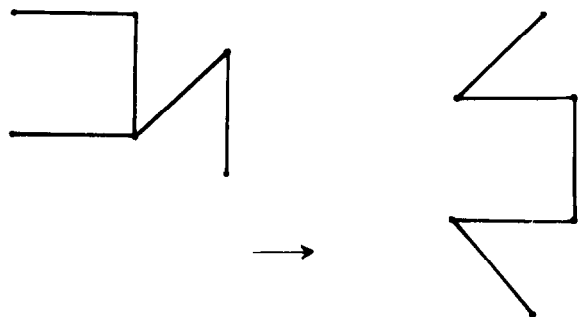


Fig. 1

Figure 1 The method noted in Limberg's textbook.

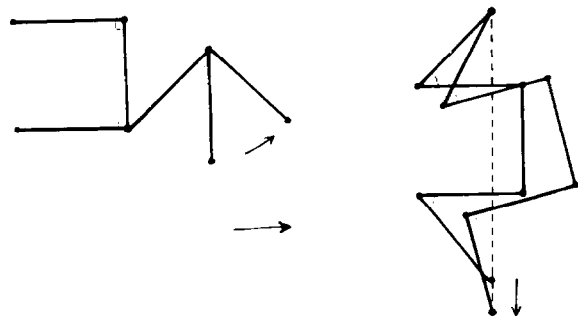


Fig. 2

Figure 2—Making the angle of one of the triangular flaps larger increases the lengthening effect and leaves no scar in the line of extension.

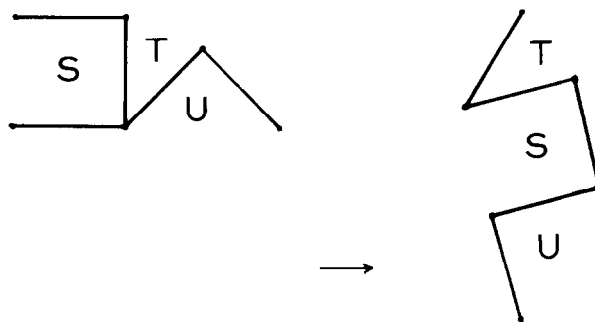


Fig. 3

Figure 3—Basic design of our method before and after transposing flaps.

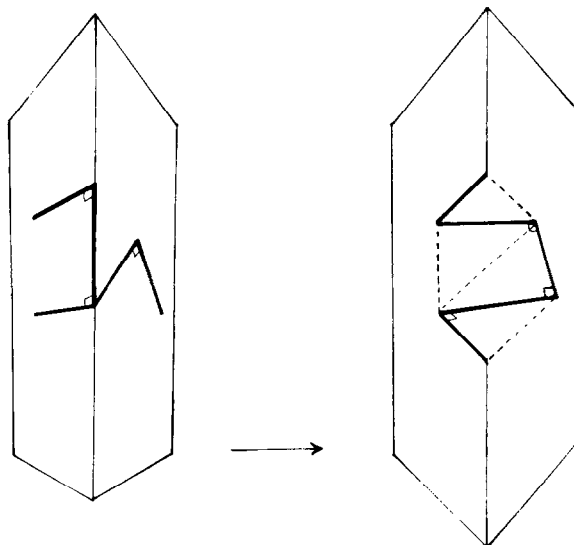
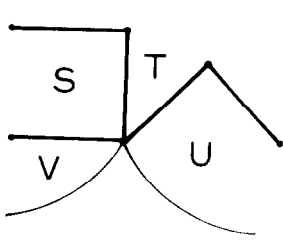


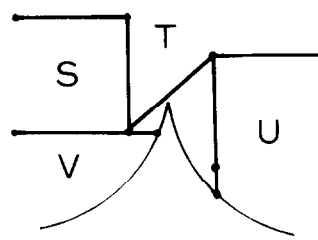
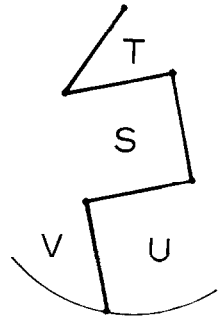
Fig. 4

Figure 4 Application of our method to the removal of scar contractures in a web-plasty.



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Fig. 5

Figure 5---Application of our method to cleft repair is shown. The area between the side of the S-flap and the side made by the cleft is named the V-flap.



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Fig. 6

Figure 6 Re-design of flaps to repair deep clefts.

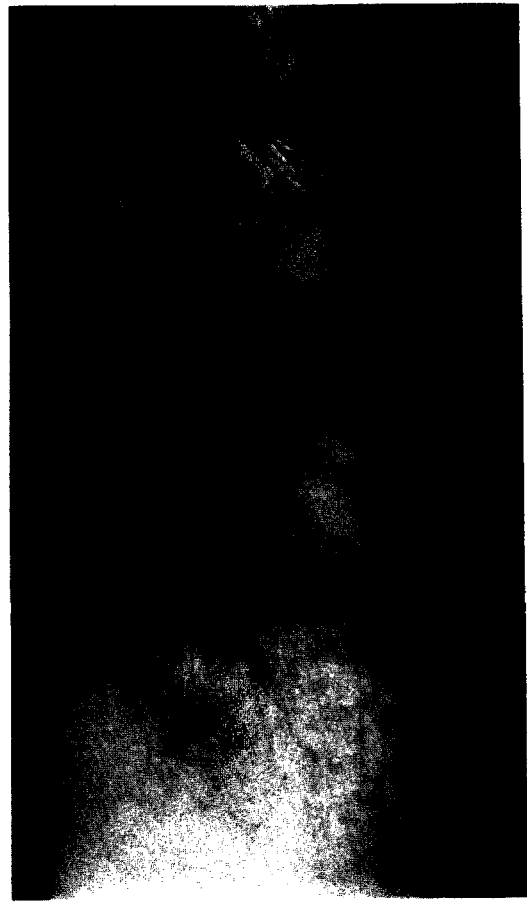


Fig. 7

Figure 7---(A, B) Case 1. (A) Preoperative design. (B) Two years after the operation.

Our method differs from Limberg's in that the tip of one triangular flap is a right angle. This gives better lengthening, better advancement of the square flap and avoids the suture lines running parallel to the direction of lengthening (Fig. 2).

Method

The fundamental design is shown in (Fig. 3). The flaps are named the S-flap, T-flap and U-flap and all their sides are the same length. The angle of the tip of the T-flap is, ideally, 45° and that of the tip of the U-flap should be a right angle.

This method is suitable when skin is available for advancing at right angles to the required direction

of elongation and is particularly good for correcting webs (Fig. 4). Moreover, it can be applied to cleft cases with the fundamental design shown in (Fig. 5). This design can be reshaped for cases of very deep cleft or cleft with double lobules in which small portions of the cleft are likely to be resected (Fig. 6).

Results

We have used the square flap method to reconstruct 59 scar contractures in 28 patients, 9 cases of cleft and 3 cases of cryptotia. The contractures were in 4 necks, 13 axillae, 4 elbows, 2 finger joints, 1 foot and 35 inter-digital webs. Two years have

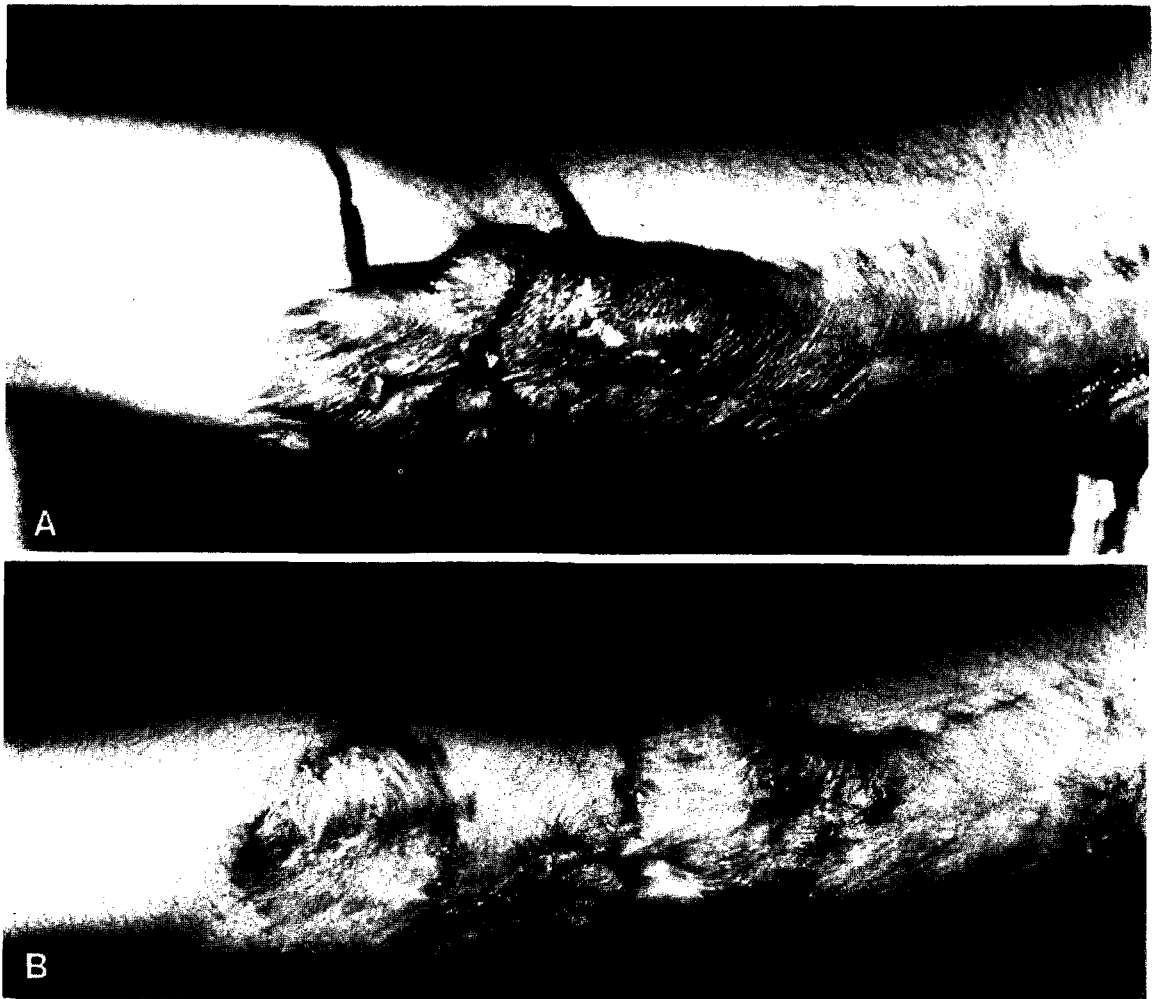


Fig. 8

Figure 8—(A, B) *Case 2.* (A) Preoperative design. (B) Nine months after the operation. Design is slightly modified (see Fig. 15).

elapsed since our first such case and, to date, the results of almost all of them appear to be more satisfactory than the usual Z-plasty or other methods derived from it. Especially excellent results have been obtained in repairs of axillary scar contracture (Hyakusoku *et al.*, 1985) and cleft earlobe.

Illustrative cases

Case 1

A 9-year-old girl had a scar contracture in her left axilla after burns. Our method was used to correct it. The

region where axillary hair will grow in the future was included in the square flap to avoid dividing it after the flaps had been transposed (Fig. 7).

Case 2

A 6-year-old boy had a scar contracture in his left elbow after burns. Our method was used to correct the scar contracture (Fig. 8).

Case 3

A 6-year-old boy had a congenital cryptotia of his left auricle. Our method was applied to elongate the distance between the helix and the temporal skin (Fig. 9).

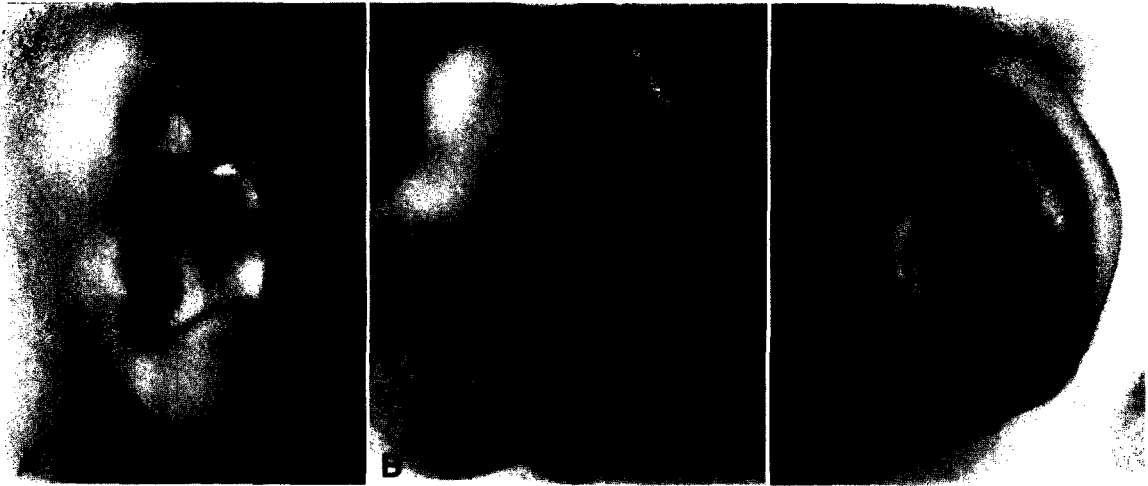


Fig. 9

Figure 9—(A, B, C) *Case 3*. (A) Preoperative view (B) Preoperative design of skin incisions. (C) One year after the operation. There is no recurrence of the cryptotia.



Fig. 10

Figure 10—(A, B, C) *Case 4*. (A) Preoperative view of the patient. (B) Preoperative design. (C) Eleven months after the operation.

Case 4

A 7-year-old girl had a congenital cleft earlobe in her left auricle. The square flap method was used to repair the cleft (Fig. 10).

Case 5

A 17-year-old girl had a congenital nasal cleft repaired by our method (Fig. 11).

Discussion

Various methods have been proposed for lengthening the distance between two points on the skin surface. The fundamental method is Z-plasty. The multiple Z-plasty, the four flap Z-plasty and double opposing Z-plasties are essentially derivations of it (Converse, 1977). The square flap method could be called a three flap Z-plasty (Fig. 12).

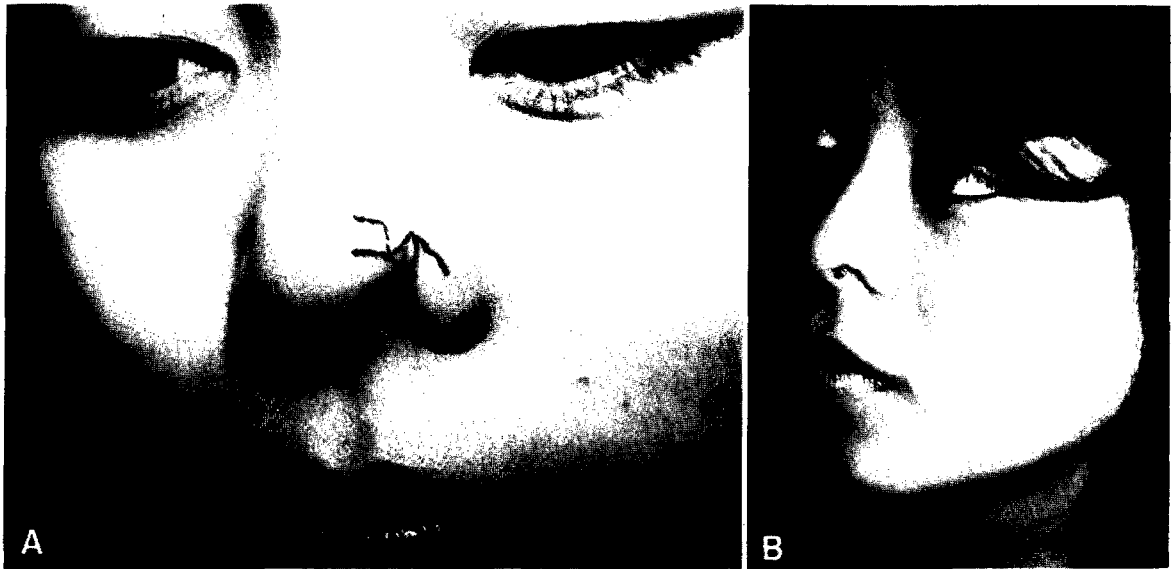


Fig. 11

Figure 11—(A, B) *Case 5*. (A) Preoperative design. (B) Six months after the operation.

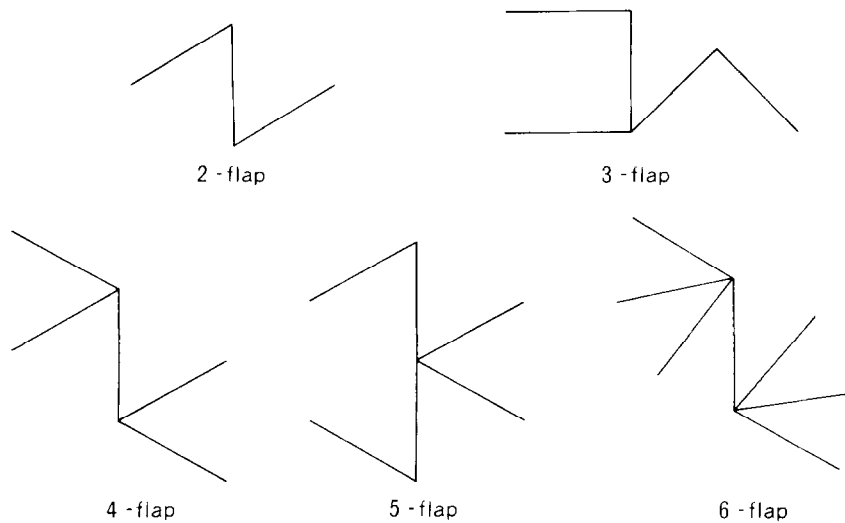
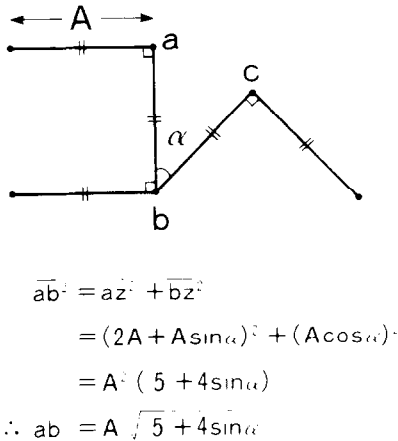


Fig. 12

Figure 12—The square flap method could be called a three flap Z-plasty.

Theoretically the total lengthening achieved by a Z-plasty is, if the angles of the flap are 60°, about 1.73 times the original length. In the four or six flap Z-plasty the amount of lengthening is greater but the incisions extend in the direction of lengthening beyond the two measured points. Our square flap method has an excellent extension rate without doing this.

A geometrical analysis of our method proved



this fact (Fig. 13). When the angle of the T-flap "α" is 45° and of the U-flap 90°, there will be an increase of 2.80 times the original length after transposition of the flaps. This is better than that achieved by the other methods, when all the incision lines are made within the distance between the given two points in the direction of lengthening (Fig. 14).

A possible disadvantage of our method is that

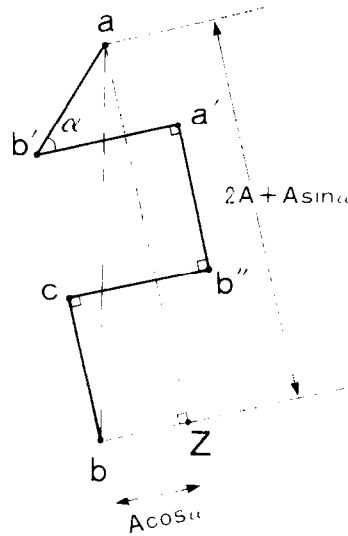


Fig. 13

Figure 13—A geometrical analysis of the square flap method. The sides of the flaps are the same length "A". The angle of the tip of the T-flap is made to be "α". The angle of the tip of the U-flap is a right angle. When "α" is a 45° angle, the lengths between ab will be about 2.80 times the original length.

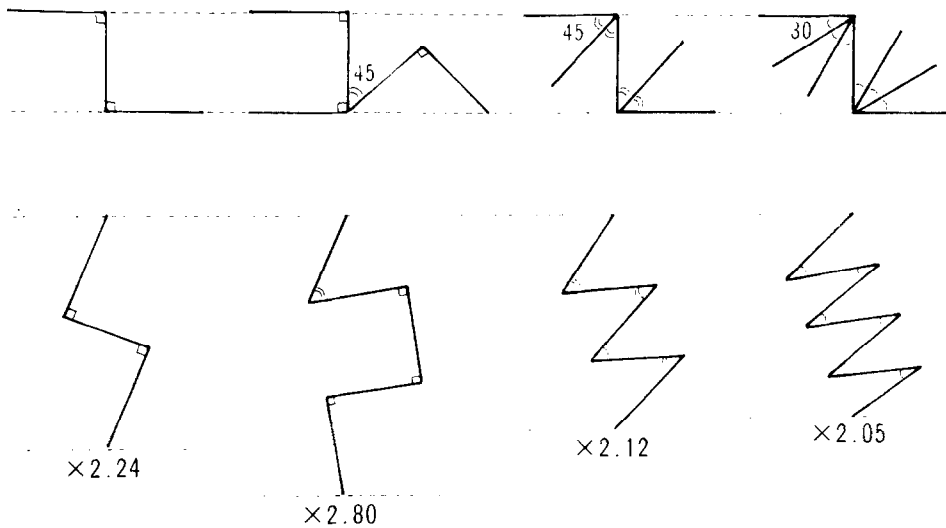


Fig. 14

Figure 14--Amount of lengthening of different designs of flaps.

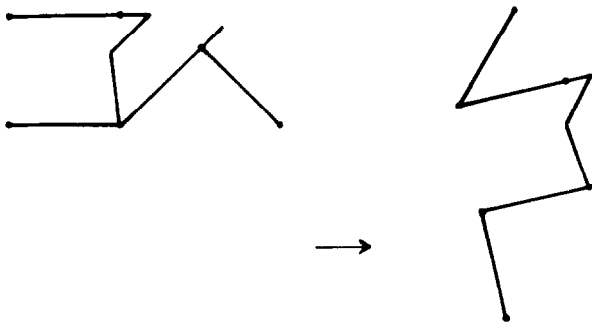


Fig. 15

Figure 15— Modifications to make our method more effective when the advancement effect of the square flap is likely to be limited.

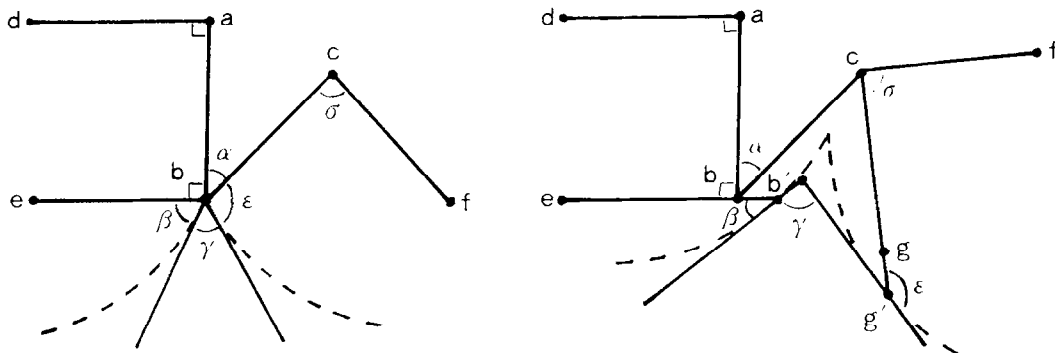


Fig. 16

Figure 16 The geometry of the modification used for clefts. *Left* shows a case in which the surplus portion is not resected (as shown in Fig. 5). The angles " α " and " γ " are equal. The sum of the angles " β " and " ϵ " must be 180° . Ideally, " δ " is 90° . *Right* shows how our method can be used to resect the surplus portion (see Fig. 6). The sum of " β " and " ϵ " must again be 180° and " δ " should be 90° for the greatest elongation. " γ " should be 90° .

the longitudinal scar at the tip of the square flap could be a cause of re-contraction, but the suture lines are not exactly parallel with the line of extension and the disadvantage can often be minimised by advancing the tip of the square flap to a point where the influence of joint mobility is minimal. In addition, some modifications may make our method more effective when the advancement of the square flap is limited (Fig. 15). The dog-ear formed by transposing the right-angled triangular flap sometimes needs to be corrected, but only a few of our cases needed such trimming.

Although various methods for the repair of cleft ear lobe have been suggested, we have not found a method similar to ours. In fact, we originally used our method for the correction of clefts before we realised its suitability for repairing scar contractions. When it is applied to repair of cleft cases, some modifications of the design may be necessary.

At the end of the procedure, the angle at the free margin must be 180° for the complete repair of the cleft (Figs 5, 6 and 16). We must therefore make the sum of the angles β and ϵ 180° (i.e. $\beta + \epsilon = 180^\circ$) as shown in (Fig. 16). For the greatest elongation, the angles of the U-flap should be 90° . However, it can be made less than 90° if necessary, with a resulting reduction in elongation.

We have shown that the square flap method is effective for elongating the distance between two points on the skin surface and has a number of practical applications.

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