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"A square peg into a round hole": a modified rhomboid flap and its clinical application

A. A. QUABA and B. C. SOMMERLAD

North East Thames Regional Plastic Surgery Unit, St Andrew's Hospital, Billericay and The London Hospital

Summary—Two modifications to the classic design of the rhomboid flap are described. Firstly, no attempt is made to engineer a rhomboid defect and, secondly, the flap is made smaller than the defect to be reconstructed. The advantages of these modifications are discussed and their application in 175 reconstructions is reported.

Clinical applications of a modified rhomboid flap

Alexander Limberg (1946, 1966) described the use of a flap to fill a rhomboid-shaped defect. Lister and Gibson (1972) amplified the geometry and design of the rhomboid flap, emphasising the classic measurements: all angles being 60° or 120° and all sides being equal. A number of modifications have been described (Dufourmentel, 1963; Webster *et al.*, 1978; Becker, 1979). Most of the published work concentrated on the mathematical principles of the flap rather than on its clinical application (Jervis *et al.*, 1974; Borges, 1981; Larrabee *et al.*, 1981).

This paper describes a clinical approach to the use of the rhomboid flap with two modifications.

Modifications to the classic design

The lesion is excised as necessary, without considering the shape of the defect produced; corners need not be sacrificed to produce a rhomboid-shaped defect. Many defects will end up having an almost circular shape. The "diagonal" of the defect, to be extended as one side of the flap, is then chosen. It may not be the shortest but may be selected so that the donor site can be closed most readily and with the least conspicuous scar. Choosing the shortest diagonal, however, does make flap transposition easier and minimises dog-ear formation. These factors have to be weighed up in each case.

The flap is always planned to be smaller than the defect. The chosen "diagonal" is, therefore, extended by about two-thirds of its own length; the exact length depends on the tension of the skin surrounding the defect. The other side of the flap is equal to the extension, drawn at 60° to it, and is almost parallel to one side of the defect, following its curve, but care should be taken not to narrow the base of the flap (Fig. 1). The flap is raised and the secondary defect closed directly after undermining if necessary. The flap is then positioned into the defect with key stitches to distribute the tension evenly. Although it may look rather like putting a "square peg into a round hole", surprisingly, it is rarely necessary to trim the corners of the flap. When suturing is completed, the configuration of the sutured wound would not be significantly different from that which follows the classic operation (Fig. 2).

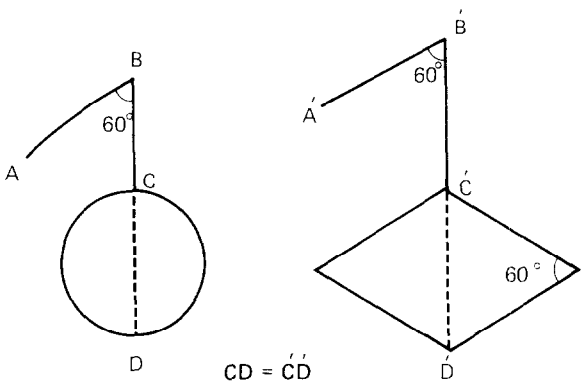

Fig. 1

Figure 1—Comparison between the modified and the classic designs. The defect is not necessarily rhomboid-shaped and the flap is smaller than the defect.

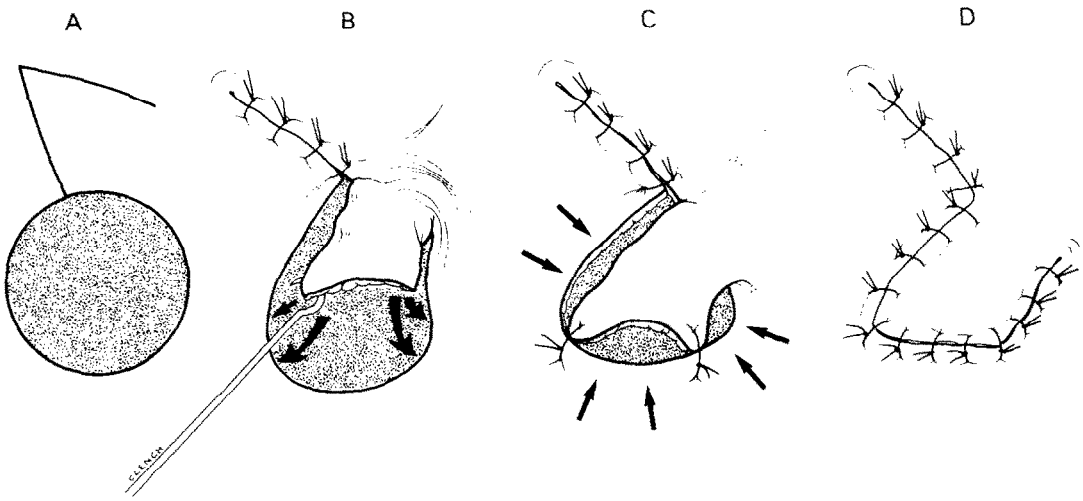

Fig. 2

Figure 2—Fitting a "square peg into a round hole". In the modified design the positioning of the flap into the defect is not predetermined. This allows for more flexibility and better distribution of tension.

Clinical application

A hundred-and-seventy-five patients who had reconstructions using the modified flap were reviewed.

The average age was 59.8 years and the two sexes were equally represented. Table 1 shows the pathological processes requiring excision and Table 2 and (Fig. 3) show the anatomical distribution of the resulting defects. One-third of the reconstructions were performed by a consultant and two-thirds by trainees. About half of the operations were carried out under local anaesthesia.

Table 1 Pathological processes requiring excision

Pathological process	*Number (%) of cases*
Basal cell carcinoma	113 (64.6)
Squamous cell carcinoma	17 (9.7)
Malignant melanoma	16 (9.2)
Others	29 (16.5)
Total	175 (100)

Table 2 Anatomical distribution of skin defects

Anatomical region	*Number (%) of cases*
Forehead and scalp	21 (12.0)
Temporal area	23 (13.1)
Outer and inner canthi	37 (21.2)
Cheeks	31 (17.7)
Nose	14 (8.0)
Upper lip and commissures	14 (8.0)
Lower lip and chin	5 (2.9)
Post-auricular and mastoid	12 (6.8)
Others	18 (10.3)
Total	175 (100)

Results

Post-operative complications were few (Table 3). Partial flap necrosis, with or without partial wound dehiscence, was noted in eight patients (4.5%). It usually followed closure under escessive tension, particularly in the forehead and scalp region, or when the base of the flap was close to a fixed landmark such as the preauricular margin. In no case was necrosis sufficient to warrant further surgery.

The cosmetic result, assessed at an average follow-up interval of 1.7 years, was judged with

Table 3 Complications

Complication	*Number (%) of cases*
Infection	6 (3.5)
Haematoma	2 (1.1)
Partial necrosis and/or partial dehiscence	8 (4.5)
Total	16 (9.1)

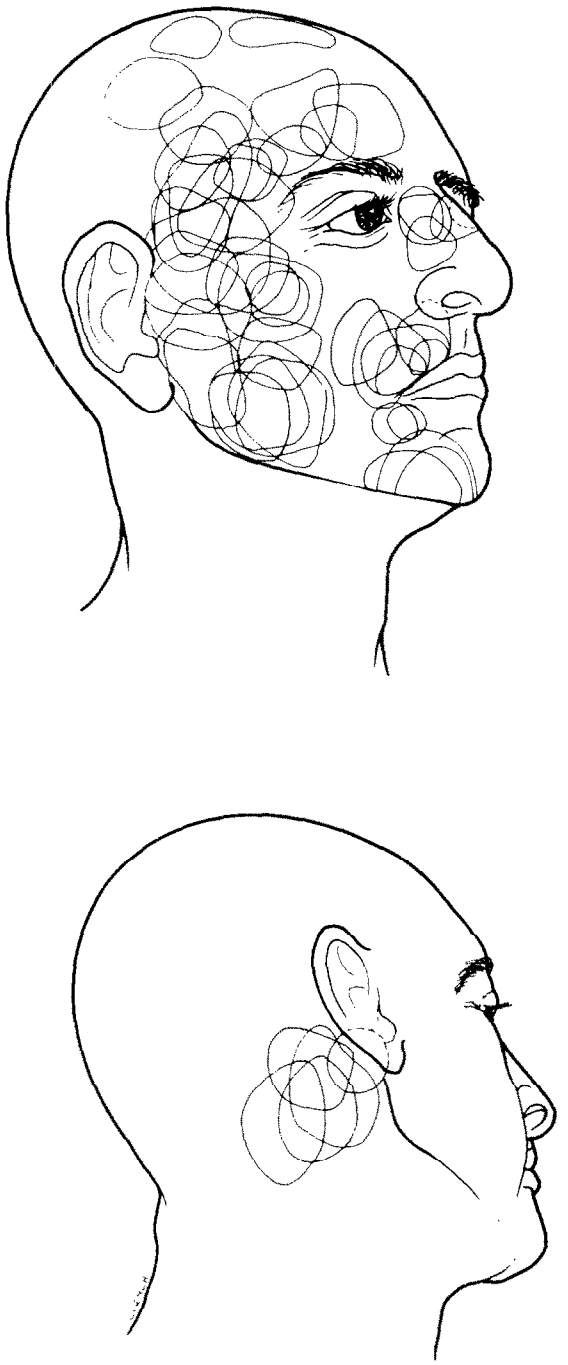

Fig. 3

Figure 3 -A diagram to show the approximate shape, site and size (relative) of 50 consecutive skin defects in the head and neck area which were reconstructed using the modified design. Some of the larger defects required more than one flap for closure. Note that the flap was not used in the nasal tip and eyelid regions.

particular reference to scarring, distortion of the landmarks, trapdooring and dog-ear formation.

Most of the scars were classified as hairline and some were hardly noticeable (Fig. 4). In 9% of cases the scar was significantly stretched, especially at the site of closure of the secondary defect. A few of the scars, especially those on the trunk, were hypertrophic (4.5%).

There was no distortion of facial landmarks in more than three-quarters (77.5%) of the patients. Some distortion (mainly of the hairline, sideburn and eyebrow) was noted in 22.5% of the cases reviewed. This caused minimal cosmetic but no functional deficit.

Trapdooring (pin-cushioning) was observed in 9% of patients, especially where small defects were closed with apparently over-generous flaps.

Dog-ears were visible in 22% of cases and were always at the hinge-point of the base of the flap and never at the apex of the donor site.

Discussion

There are three advantages of not engineering a rhomboid defect:

1. The positioning of the transposed flap into the defect is not predetermined. It can be sited to distribute tension evenly. The geometric and paper models of the classic design assume rigidity of size and shape of the skin defect and of the flap and that, of course, is not true in the clinical situation.
2. There is more flexibility in choosing the donor site. The classic design allows only four possible choices of flaps while our modification gives an unlimited choice of flaps (Fig. 5), allowing the scar to be placed in the least conspicuous site and minimising distortion of landmarks.
3. Tissue does not need to be unnecessarily sacrificed to produce a rhomboid defect.

The second modification, where the flap is made smaller than the defect and the surrounding tissues contribute to the closure, allows the donor site to be closed more easily. This means that the flap can be used to reconstruct larger defects than would be possible in the classical description. In addition, the transmission of even tension across the flap may contribute to the low incidence of trapdooring, as was noticed in this series.

A study of the pattern of scar stretching and the distortion of landmarks suggests that, following transposition, the area of maximum tension is

Fig. 4

Figure 4—Two operative series and post-operative results to demonstrate the use of the modified flap.

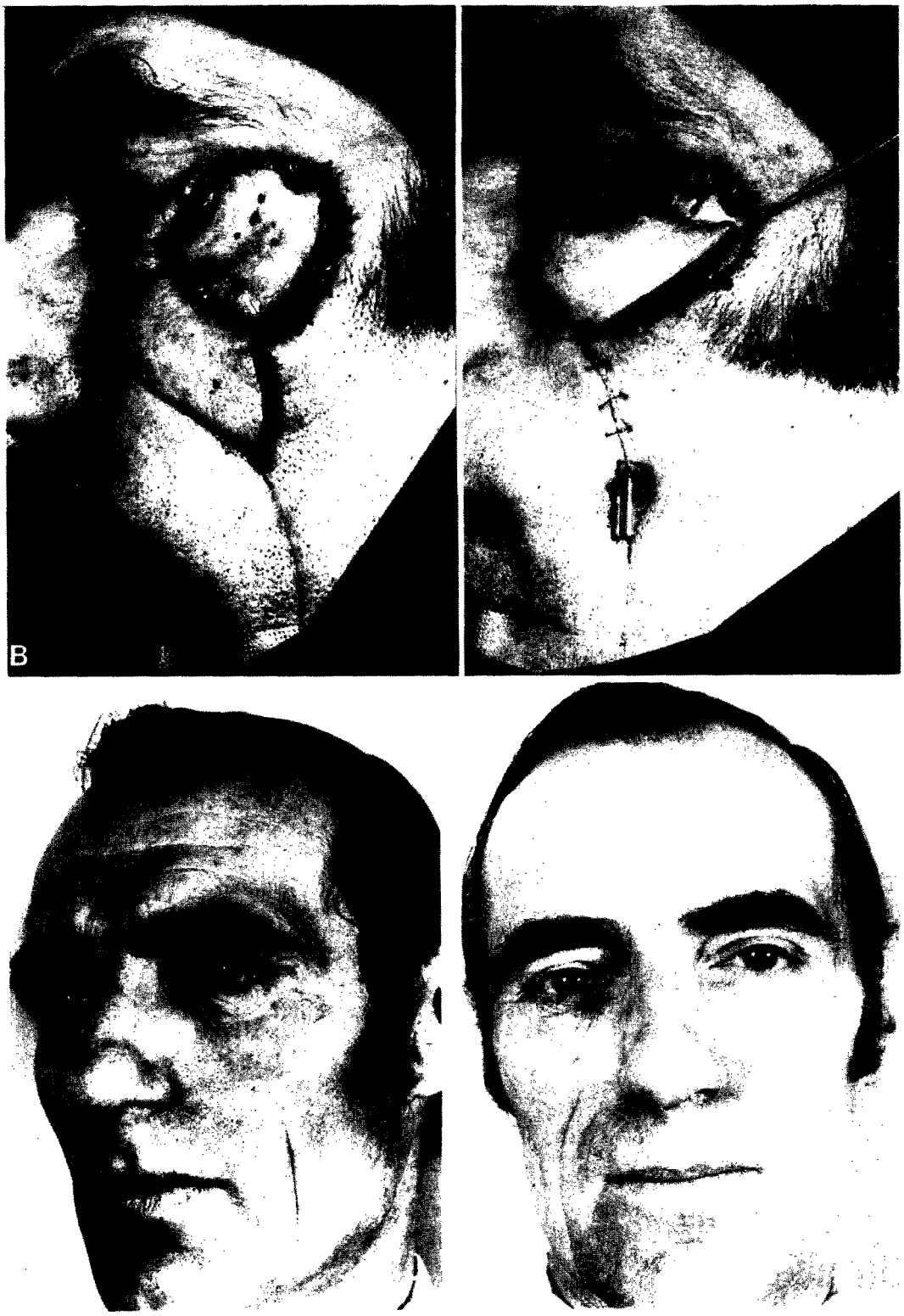

Fig. 4

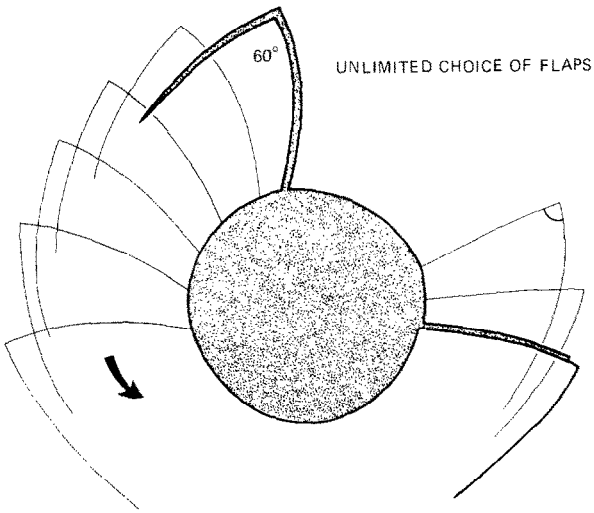

Fig. 5

Figure 5—After a rhomboid defect has been engineered only four choices of donor site are possible but by keeping the defect circular or nearly so, the options may be unlimited.

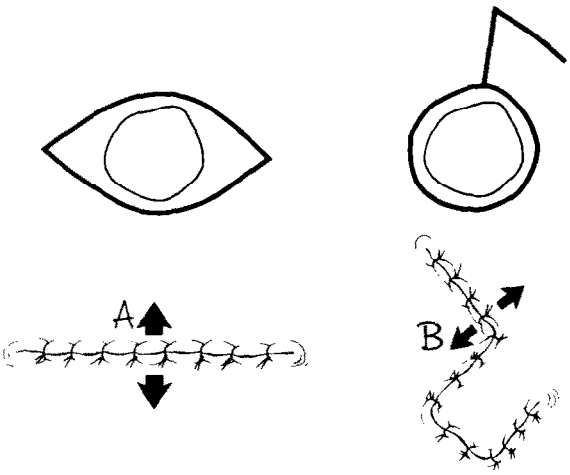

Fig. 6

Figure 6—Elliptical excision and direct closure or circular excision and flap closure? Better distribution of tension is an argument for the use of the modified design in the closure of skin defects where no differential skin laxity exists. A and B are the points of maximum tension but the tension across B is less than that across A due to the use of a flap smaller than the defect and allowing the surrounding skin to participate in the closure.

located across the donor site closure rather than at the flap tip.

This modified rhomboid flap is still basically a 60° transposition flap and one of its great advantages is that the resulting dog-ears are rarely a problem. Even if noticeable at operation, they settle remarkably well with time and none was revised in this series. In fact, the good cosmetic results in these patients have led us to use the rhomboid flaps in situations (*e.g.* the cheeks) where elliptical excision and closure would be possible but would produce unsightly dog-ears.

There is controversy regarding the use of the rhomboid flap in areas where there is no differential skin laxity such as the scalp, forehead and back. It may be argued that if there was no difference of tension in the skin surrounding a defect then its direct closure would be no more difficult than closure of the donor site of a classically designed rhomboid flap (equal short diagonals and equal skin tension). By using the modified flap, however, closure of both defects may become easier due to the smaller size of the donor site and contribution of the skin surrounding the primary defect toward its closure, which permits better distribution of tension (Fig. 6). In this series more than 20 fairly large scalp and forehead defects were closed by the judicious use of the modified flap, avoiding skin grafting (Figs 3 and 7).

Since the completion of our detailed review of 175 reconstructions using the modified design, over 400 patients have had facial and other defects closed using this flap. The results in these patients confirmed our findings that the flap is versatile, has few complications and gives superior cosmetic results when compared to techniques used previously. The flap has become our workhorse for facial reconstructions.

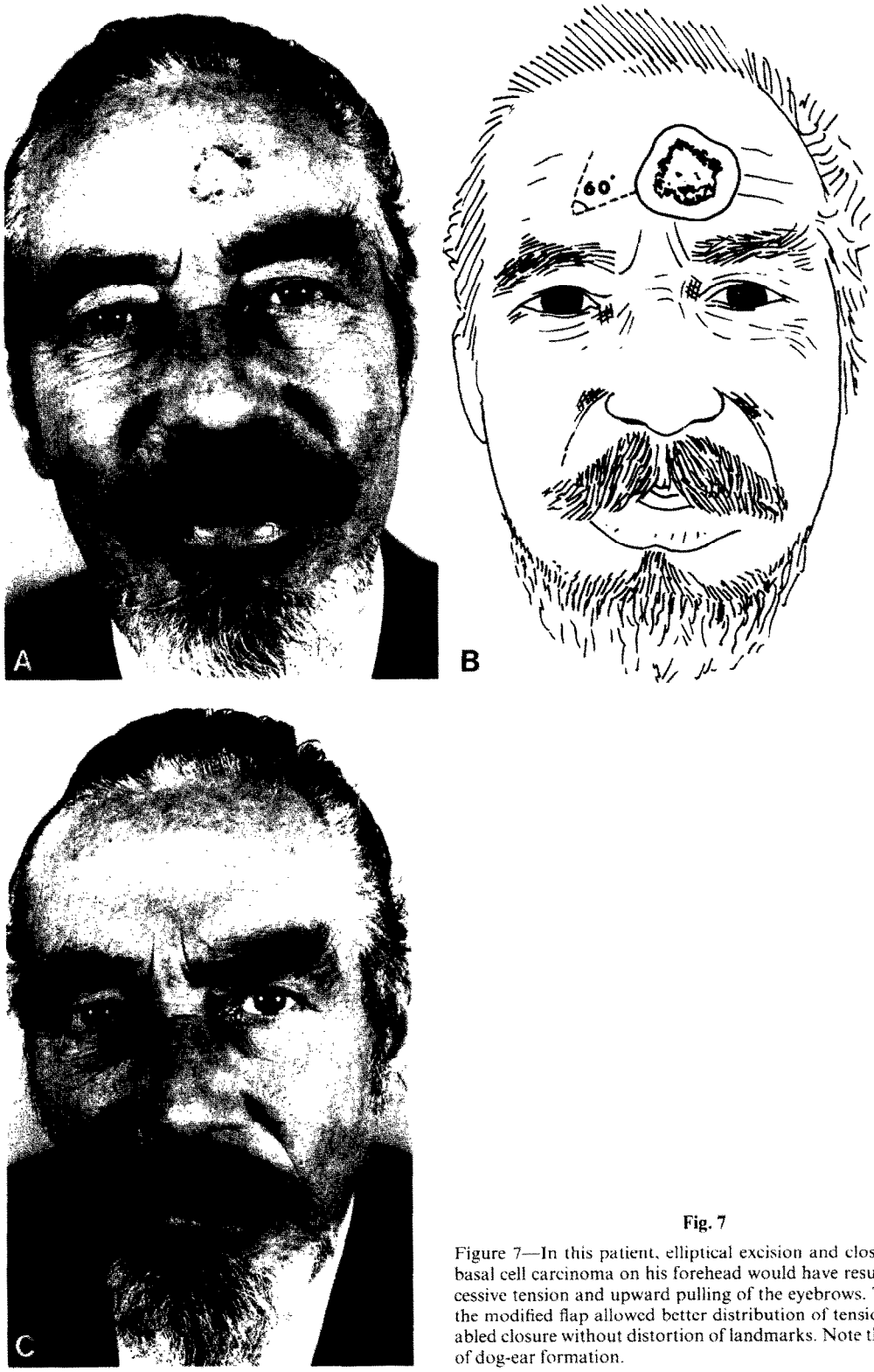

Fig. 7

Figure 7—In this patient, elliptical excision and closure of the basal cell carcinoma on his forehead would have resulted in excessive tension and upward pulling of the eyebrows. The use of the modified flap allowed better distribution of tension and enabled closure without distortion of landmarks. Note the absence of dog-ear formation.

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The Authors

A. A. Quaba, FRCS, Senior Registrar in Plastic Surgery, St Andrew's Hospital, Billericay.

B. C. Sommerlad, FRCS, Consultant Plastic Surgeon, St Andrew's Hospital, Billericay and The London Hospital.

Requests for reprints to: Mr A. A. Quaba, FRCS, North East Thames Regional Plastic Surgery Unit, St Andrew's Hospital, Billericay, Essex.