

# VERSATILITY OF SQUARE FLAPS IN POST-BURN CONTRACTURES INVOLVING UPPER LIMB

## FIABILITÉ DU DOUBLE LAMBEAU RHOMBOÏDE OU LAMBEAU CARRÉ DE HYAKUSOKU POUR LE TRAITEMENT DES RÉTRACTIONS SÉQUELLAIRES DE BRÛLURE AU MEMBRE SUPÉRIEUR

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**SUMMARY.** Post-burn contractures are a common problem and functionally limiting for upper limbs. Many different techniques have been described in the literature for their treatment. Z-plasty and release with SSG cover are the commonest procedures done for post-burn contractures. In this study we assess the use of the square flap technique in post-burn contractures of upper limb. Eleven patients with a total number of twelve upper limb contractures (mild to moderate) involving axilla, elbow and finger underwent release by standard square flap technique. All cases were followed up for at least 6 months and analyzed for range of motion and aesthetic outcome. Patient and surgeon satisfaction was recorded. All operated cases achieved a satisfactory range of movement post-operatively without any recurrence. The number of patients who were satisfied with the surgery were 7 out of 11, and 4 patients were somewhat satisfied with the results obtained. In contrast, the surgeons were satisfied in all cases. Square flap is shown to be an easy and reliable flap for mild to moderate contractures of the anterior or posterior axillary folds, elbow contractures and finger contractures with low recurrence rate.

**Keywords:** burn, axillary, finger, elbow, contracture, square flap

**RÉSUMÉ.** Les rétractions séquellaires de brûlure sont fréquentes et engendrent des limitations fonctionnelles au membre supérieur. Beaucoup de techniques différentes ont été décrites dans la littérature pour leur traitement : plastie en Z, libération et couverture par greffe de peau, sont les techniques les plus couramment utilisées. Dans cette étude, nous évaluons l'usage du double lambeau rhomboïde ou lambeau carré de Hyakusoku dans les rétractions séquellaires de brûlure du membre supérieur. 11 patients représentant 12 rétractions au membre supérieur (minimes à modérées) intéressant la région axillaire, le coude, et les doigts ont bénéficié d'une libération de la rétraction par la technique du double lambeau rhomboïde ou lambeau carré de Hyakusoku. Tous les patients ont été suivis pendant au moins six mois post-opératoire. L'analyse porte à la fois sur les mobilités et le résultat esthétique. La satisfaction du patient et du chirurgien a été notée. Toutes les interventions ont permis une nette amélioration de la fonction, sans récurrence. 7 patients sur 11 ont été satisfaits par le résultat du geste chirurgical et quatre patients ont été assez satisfaits. En revanche, les chirurgiens ont noté les résultats comme satisfaisants dans tous les cas. Le double lambeau rhomboïde ou lambeau carré de Hyakusoku semble donc être un lambeau simple et fiable dans le traitement des rétractions minimes à modérées des piliers axillaires antérieur ou postérieur, du coude ou des doigts avec un très faible taux de récurrence.

**Mots-clés:** brûlures, axillaire, coude, doigts, rétraction, double lambeau rhomboïde, lambeau carré de Hyakusoku

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## Introduction

The incidence of burn victims in a developing country like India is very high and many patients go on to develop complications like burn contractures due to negligence.<sup>1</sup> Burn contractures of the axilla, elbow or fingers are debilitating problems as they affect joint movements, causing difficulty in performing activities of daily living.<sup>2</sup>

Numerous methods have been suggested by various authors for surgical management of contractures at the axilla, elbow and fingers: skin grafting, Z-plasty, Y-V plasty and its modifications, other local-flap plastys, fasciocutaneous and musculocutaneous pedicled and free flaps.

Release of the contracture along with split skin grafting is a simple design and can be performed in any patient and in all types of contractures, but it has a risk of failure of graft take, re-contracture, and long term splint.<sup>3</sup>

Use of flaps over joints can decrease the recurrence rate.<sup>4</sup> Local flaps are used in cases of contractures having some adjacent healthy tissue. These flaps include Z plasty and its modifications, transposition flaps and propeller flaps.<sup>5</sup>

Z plasty is the most commonly performed local skin flap technique<sup>6</sup> in axillary contractures. Transposition flaps in axilla require healthy adjacent skin that can be transposed after release of contracture.

The 'square flap method' is a local tissue transposition technique used to increase distance between two skin points. It was first coined by Hyakusoku who presented it in Japanese in 1985 and later in English in 1987.<sup>7,8</sup> Earlier, Limberg in 1963 used an almost similar technique keeping the acute angles of the triangular flaps, which was modified by Hyakusoku and used as a method for scar contracture release.

In this study we would like to determine the use of the square flap technique in contractures of the axilla, elbow and finger.

## Methods

All post-burn upper limb contractures that presented to our outpatient department from Septem-

ber 2015 to August 2018 were considered for the study. This includes patients presenting with axilla, elbow and finger contracture. We also encountered wrist contracture cases, but due to severity and lack of healthy tissue in the surrounding area we excluded them.

Patients' demographic data, history regarding the cause of burns, the course of treatment, splintage and post-operative physiotherapy were recorded. Type of contracture and its severity was noted. All the patients were evaluated for availability of surrounding healthy tissue and selected accordingly for surgery.

Departmental ethics clearance was granted. Written informed consent was taken.

We performed all the axillary contracture release surgeries in general anesthesia. The elbow and finger contractures were performed under regional block and with application of arm or finger tourniquet where feasible. Along the line of contracture the square is designed on the side from where the tissue is pliable and can be advanced with ease (*Fig. 1*).

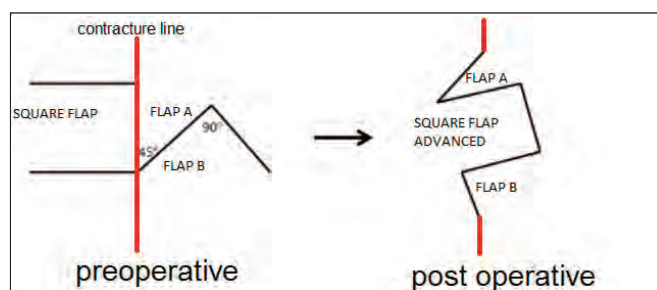


Fig. 1 - Line diagram

On the other side, two triangular flaps are marked. Angles are kept at 45 degrees for the first one and 90 degrees for the second one. All the limb lengths of square and triangular flaps are kept equal. Incisions are made along the marked line and the contracture is released up to a permissible limit. Three flaps are elevated. Tourniquets are released where applied. Square flap is then advanced across the previous contracture line, and the two triangular flaps are transposed and sutured on either side of the square flap. Where the raw area was larger, split thickness skin graft was used to cover the defect. Dressing of the wound was done according to our hospital protocol.

Sutures were removed after complete healing at 10-14 days. Postoperative splint was given for 14-21 days. Pressure garments were advised for 3-6 months to soften the scar and to reduce the possibility of scar hypertrophy. Any postoperative complications were noted and managed accordingly. Regular physiotherapy was started post-operatively. Follow up visits were scheduled for a minimum period of six months and range of motion and pre- and post-operative photographs were taken. Patient and surgeon satisfaction was recorded.

## Results

A total of twelve square flaps were used in a total of eleven patients with an age range of 6 to 42 years, of which four were males and seven were females, male:female ratio of 1:1.7. The cause of contracture was thermal burns in ten of these patients, and one patient had electrical injury. In all cases, the wounds healed with conservative management and the patients did not follow any splinting or exercise protocols. One patient with bilateral upper limb involvement underwent square flap surgery for both axilla and the right elbow. Thus five involved the axillary fold, four involved the elbow and two cases involved volar finger contractures. Duration of contracture ranged from 6 months to 4 years.

Two patients required additional skin graft to cover the raw area created after release. No complications were noted post-operatively in any of the patients. One patient had marginal tissue loss at one of the triangular flaps, managed conservatively, and which subsequently healed. All patients were followed up for a minimum of six months.

Pre-operatively, axillary abduction ranged from 35 to 90 degrees, 40-60 degrees for elbow and around 30-60 degrees for fingers. Near complete range of motion ranging from 170°-180° was achieved in all cases and no recurrences were observed (Table I, Images 1,2,3,4).

The number of patients who were satisfied with the surgery was 7 out of 11, and 4 patients were somewhat satisfied with the results obtained (Table II). In contrast, the surgeons were satisfied in all the

cases. Thus it is not possible to fully satisfy the patients, even when one thinks one has done enough justice to the case.

Table I - Patient data

Case	Age	Sex	Region	Complication	Follow up
1 [Image 1]	27 years	F	Axilla	None	1 year
2	40 years	M	Elbow	None	1 year
3 [Image 2]	36 years	F	Axilla	None	10 months
4	14 years	M	Axilla	None	10 months
5 [Image 3]	28 years	M	Elbow	Marginal tissue loss	8 months
6 [Image 4]	33 years	F	Finger-PIPJ	None	7 months
7	6 years	F	Finger	None	6 months
8	42 years	F	Axilla and Elbow	None	Lost to follow up after 5 months
9	19 years	M	Elbow	None	6 months
10	34 years	F	Elbow	None	11 months
11	16 years	F	Axilla	None	6 months



Image 1 - Case 1



Image 2 - Case 3



Image 4 - Case 6



Image 3 - Case 5

Table II - Satisfaction score

Satisfaction level	Patient	Surgeons
Extremely satisfied	1	0
Satisfied	6	11
Somewhat satisfied	4	0
Not satisfied	0	0

## Discussion

The square flap method was first presented by Hyakusoku et al. in 1985.<sup>8</sup> A similar method was described by Limberg in 1963,<sup>9</sup> which Hyakusoku modified by changing the angle of one triangular flap. It is basically a three-flap Z plasty. The method is an advancement transposition technique that consists of two triangular flaps (transposed) and a square flap (advanced). It was observed that if one triangular flap is a right-angled flap, there is better lengthening, better advancement of the square flap, and it also avoids the suture lines running parallel to the direction of lengthening. When the angle of the triangular flap is 45° and the advancement flap 90°, as given by Hyakusoku et al., there will be an increase of 2.80 times the original length. This is better than the gain achieved by the other methods.<sup>8</sup>

Huang et al.<sup>10</sup> used stereometric geometric modelling and revealed that square flap yields a larger flap area, higher length: breadth ratio compared to Z plasty, and is associated with the lowest physiological tension, which means that the deformity of the adjacent skin and the dependence on the laxity of the adjacent skin is minimal. It is also associated with sufficient anatomical blood supply, and does not require excision of normal skin. This is probably the basis of the low recurrence rate when square flaps

are used.

In our study we achieved significant lengthening in all cases of axillary, elbow and finger contracture. Thus appreciable abduction of shoulder and extension of elbow and finger joints was achieved in carefully selected cases. Range of movement is maintained at the end of 6 months.

It has been seen that the overall satisfaction achieved in patients as well as surgeons with relation to square flaps is higher than that with grafting. In our study, the number of patients who were satisfied with the surgery was 7 out of 11, and 4 patients were somewhat satisfied with the results obtained. In contrast, the surgeons were satisfied in all the cases. Thus it is not possible to fully satisfy the patients even when one thinks one has done enough justice to the case.

Square flaps are easy to plan and perform in well-selected subjects and also easy to replicate. They give considerable lengthening compared to other existing procedures, as proven theoretically, require less post-operative splinting, and give an overall good cosmetic and functional outcome with low recurrence. Moderate contractures can be managed well using supplemental skin grafting, but they have a very limited role in severe contracture where there

is no available healthy tissue perpendicular to the line of contracture. The limitations of this study lie mainly in the small number of patients. More cases with longer follow-up periods will be required to confirm the effectiveness and efficiency of the square flap method.

## Conclusion

Square flap is shown to be an easy and reliable flap for mild to moderate contractures of the anterior or posterior axillary folds, elbow contractures and finger contractures. It is seen to have less chances of recurrence in follow up than any other method.

In our study, the number of patients who were satisfied with the surgery was 7 out of 11, and 4 patients were somewhat satisfied with the results obtained. In contrast, the surgeons were satisfied in all the cases. Thus it is not possible to fully satisfy the patients, even when one thinks one has done enough justice to the case.

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