



SUPRACLAVICULAR FLAP IN POST BURN NECK CONTRACTURE – TAILORING FOR OPTIMAL OUTCOME

Soumya Kanti Bag Plastic & reconstructive surgery Dept, Medica Superspeciality Hospital, Kolkata.

Cinjini Das Plastic & reconstructive surgery Dept, Medica Superspeciality Hospital, Kolkata.

KEYWORDS :

INTRODUCTION:

Reconstructing post burn neck contractures have been always challenging for plastic surgeons. As options for reconstruction, controversy has been for ages between flaps and grafts. Numerous surgeons have advocated split thickness skin grafts as most suitable coverage after release of post burn contracture (PBC) neck showing excellent aesthetic outcome. But, incidence of re-contracture is quite common in these patients which has been a major drawback. On the other hand, flaps like anterolateral thigh though minimizes risks of re-contracture is not preferred by many surgeons as they are bulky and result in effacement of cervicomental angle. It almost always requires flap debulking in post operative period. Otherwise flap need to be thinned before harvesting which is a very tedious job & sometimes may cause vascular compromise of some parts of flap. Other way out is pre expansion of ALT flap donor site which again requires another stage of surgery. Nevertheless, colour mismatch is not quite uncommon with neck skin specially in Indian population. Onah et al.¹ have classified post burn neck contracture into four types (types 1 to 3 for anterior & 4 for posterior neck). Mainly types 1C, 2C & 3B will require skin graft or flap as by definition these types don't have sufficient neck skin to cover the defect. In our series, we have used supraclavicular flap (with or without skin graft) in these three subtypes of patients. Being, a thin, pliable flap with good colour match, supraclavicular flap provides an excellent and reliable option for neck reconstruction since Pallua² first used it for neck reconstruction. We have used this flap as non-expanded in all the cases with or without skin grafting. We have divided our patients into three groups according to location of the resultant defect and coverage option used. Comparing the aesthetic result of these three groups (in terms of cervicomental angle) we tried to draw a conclusion regarding how to tailor aesthetic outcome by combining flap and skin graft.

MATERIALS AND METHODS:

Study Type: Retrospective study

This study was carried out among patients with post burn neck contracture treated with excisional release and coverage with supraclavicular flap with or without skin graft between January 2019 to January 2024 in our institution. 15 patients (9 females and 6 males) with post-burn neck contracture were subjected to reconstruction with 15 unilateral unexpanded supraclavicular artery flaps supplemented with split-thickness skin graft in 6 patients.

Exclusion criteria: patient not fit for surgery, burnt donor site, previous block dissection of the neck or previous neck irradiation. The minimum flap dimension was 9 x 5 cm² and maximum dimension 20 x 6 cm².

All patients had undergone excisional release of the contracture.



Fig1

Operative procedure : The perforator was detected pre-operatively with hand-held doppler signal. Defect created after adequate release & flap size was marked accordingly. Flap was marked in fusiform shape & islanded. Flap elevation was done from distal to proximal direction in subfascial plane like any other perforator flap. Periosteum over clavicle was elevated & taken with the flap pedicle. In some cases, proximal part of flap overlying the pedicle was de-epithelized for proper inset of flap (Fig 1). In all cases, flap donor site was closed primarily in 2 layers. In 6 cases, split thickness skin graft was applied in submental region (Fig 2).



Fig 2

Post-operative period : Shoulder mobilization was gradually started after 7 days. For those patients who needed skin graft in submental area, a chin strap was applied after 1st dressing change & gradual mobilization of neck started after 7 days. Active & passive physiotherapy was started after 3 weeks. In follow up visits at 3, 6, 9 & 12 months, range of motion (ROM) of neck was measured for neck flexion – extension, lateral flexion & rotation to assess functional outcome and cervicomental angle was measured for aesthetic outcome.

RESULTS

The study was conducted on 15 patients (9 females and 6 males) who were suffering from post-burn neck contracture. They were subjected to reconstruction with 15 unilateral supraclavicular artery flaps. Among them, flap reconstruction was supplemented with split thickness skin grafting (in submental region) in 6 patients. Mean age was 27.6 years (range 12 - 45 years). All the 15 patients had anterior post-burn neck contractures (2 cases of type 1c, 9 cases of type 1Ic, 4 cases of 1IIB).

The size of the reconstructed defect ranged from 7 x 4 cm² to 15 X 12 cm², and the size of the flap varied from 20 X 6 cm² to 9 X 5 cm². Tissue expansion was not used in any of the cases. In all cases, flap donor sites could be closed primarily. Follow-up period ranged 12 - 18 months (average 14.6 mnth.). 14 flaps survived completely. One flap had partial necrosis (distal most 2 cm) which was managed by skin graft later. 1 patient had seroma which was managed with aspiration & pressure bandage. 6 patients had scar hypertrophy which responded well with conservative management (silicone sheet, pressure garment, intralesional steroid) and diminished on subsequent follow up.

For the sake of discussion, we divided patients into 3 groups according to location of post-excisional defect and method of their reconstruction.

Group A : Defect located in anterior neck subunit only and width $\leq$ 6 cm, where only flap was used for reconstruction.

Group B : Defect involving both anterior neck and submental subunit with width $\leq$ 6 cm, where only flap was used for reconstruction.

Group C : Defect involving both anterior neck and submental subunit with width > 6 cm, where flap was used for reconstruction of anterior neck and skin graft was applied over submental area.



Fig 3 : Group C patient - pre op



Fig 4 : Group C patient - post op

Functional and aesthetic outcomes were measured in terms of Range of motion (ROM) for all movements of neck & Post op cervicomeantal angle (degree) during follow up which showed results as below:

Table 1

Group	No of patients	Onah Type	ROM (Flexion – extension)		ROM (Lateral Flexion)		ROM (Neck Rotation)		Post op cervicomeantal angle (degree)	
			Mean	Median	Mean	Median	Mean	Median	Mean	Median
A Defect confined to anterior neck only	5	1C – 1 2C – 4	118	120	88	90	152	150	98	100
B Defect in both submental area & anterior neck – covered with single supraclavicular flap	4	1C – 1 2C – 2 3B – 1	95	95	75	75	82.5	75	151	155

C Defect in both submental area & anterior neck – covered with single supraclavicular flap with STSG in submental region	6	2C – 3 3B – 3	118.3	120	88.3	90	146	150	100	100
--	---	------------------	-------	-----	------	----	-----	-----	-----	-----

DISCUSSION:

Resurfacing defects after release of post burn contractures while maintaining aesthetics of cervical region has been a challenging job for ages. Applying split thickness skin graft has not been able to provide final answer as colour & texture match is suboptimal. Moreover, re-contracture rate is quite high specially in less compliant patients, & patients with tendency for scar hypertrophy. One other well exercised option is use of free microvascular fascio-cutaneous flaps (e.g. anterolateral thigh flap). But, these flaps have to be thinned intraoperatively which need prolonged operation time & specialized super-microsurgery instruments. Moreover, marginal skin necrosis is not very uncommon following such vigorous thinning. Otherwise they can be thinned postoperatively by liposuction or surgical flap thinning which increases stages of reconstruction, and hence expenditure of treatment. Use of expanders have been able to address problems of skin grafting & free flaps in one go, but as it involves many stages, and also expensive, hence not acceptable to many patients.

We have considered supraclavicular flap as answer to all these problems. Studies by Hyakusoku and Gao discovered that the shoulder skin is very reliable for neck reconstruction and resurfacing.⁸ Lee and Hwang concluded that the skin of the supraclavicular fossa and adjacent skin over the upper half of the deltoid has even thinner skin than that of the neck.⁹ Hence, reconstructive surgeons have tried to use this supraclavicular skin to reconstruct cervical region from long back, though vascular basis for such transfer was not clear till very late. As we know, supraclavicular flap is supplied by supraclavicular artery which is a branch of transverse cervical artery. In ancient literature, it was first described by Mutter³ in 1842 as medially based random shoulder flaps, though vascular basis of it was not clear at that time.

However in 1979, Lamberty⁴ properly described supraclavicular flap as an axial flap based on supraclavicular artery which he found as branch of transverse cervical artery (93%) or suprascapular artery (7%).

Though well described by Lamberty, it was not found in literature till Pallua⁵ used the flap for neck contracture in 1997. After his pioneering work, much of the following literatures have proved its reliability & efficacy as a flap to be used in post burn contractures^{5,6,7}.

Though used quite frequently, this flap has not been used in all types of contractures, mainly for limitation of donor area. Many authors like Yang Z¹⁰, Sever C¹¹ have used it as pre – expanded successfully for Onah Type 2C or 3 B contractures. In our study, we have used this flap alone, or combined with skin graft according to type of contracture. Maximum breadth of the flaps used was 7 cm. Using this approach, we have managed to close the donor site primarily in all cases, while avoiding the use of expanders. In our study, largest flap harvested had length of 20 cm. Only one flap had partial necrosis (n = 1) in distal most 2 cm (6.6 %). Hence these data re establishes the reliability and robustness of supraclavicular flap and corroborates with many other authors' observations like VinH VQ (3.9%)¹², Loghmani (6.3%)¹³, Balakrishnan and Sivarajan (9.3%)¹⁴. We have islanded all our flaps. In larger flaps (>10 cm length) adipofascial pedicle was dissected to preserve superficial veins for better drainage. (Fig 1)

For the sake of discussion, we can divide them into 3 groups according to the resultant defect as already mentioned above. Functional outcome has been compared by assessing range of motion (ROM) of all three axis of neck movement i.e. neck flexion- extension, lateral

flexion, rotation. As clearly seen from data analysis, it was better in Group A & Group C patients with comparable values than Group B with significantly low values.

Similar findings noted regarding aesthetic outcome. Aesthetic outcome is assessed by measuring cervicomental angle (formed by cervical and submental plane¹⁵). The normal cervicomental angle ideally has been reported to be 90°. ^{16,17,18} Ellenbogen and Karlin¹⁹ concluded that a cervicomental angle in the range of 105–120° is acceptable.

In present study, Group A patients had a mean post op cervicomental angle of 98° and Group C patients had a mean post op cervicomental angle of 100°, but Group B patients showed a post op cervicomental angle of 151° (std. dev. +/- 11.8) (Table 1). Such better aesthetic outcome in Group A & C can be attributed to maintenance of subunit principle in reconstruction. In Group A & C patients, supraclavicular flap has been used in anterior neck subunit only (Group C patients had been supplemented by skin grafting in submental area), whereas in group B patients the flap has been used to cover defects involving both subunits.

Using flap to only ant. neck subunit also improved donor site morbidity. Previously, where supraclavicular flap has been used for neck contracture, either it has been pre-expanded for primary closure or donor area has been skin grafted in most of the cases (specially where resultant defect was wider than 7 cm^{20,21}). Using the subunit principle, we have been able to restrict the flap width to 6 cm even with resultant defects as wide as 12 cm. Hence, all the flap donor sites could be closed primarily without any tissue expansion. This diminished donor site morbidity to a great extent & improved aesthetics of the patients. Precluding pre-expansion, the whole reconstruction could be completed as an one stage procedure in all cases, which improved our patient compliance to a great extent. Only donor site morbidity noticed was hypertrophied scar in 6 cases which could be managed with conservative measures (scar massage, exercise, Silicone sheet, pressure garment) successfully.

CONCLUSION

We recommend very strongly the supraclavicular flap as first choice for post burn neck contracture, whenever the said area of skin is available for flap harvest. In our study, it has been used in all types of post burn neck contracture. For Onah Type 2C, 3B neck contracture, we recommend to use it in combination with thick STSG according to subunit principle (flap for anterior neck and graft for submental area). This approach improves both functional and aesthetic outcome while decreasing donor site morbidity (precluding skin graft in donor site) and also making it a single stage procedure (avoiding tissue expansion) in one go.

REFERENCES

1. I. Onah, A classification system for postburn mentosternal contractures, Archives of surgery 2005, DOI:10.1001/ARCHSURG.140.7.671 Corpus ID: 23224209
2. Pallua N, Machens HG, Rennekampff O, Becker M, Berger A. The fasciocutaneous supraclavicular artery island flap for releasing postburn mentosternal contractures. *Plast Reconstr Surg.* 1997;99(7):1878-1886.
3. Mutter TD. Case of deformity from burns relieved by operation. *Am J Med Sci.* 1842;4:66.
4. Lamberty BG. The supraclavicular axial patterned flap. *Br J Plast Surg.* 1979;32(3):207-212.
5. Vinh VQ, Ogawa R, Van Anh T, Hyakusoku H. Reconstruction of neck scar contractures using supraclavicular flaps: retrospective study of 30 cases. *Plast Reconstr Surg.* 2007;119(1):130-135.
6. Rashid M, Zia-Ul-Islam M, Sarwar SU, Bhatti AM. The "expansile" supraclavicular artery flap for release of post-burn neck contractures. *J Plast Reconstr Aesthet Surg.* 2006;59(10):1094-1101.
7. Di Benedetto G, Aquinati A, Pierangeli M, Scalise A, Bertani A. From the "charretera" to the supraclavicular fascial island flap. *Plast Reconstr Surg.* 2005;115(1):70-76.
8. Hyakusoku H, Gao H: The "super-thin" flap. *British Journal of Plastic Surg.* 47: 457-464, 1994.
9. Lee Y, Hwang K: Skin thickness of Korean adults. *Surgical and Radiological Anatomy Journal*, 24: 183-189, 2002.
10. Zhe Yang , Chunmei Hu, Yangqun Li, Yong Tang, Muxin Zhao, Wen Chen, Lisi Xu, Yuanyuan Liu, Pre-expanded cervico-acromial fasciocutaneous flap based on the supraclavicular artery for resurfacing post-burn neck scar contractures. *Ann Plast Surg* 2014 Sep;73 Suppl 1:S92-8.
11. Celalettin Sever , Yalcin Kulahci, Fikret Eren, Cihan Sahin, Fuat Yuksel, Reconstruction of postburn cervical contractures using expanded supraclavicular artery flap. *J Burn Care Res* Jul-Aug 2013;34(4):e221-7.
12. Vinh VQ, Anh TV, Ogawa R, Hyakusoku H: Anatomical and clinical studies of supraclavicular flap: analysis of 103 flaps used to reconstruct neck scar contractures. *Plastic and Reconstructive Surgery*, 123: 1471-1480, 2009
13. Loghmani S, Eidy M, Mohammadzadeh M, Loghmani A, Fhimeh R: The Supraclavicular Flap for Reconstruction of Post-Burn Mentosternal Contractures. *Iranian Red Crescent Medical Journal*, 15: 292-297, 2013.
14. Balakrishnan TM, Sivarajan N: Anatomical study of supraclavicular perforator artery and its clinical application as sensate supraclavicular artery propeller flap in the

reconstruction of post burns scar contracture neck. *Indian Journal of Science and Technology*, 5: 3137-3141, 2012.

15. Hayes RJ, Sarver DM, Jacobson A. The quantification of soft tissue cervicomental changes after mandibular advancement surgery. *Am J Orthod Dentofacial Orthop.* 1994;105:383-91.
16. Marino H, Galeano EA. Plastic correction of double chin. Importance of the position of the hyoid bone. *Plast Reconstr Surg.* 1963;31:45-50.
17. Millard RD, Piggot RW, Hedo A. Submandibular lipectomy. *Plast Reconstr Surg.* 1968;41:513-22.
18. Vistnes LM, Souther SG. The anatomical basis for common cosmetic anterior neck deformities. *Ann Plast Surg.* 1979;2:381-8.
19. Ellenbogen R, Karlin J. Visual criteria for success in restoring the youthful neck. *Plast Reconstr Surg.* 1980;66:826-37.
20. Sommerville JM, Sperry TP, BeGole EA. Morphology of the submental and neck region. *Int J Adult Orthodon Orthognath Surg.* 1988;3:97-106.
21. Ismail H.1, Elshobaky², Supraclavicular artery perforator flap in management of post-burn neck reconstruction: clinical experience, *Annals of Burns and Fire Disasters* - vol. XXIX - n. 3 - September 2016.