Versatility of Fenestrated Groin Flap in the Reconstruction of Post-Burn Dorsal Contractures of Thumb

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ABSTRACT

BACKGROUND

In reconstruction of post burn scar contracture of hand, thumb reconstruction is crucial. Among various flaps that are available for thumb reconstruction groin flap is ideal for large defects and defects also involving 1st webspace. Modification in groin flap with fenestration provides more inset, splints thumb in abduction thereby maintaining 1st web space and no soddening of thumb and 1st web space.

METHODS

In a 2-year period between 2017 and 2019, fenestrated groin flap was performed. It was done in 12 cases of which 9 were males and 3 were females.

RESULTS

All 12 patients had Post-burn Dorsal Contracture (PBSC). The time interval between injury and reconstruction ranges from 10 months to 8 years (mean 3.25). All patients after contracture release were reconstructed with fenestrated groin flap in 2 stages. After 2 weeks flaps were divided and remaining insets were given. Donor sites were closed primarily by undermining or resurfaced with SSG where necessary. All flaps survived with no postoperative complication.

CONCLUSIONS

Based on our experience with fenestrated groin flap, this is an ideal flap after release of dorsal PBSC thumb.

KEYWORDS

Groin Flap, Fenestrated Groin Flap, PBSC Thumb, Z Deformity Thumb

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BACKGROUND

Hand is ranked as one of the three most frequent sites of burn scar contracture deformity.[1] The most common pathophysiology of burn deformity is insufficient skin coverage due to scar contracture. The goal of reconstruction should be maximum restoration of hand function. Being the only opposing digit against the others, when the thumb is involved, functional loss may be more severe than anticipated. Mild to moderate contractures can be corrected by release combined with skin grafting, variations of Z-plasty flaps and Y-V advancement techniques or combination while the severe contractures that cause a major deformity require more complex procedures such as local or regional flaps.[2,3] In this article we have discussed about groin flap with fenestration in dorsal contracture of thumb and its advantages over conventional groin flap.

We wanted to assess the versatility and advantages of groin flap in reconstruction of post burn dorsal contractures of thumb.

METHODS

Twelve cases of Post burn dorsal contractures of thumb were treated with fenestrated groin flap between 2017-2019. Nine were male and three were female. None of them had previous abdomen or groin surgeries. Informed and written consent were obtained from all patients. Patients with dorsal contractures involving thumb with hyperextension of MP joint were included in the study. Patients with multiple digit involvement were excluded from the study.

Operative Technique

Flap Design and Harvest- The groin flap is based on the superficial circumflex iliac artery (SCIA). The ASIS and pubic tubercle are marked and a line is drawn connecting the two landmarks. A line is drawn two-fingerbreadths (approximately 3 cm) below and parallel to the inguinal ligament. This is the line of the vascular pedicle. The superficial femoral artery is palpated in the femoral triangle. 2 finger breadth lateral to the prior point marked. The flap is cantered over this line and the upper margin can be extended 5–15 cms above and the lower margin only up to 5 cm. On the lateral aspect of the flap, the incisions are made down to the deep fascia, the inguinal ligament, and the external oblique, and the dissection is carried medially superficial to these fascial structures. As the dissection proceeds medially, the sartorius muscle with its overlying fascia becomes visible. The pedicle can be seen on the under surface as the dissection approaches the lateral border of the sartorius muscle. If necessary, the flap is dissected medially further by incising the fascia over Sartorius and tracing the pedicle deep to fascia of Sartorius. Once the post burn scar is excised and the deformity at the dorsal aspect of digit is corrected and (the skeleton stabilised with k wire where necessary) the flap is placed over the dorsal aspect and the site of making a fenestration is marked approximately. Then the flap is held stretched, overhead lights are put off and a light is focussed on the under surface. The vascular tree of SCIA vessels are seen now and in between its branches marking is made to make the fenestration. A small full thickness incision is made with 11 blade which is gradually enlarged using an artery forceps until it admits thumb into the opening made. Thus letting the thumb out, the flap is draped over the defect and an inset of about 90% is given in stage I except at the distal edge of defect where the flap climbs over around the thumb.

RESULTS

Case 1:
Figure 1. Hypertrophic Scar Dorsum of Hand Causing Z Deformity of the Thumb -Dorsal Aspect

Figure 2.
Lateral Aspect

Figure 3.
After Release of Contracture and K Wire Placement

Figure 4.
Marking of Groin Flap

Figure 5.
After Elevation of Groin Flap -Showing the Pedicle

Figure 6.
Fenestration Made

Figure 7.
After Inset

Case 2:
Figure 8. Scar Over Dorsum of Hand and Thumb Causing Z Deformity of Thumb and Clawing of Fingers -Dorsal Aspect

Figure 9.
Volar Aspect

Figure 10.
After Release of Contracture and Correction of Deformity

Figure 11.
Groin Flap Elevation with Fenestration

Figure 12.
Flap Inset

Figure 13.
6 Months Post-Op

Case 3:
Figure 14. After Release of Contracture and Correction of Deformity

Figure 15.
Vascular Tree of SCIA Vessels

Figure 16.
Full Thickness Incision is Made and Gradually Enlarged

Figure 17.
Flap Inset

Figure 18.
2 Years Post-Op

There were 9 males and 3 females. Age ranges from 4 to 39 (mean 21.75). Out of 12 patients 3 had Scalds, rest due to flame burns. The time interval between injury and reconstruction ranges from 10 months to 8 years (mean 3.25). All patients after contracture release were reconstructed with fenestrated groin flap by 2 staged procedure. After 2 weeks flaps were divided and remaining inset were given. Donor sites were closed primarily by undermining or resurfaced with SSG where necessary. All flaps survived with no postoperative complication. The patients were followed 9-18 months (mean 12 months). Post-operatively, all patients were given physiotherapy regimen for rehabilitation. Since we were able to give 90% inset in the 1st stage we were able to divide the flap in 14 days. As the thumb is not buried under the flap, but let out through the fenestration it does not get soddened which occurs during conventional application of groin flap over the thumb.

Sl. No.	Age /Sex	Cause	Duration	Deformity
1	4/M	Scalds	10 m	Hypertrophic scar dorsum of thumb
2	18/M	Flame burns	7 y	Hypertrophic scar dorsum of thumb
3	22/M	Flame burns	5 y	Hypertrophic scar dorsum of thumb
4	18/F	Flame burns	2 y	Z deformity of thumb
5	34/M	Flame burns	11 m	MP joint dorsal contracture of thumb and 1st web space
6	7/M	Scalds	9 m	Z deformity of thumb
7	26/F	Flame burns	2 y	MP joint dorsal contracture of thumb c 1st web space contracture
8	19/M	Flame burns	8 y	Z deformity of thumb
9	12/F	Scalds	1 y	Hypertrophic scar dorsum of thumb
10	29/M	Flame burns	3 y	Hypertrophic scar dorsum of thumb
11	33/M	Flame burns	5 y	MP joint dorsal contracture of thumb
12	39/M	Flame burns	5 y	Z deformity of thumb

Table 1

DISCUSSION

Function of hand determines the quality of life in patients who sustained burn injury. Although the hands represent approximately 5% of the total body surface area, hand dysfunction can result in severe long-term impairment and disability.[4] The incidence of post-burn contractures is extremely high in our country. Quite often, they are not only multiple in each subject but also very severe and diffuse. The burn subjects are treated by a variety of service providers who aim at closing the raw wounds and this leads to invariable development of wound contraction and scarring[5,6] Despite advances in the overall management of burn injuries, severe post-burn contractures continue to be a formidable foe for reconstructive surgeons in developing countries.

Clawing of digits can occur in the early postinjury period as a result of oedema, tendon injury, or scar contracture. An immediate consequence of postburn oedema can be hyperextension of the metacarpophalangeal (MP) joints and flexion of the interphalangeal (IP) joints, which is commonly referred to as a claw deformity. The severity of these deformities seems to be oedema dependent. Hyperextension of the MP joints occurs as the dorsal skin is drawn taut by the fluid shift into the extravascular tissues and as the palmar arches flatten. Flexion of the interphalangeal (IP) joints follows as a result of this oedema-imposed tension on the common digital extensor tendon system and concurrent hyperextension of the MP joints.[7,8]

The predisposition for MP joint hyperextension deformity to occur is intensified when the dorsal surface of the hand is also burned. Hyperextension contractures of the MP joints may develop despite early surgical and well-planned therapy intervention, particularly in the presence of long-standing oedema. The ring and little fingers account for 65% of problem digits, as studied by Graham and associates.[9,10] With time, the joints become stiff and the extensor tendons undergo adaptive shortening. The poor quality of skin at the PIP joint may expose the tendon and the extensor may rupture secondary to stretch and ischaemia. The thumb may lie in the plane of the palm with narrowing first web space.

The most obvious deformity in the thumb appears at the MCP joint. When there is hyperextension contracture at the MCP joint, swan neck-type deformity or Z deformity occurs in the thumb. Adduction contractures of the first-web space can have a significant impact on overall hand function.[11] Burn scar contractures have been classified by Mc Cauley.

Grade I	Symptomatic tightness but no limitations in range of motion, normal architecture
Grade II	Mild decrease in range of motion without significant impact on activities of daily living, no distortion of normal architecture
Grade III	Functional deficit noted, with early changes in normal architecture of the hand
Grade IV	Loss of hand function with significant distortion of normal architecture of the hand
Subset classification for Grade III and Grade IV contractures: A: Flexion contractures, B: Extension contractures, C: Combination of flexion and extension contractures	

Table 2. Classification of Burn Scar Contracture[12]

Care of these deformities is more appropriately termed postburn hand reconstruction rather than treatment of burn scar contracture. In addition to release of the contracted skin and coverage of the soft-tissue defect, the surgeon must address the secondary changes to the musculotendinous unit, ligaments, and joints. Paucity of nearby good vessels at recipient site in burn patients pose a challenge for microvascular surgery and many times they become distant dream. In extensive burn areas, pedicled regional flaps cannot stand in the choice of reconstructive procedures. The distant flaps remain as feasible and reliable option in these patients despite them bearing the disadvantages like staged procedure and difficult positioning.

The groin flap is an axial pattern flap based on the superficial circumflex iliac artery and the superficial venous network of the groin area. The superficial circumflex artery commonly arises from the femoral artery and in about 50% of cases there will be a common trunk with the superficial inferior epigastric artery. The point of origin lies approximately three centimeters below the mid-inguinal point. McGregor and Jackson[13] first reported this flap as a pedicled skin flap. This flap has been used as a free flap by Ian and O'Brien et al[14] and modified as the free iliac flap with a lateral skin island by Acland.[15]

The SIEA and the SCIA more commonly arise separately from the common femoral artery 2-5 cm below the inguinal ligament. Either the SIEA or the SCIA may be the larger, or they may be equal in size. They have a common origin in up to 48% of patients. The diameter of the SCIA is between 0.8 and 3.0 mm (avg 0.5 mm), and the SIEA between r and 3 mm. Pedicle length is 2-3 cm for both vessels.[16,17] Rarely, one vessel may be completely absent.[18]

Within the first 3.5 cm the SCIA divides into superficial and deep branches of approximately equal size. The superficial branch of the SCIA then runs below Scarpa's fascia parallel to the inguinal ligament while the deep branch continues below the deep fascia as the source of some muscular branches. The deep branch then penetrates the deep fascia of the thigh between 2 and 5 cm lateral to the common femoral artery, but always medial to the lateral border of the sartorius muscle, to continue in the

subcutaneous fat. In comparison with the arterial inflow, the veins draining the groin flap are more numerous and of larger caliber. The flap may be drained by both a superficial and a deep venous system. The superficial outflow is via the superficial circumflex iliac vein (SCIV) which drains into the greater saphenous vein. The venae comitantes, traveling with the SCIA and draining into the common femoral vein, comprise the deep venous system.

In correction of deformities involving the thumb, the first step should be the release of soft tissue contracture. Minor soft-tissue contractures can be corrected with Z-plasties when there is a localized band with surrounding healthy skin. However, release of more complicated contractures discloses skin defect usually larger than anticipated and may include 1st web. It may result in exposure of APL, EPB, EPL tendons, neurovascular bundles or even bone. Different flaps have been proposed for thumb and first web space reconstructions, including FDMA flap, dorsal metacarpal flaps, neurovascular island flap (Littler Flap) .However there are limitations for their use, such as donor site morbidity and inadequate flap size. Our fenestrated groin flap has adequate flap size, reliable pedicle, splints the web in abduction, concealed donor site, majority flap inset in initial stage and hence early flap division and no soddening of thumb. Only disadvantage is two staged procedure but still since we could give maximum inset at initial stage, early division is possible.

When groin flap is used by conventional method the flap has to turn around the digit when inset is given which causes twisting of pedicle. Due to such a lie of flap a longer flap is required and also there is a risk of dehiscence. If flap is put burying the thumb then the thumb and web gets soddened. Making a fenestration obviates these problems. On review of literature no documentation has been found on fenestration in groin flap except in one article where fenestration in free groin flap has been made to let the intact nipple out when the flap was used to reconstruct breast after excision of hemangioma.[19] We have also used the flap in dorsal Post burn contracture involving only the index finger in one patient.

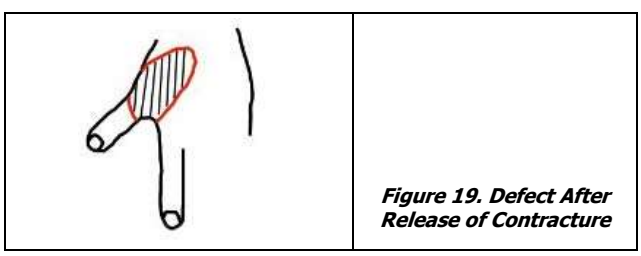

Figure 19. Defect After Release of Contracture

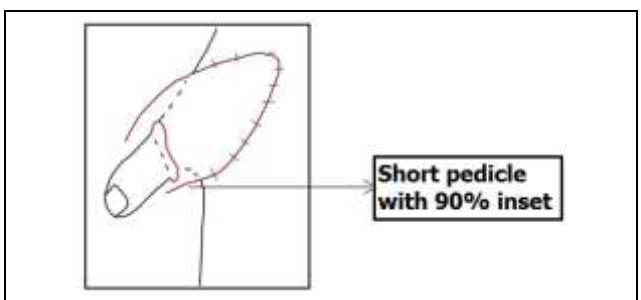

Figure 20. Flap Cover with Fenestrated Groin Flap

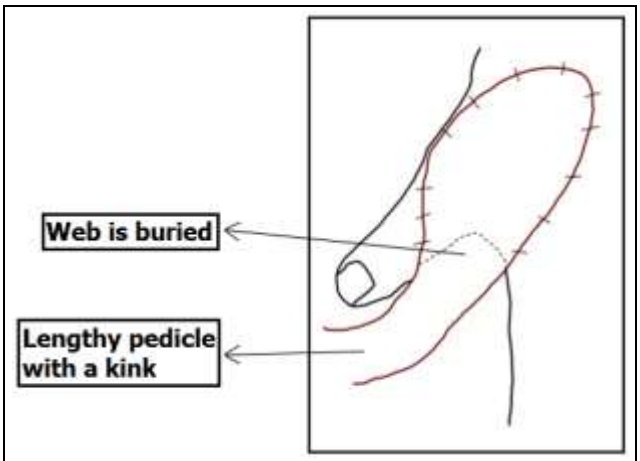

Figure 21. Flap Cover With Conventional Flap

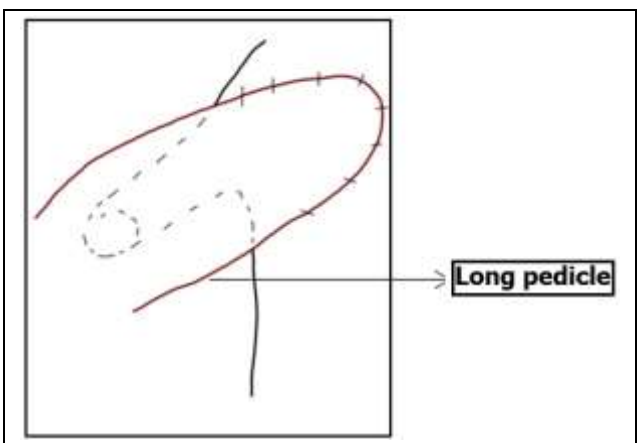

Figure 22. Flap Cover with Conventional Flap Where Thumb is Buried and Gets Soddened

CONCLUSIONS

The idea of making a fenestration in groin flap was conceived and executed. Based on our experience with fenestration in the groin flap, following points have been observed: 1. no compromise in blood supply in any of the cases as there is no kinking of pedicle. 2. pedicle bridge segment is reduced and so flap length is lesser. 3. comfortable hand positioning. 4. splints the thumb in abduction. 5. 90% inset is possible. 6. no soddening of thumb. Groin flap with fenestration is an ideal flap after release of dorsal PBSC of thumb.

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