

Outcome of Coverage of Post Burn Palmar Hand Contractures with Glabrous Intermediate-Thickness Plantar (ITP) Skin Graft

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Abstract

Objective: To determine the outcome of use of glabrous intermediate thickness plantar (ITP) skin graft for the coverage of defects on palmar aspect of hand after release of post burn contractures (PBC).

Methods: This prospective study was completed at Department of Plastic Surgery & Burn Unit, KEMU, Mayo hospital, Lahore from 18th January 2014 to 17th December 2015. Seventy four patients of both genders with post burn contractures (PBC) on palmar aspect of hand were included. After release of PBC defect was covered with glabrous intermediate thickness plantar (ITP) skin graft.

Results: Out of 74 patients included in this study, 62% were males. Size of the defect after release of contracture was $5 \pm 2 \text{ cm}^2$. Patients started walking in 2 ± 0.5 days. Final graft take was 93 ± 2 percent on 14th day. There was infection of graft in four patients. Patient satisfaction for color and texture match was 4 ± 1 . Donor site healed in 25 ± 1.8 days with infection occurring in 5% patients. Hypertrophic scarring was recorded in three patients at recipient site and in four patients at donor site. Two patients developed recurrence however no walking difficulty observed at 13 ± 1 months follow up.

Conclusion: Application of intermediate thickness plantar skin graft on the palmar skin defects results in excellent graft take with acceptable color and texture match and minimal donor site morbidity.

Key words: Hand, Burns, Palmar defects, Plantar, Graft.

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Introduction

Burn injury is a common form of trauma affecting hands. Young males are the commonest victims of hand burn and mostly sustain injury at workplace.^{1,2} Inadequate management (healing by secondary intention, inappropriate positioning, lack of physiotherapy and inadequate scar therapy) of these burn injuries leads to hypertrophic scarring and contractures causing functional disability. Functional loss of the hands has been estimated to make up to 57% loss of function of an individual^{3,4}. Post burn contractures need releases to improve hand function. Coverage of defects after releases of these contractures on palmar aspect of hand requires skin with structural and functional characteristics similar to palmar skin. Palmar skin is thick, inelastic and hairless. It is designed to combat the daily

strong and tough work of an individual⁵. Traditionally non glabrous skin grafts of variable thickness (intermediate or thick split thickness or full thickness) harvested from medial arms, thighs, buttocks or groin are mostly used for coverage of palmar skin defects. These non-glabrous skin grafts lack similarities with palmar skin and use of these skin grafts is associated with hyper-pigmentation, scarring, recurrent contractures, hair growth and unacceptable cosmetic appearance^{6,7}. Glabrous plantar skin is the only area of body sharing characteristics of palmar skin.

Plantar skin can be harvested as split thickness, dermal only or full thickness skin graft^{8,9,10}. There are few studies available describing effectiveness of use of intermediate thickness plantar (ITP) skin graft for coverage of defects after release of post burn contractures of hand.

This prospective study was designed to determine the outcome of intermediate thickness plantar skin graft for the coverage of defects on palmar aspect of hand after release of PBC in terms of graft take, complications, recurrence and patient satisfaction for color and texture match.

Methods

This prospective study was completed at Department of Plastic and Reconstructive Surgery and Burn Unit KEMU, Mayo Hospital Lahore from Jan 2014 to December 2015. Sample size of 74 Patients was calculated with 95% confidence level, 10.5% margin of error and taking assumed percentage of complete graft take (as per operational definition) i.e 70% and color and texture match 4 on likert scale in patients with palmar defects after release of post burn contracture, undergoing intermediate thickness plantar skin graft. Patients were scrutinized in outpatient clinic. Patient's demographic information (age, gender), clinical characteristics (site of contracture with involved fingers, degree of contracture, passive range of motion of underlying joint), co-morbidities (diabetes mellitus, hypertension), smoking status, previous surgical treatment, and X- ray findings of affected hands were noted. Seventy four patients of both genders with post burn contractures (PBC) involving palmar aspect of hand requiring skin graft for coverage after release of the contractures were included. Patients having wounds with exposed

vessel, tendon or bone after release of contractures or those having wound size more than 10cm² were excluded from study. Contractures less than one year of duration were also excluded. Patients with history of diabetes mellitus, hypertension and smoking were also excluded. Surgical treatment was employed after patient counseling and obtaining informed consent.

All Patients were operated under general anesthesia without tourniquet using tumescent solution. One dose of cefradine 500mg intravenous (IV) was injected, one hour before surgery to every patient. Incision was marked and infiltration was performed with tumescent fluid of 0.18% lidocaine with 1:221,000 epinephrine. Surgery was started 25 minutes after infiltration of tumescent solution¹¹. Contracture was released and all abnormal tissue was excised down to healthy tissue Figure. 2B, 3B. Resultant defect was measured and marked out on instep of foot in 1:1 fashion. Tumescent solution was also injected into the area marked for graft harvest. Figure. 1A. Intermediate-thickness plantar (ITP) skin graft was harvested with Watson knife (Downs Surgical Sheffield England) and was stabilized to recipient site. Figure. 1B, 2C, 3C, 4B. Recipient site was dressed with tulle-grass dressing. This was reinforced with tie over wet cotton dressing followed by dry gauze and crepe bandage. Donor site was also dressed with tulle-grass dressing covered with dry gauze and crepe bandage. Operated hand was splinted in postoperative period with POP cast. Nalbuphin 0.2 mg/kg IV was given thrice daily for relief of pain for 5 days.



Figure 1. A. Infiltration of tumescent solution on donor site of right foot

B. Harvested Intermediate- thickness planter graft and donor site Immediately after harvesting



Figure 2. **A.** Recurrent Post burn contracture of left hand involving MCPJ of all four fingers with pigmentation of previous graft
B. Defect after release of contracture
C. Intermediate- thickness planter graft secured to defect.
D. donor site on left foot at 6 month



Figure 3. **A.** Post burn contracture involving 3rd,4th,5th fingers and ulnar aspect of left hand
B. Defect after release of contracture
C. Coverage of defect with Intermediate- thickness planter skin graft
D. Donor site on left foot at one year

Patients were allowed to bear weight after surgery as tolerated. First change of dressing and recipient site inspection was done at 5th post operative day. Patients were discharged at 5th to 7th postoperative day. Donor site was inspected at 14th postoperative day. Graft take (defined as graft



Figure 4. **A.** Post burn contracture of left hand
B. Defect after contracture release and Coverage with Intermediate- thickness planter skin graft
C. Excellent color match of intermediate-thickness planter graft at one year
D. hypertrophic scarring of some area of donor site one year

which is well adherent to its bed without the aid of sutures) was measured on 14th postoperative day in terms of percentage using formula (Graft take % = size of graft take/ total size of graft applied x 100). Massage with steroid cream twice daily and application of silicone sheet for 8 hours at night time was advised 3 to 4 weeks after surgery and continued for 3 months at both recipient and donor sites. Patients were also advised to wear pressure garments on hand as well as donor foot for 1 year. Patients were followed for one year postoperatively. Frequencies and percentages of both recipient and donor sites complications like infection (defined as discharge of pus), hypertrophic scarring (defined as red and raised scar measured on Vancouver scar assessment scale), recurrence (defined as development of new flexion contracture at operated site) and difficulty in walking (defined as pain on walking and abnormal gait) were noted. Patient satisfaction for color and texture match to neighboring skin at recipient site was assessed by adult patients themselves 6 months after the operation using five points Likert scale, where score 1 was considered as not at all satisfied, and score 5 was considered as highly satisfied. In case of children this assessment was

done by their parents. Continuous variables (age, pain, graft take and patient satisfaction for color and texture match) were presented as mean $\pm$ SD. Categorical variables (gender, complications and recurrence) were presented as frequencies and percentage.

Results

Out of 74 patients included in this study 46 (62%) were males and 28(38%) were females with median (mode) age 18(17) years (Range 6 to 39 years). Forty four (59%) patients had contractures of palmextending onto fingers, and 30(41%) had contractures limited to palmar aspect of fingers only. Mean $\pm$ SD size of defect after release of contracture was 5 ± 2 cm². Pain scores calculated for both recipient and donor sites were 5 ± 1 and 5 ± 1 respectively. Patients started walking in 2 ± 0.5 days. Final graft take measured at 14th postoperative day was 93 ± 2 percent. There was infection of grafting four cases (5%) which resulted in partial graft loss. These patients were managed conservatively. Patient satisfaction for color and texture match at recipient site was 4 ± 1 on five point likert scale. The donor site healed in 25 ± 1.8 days. During 13 ± 1 months (range 12 -16 months) follow-up period three patient (4%) developed hypertrophic scarring at recipient site while four (5%) at donor site. Figure. 4D. Two patients developed recurrent contracture however none of the patient had walking difficulty at end of follow-up.

Discussion

The study found excellent graft take and high level of patient satisfaction after application of intermediate thickness plantar skin graft with that of palmar skin. Figure. 4C.

The skin provides protection from environmental assaults and sensations to interact with environment. In general, qualities of skin vary in different parts of the body. Glabrous skin of palms and soles differs from hair-bearing skin. Glabrous skin is hairless, thick, and less elastic, contains few melanocytes and is without sebaceous glands. It has superior healing potential, and greater capacity to perceive protective sensations. Due to compact connective tissue and fibrous septait can withstand greater pressure and shearing forces^{5,8}.

It is inherent desire of a plastic surgeon to

Table 1: Donor and recipient site complications

Complications	No. (%age)
Donor site	
• Infection	0(0)
• Hypertrophic scar	3(4%)
• Walking difficulty	0(0)
Recipient site	
• Infection	4(5)
• Graft loss	
i) Total loss	0(0)
ii) Partial loss	4(5)
• Hypertrophic scar	4 (5%)
• Recurrent contracture	2(2.5)
• Hyperpigmentation	0(0)

follow Sir Harold Gillies famous saying “Replace like with like”. Plantar skin graft provides like tissue to coverage labrous skin defects to reestablish stability, durability and appearance.^{9,12,13} Our study reinforced literature that intermediate thickness plantar (ITP) skin graft provides supple, durable and reasonably thick skin. Harvesting is easy and simple to perform as compared to full thickness or dermal grafts¹⁴. We found excellent graft take of 93 ± 2 percent.

Graft related complications noted in our study were minimal and comparable with what has been reported in literature^{8,15}. Four patients got recipient site wound infection resulting in partial graft loss. These cases were managed with antibiotic and dressings. The scar was inconspicuous in 95% patients with hypertrophic scarring in only 4% patients and were managed conservatively. We found low recurrence rate with only two patients developing recurrent contracture during the follow up period. This is attributed to fact that planter skin have no or minimal primary and less secondary contraction.

Many studies mentioned that abundance of sweat glands in plantar skin provide multi-centric areas for epithelial budding which contributes towards rapid healing^{4,8}. In our study we found that 99% donor site wounds healed in 25 ± 1.8 days with minimal complications which were managed conservatively.

One of the major concerns after harvest of plantar skin graft has been apprehension about

future weight bearing potential.^{5,8} Patients in our study were allowed to walk as soon as they tolerated and mean $\pm$ SD time when they started walking was 2 ± 0.5 days. We found that glabrous ITP skin graft harvested from instep did not alter walking and weight bearing. These findings are in accordance with what has already been reported in literature.

Few studies have highlighted the very important issue of color and texture match of grafted ITP skin with adjacent palmar skin.^{10,13} In our study 95% patients were highly satisfied with color and texture match of ITP skin graft to adjacent palmar skin Figure 4C.

Small sample size and no assessment of reinnervation and sensibility of grafted area are the weaknesses of our study. We hope that future trials determining reinnervation of glabrous skin grafts will further enhance its utility.

Conclusion

Application of intermediate thickness plantar skin graft on the palmar skin defects results in excellent graft take with acceptable color and texture match and minimal donor site morbidity.

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