



RESEARCH ARTICLE

EVALUATION OF FUNCTIONAL AND AESTHETIC OUTCOMES OF GLABROUS SKIN RESURFACING IN CASES OF PALMODIGITOVOLAR DEFECTS

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ABSTRACT

Soft tissue injuries of hand and palm are common occurrence caused by trauma, infection, burns and various medical procedures. The criteria for selection of appropriate flap for volar defects is based on ability of the flap to provide glabrous skin, adequacy of length, adequate sensitivity and ability to allow free movement of joints. In the present study we intend to describe our experience of resurfacing of palmodigitovolar defects with glabrous skin. Study population comprised of 32 patients with palmodigitovolar defects from various causes. All routine basic investigations were carried out before the surgery. Healthy palmar defects with red granulation tissue were considered for reconstruction by different suitable approaches using glabrous skin flap/grfts above according to the requirement of the defect and feasibility of the procedure. Clinical photographs were taken. Quality of life assessment was made using Michigan Hand Outcomes Questionnaire (MHQ). Patient was discharged and follow up was done on 7th, 21st and 60th post op days and pictures were taken for each follow up. At final assessment flap/graft sensation and overall outcome was noted. It was rated at a 5-point scale where 1 indicated a good outcome and 5 indicated a poor outcome. Mean age of patients was 27.78 ± 16.38 years. There was a perfect matching of flap texture with recipient site in all the cases. Majority of cases (65.6%) had substantial matching of flap/graft colour with recipient site. On day 60, there were 30 (93.8%) cases who did not have any complications. In the remaining 2 (6.3%) had delayed donor site healing was observed as a complication. Use of glabrous skin grafts for covering the palmodigitovolar defects has been reported to be a promising option that results in superior results, improved function and sensation, near normal appearance and high durability.

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INTRODUCTION

Soft tissue injuries of hand and palm are common occurrence caused by trauma, infection, burns and various medical procedures. Soft-tissue defects on the volar surface of the palm and digits are highly common and often expose the tendons, nerves and vessels. In such circumstances, reconstruction becomes quite essential¹. The criteria for selection of appropriate flap for volar defects is based on ability of the flap to provide glabrous skin, adequacy of length, adequate sensitivity and ability to allow free movement of joints². Management of larger defects is a difficult task, especially for the volar skin defects "the ideal replacement for volar skin loss on the digits should provide padding or cushion, have a good color and texture match, be sensate or have potential to be sensate, resilient, maintain length and not

limit motion"^{3,4}. Glabrous skin seems to be perfectly suitable for this purpose. It fulfils the criteria of derivation from 'like tissue' (i.e. glabrous skin) namely the same or adjacent digits, palm and soles of the feet. However, availability of glabrous skin is scarce. The glabrous skin can be made available through loco-regional flaps. Free flaps from the foot and toes "(toe pulp, toe web, medial plantar artery perforator flap using instep skin)" or digits of the palm are also other sources of glabrous skin^{5,6,7,8}. Nonglabrous skin grafts have significant disadvantages when used for reconstruction of palmar/plantar defects. These include craters, contractures, tight subgraft fibrosis and painful build up at the periphery of the skin grafts. In the present study we intend to describe our experience of resurfacing of palmodigitovolar defects with glabrous skin at a

tertiary care centre in North India in terms of functional and aesthetic outcomes.

MATERIALS AND METHODS

This observational study was conducted at Department of Plastic Surgery, Vivekananda Polyclinic & Institute of Medical Sciences (VPIMS), Lucknow. Study population comprised of 32 patients with palmodigitovolar defects from various causes between 4 years to 56 years of age over a period of three years from August 2019 to June, 2022. The study was approved by Institutional Ethical Committee. Informed consent was obtained from all the participants. No extra financial burden was imposed on patients. All the patients falling in sampling frame and fulfilling the inclusion and exclusion criteria of study were invited to participate in the assessment. The procedure and complications involved were fully explained to the patients. Demographic information, personal and medical history of patients was noted. A thorough general and systemic examination was performed. All routine basic investigations were carried out before the surgery and procedure. X rays of the involved site were taken in all the cases pre-operatively and postoperatively whenever required.

Healthy palmar defects with red granulation tissue were considered for reconstruction by different suitable approaches using glabrous skin flap/grafts above according to the requirement of the defect and feasibility of the procedure. Cause of defect, time since occurrence of defect, size of defect, site of defect and side involved was noted. Total amount of tissue loss was recorded. Clinical photographs were taken. Quality of life assessment was made using Michigan Hand Outcomes Questionnaire (MHQ). All the patients thereafter underwent reconstructive procedure for using glabrous skin. Details of type of flap/graft used were also noted. Location of donor site was also noted.

Donor site marking was done according to the size of the defect and flap/graft was harvested. Closure of donor site was done primarily or with the graft placement or by simple sterile dressing depending upon the type and size of graft/flap harvested. Insetting of the harvested graft/flap was done and immediate post operative photograph was taken. Patient's limb was kept in position of least tension to the graft/flap and post op course of antibiotics were given. Dressing was opened and operated site was reviewed on third post op day and picture of flap/graft was taken after informing the patients.

Patient was discharged and follow up was done on 7th, 21st and 60th post op days and pictures were taken for each follow up. At final assessment flap/graft sensation and overall outcome was noted. It was rated at a 5-point scale where 1 indicated a good outcome and 5 indicated a poor outcome. Data obtained was fed into computer using Microsoft Excel software. For descriptive statistics, frequencies (numbers), proportions (percentages), mean, median and standard deviation were used. Chi-square test, paired 't'-test and Wilcoxon signed rank tests were used to compare the data. Probability of chance error allowance was 5% and thus 'p' value less than 0.05 was considered as statistically significant.

RESULTS

Mean age of patients was 27.78±16.38 years. Maximum number of cases (n=7; 21.9%) were aged between 21 and 30 years (Graph. 1). Male to female ratio of the study was 1.91. More than two-third (68.8%) patients did not have any comorbidity. A total of 7 (21.9%) patients had only one comorbidity – 3 (9.4%) hypertension, 2 (6.3%) diabetes, 1 (3.1%) chronic kidney disease and 1 (3.1%) chronic liver disease. There were 3 (9.4%) patients with more than one comorbidity – 2 (6.3%) had diabetes with hypertension and 1 (3.1%) had diabetes with CKD (Graph. 2). Maximum (n=15; 46.9%) cases had trauma/mechanical injury as the underlying etiology. There were 8 (25%) cases with burn contractures, 5 (15.6%) had post-cellulitis defects, 3 (9.1%) had congenital (campodactyly) and 1 (3.1%) had avulsion injury. Maximum number of cases (n=10; 31.3%) reported for reconstruction within 24 hours of injury followed by those reporting between 2-7 days (25%), >1 year (25%), 8 days to 1 month (15.6%) and 1 month-1 year (3.1%) respectively. Maximum (n=14; 43.8%) had defect size (largest dimension) within 2-5 cm range. Of the remaining 18 cases – 9 (28.1%) each had defect size ≤2 cm and >5 cm respectively. Median defect size was 4 cm (Table 1). Maximum number of cases had involvement of multiple fingers (28.1%) followed by those having involvement of middle finger and other sites on palm/wrist (21.9%), thumb (15.6%) and index finger (12.5%) respectively. Majority (68.8%) had involvement of skin and subcutaneous tissue. Glabrous split skin graft from left foot sole medial plantar arch region (n=9; 28.1%) was the most common procedure performed followed by Thenar flap (n=7; 21.9%), medial plantar free flap (n=5; 15.6%), Glabrous split skin dermal graft from left foot sole medial plantar arch region (n=4; 12.5%) and Moberg flap (n=3; 9.4%) respectively (Table 2). Most of the patients (n=28; 87.5%) did not experience any donor site morbidity. There were 3 (9.4%) patients had delayed healing at donor site and 1 (3.1%) developed minor infection leading to delayed healing.

There was a perfect matching of flap texture with recipient site in all the cases. Majority of cases (65.6%) had substantial matching of flap/graft color with recipient site. A total of 8 (25%) had perfect color matching and 3 (9.4%) had slight color matching. Graft volume was adequate in 26 (81.2%) cases while remaining 6 (18.8%) grafts were bulky. There was no case with hairy graft/flap (Table 3). As compared to preoperative interval, at day 7 a significant increase in domain scores for overall hand function, ADL, Work and Pain and a significant decrease in domain scores for satisfaction was observed. For esthetics, though there was an increase yet it was not significant. At day 21 and 60, a significant decrease in all the domain scores (except pain) was observed, for pain there was a significant increase in score. At day 60, the sensation status at recipient site was rated as good, fair, average and below average in 5 (15.6%), 14 (43.8%), 9 (28.1%) and 4 (12.5%) cases respectively. At day 60, overall outcome was rated as good, fair, average and below average in 10 (31.3%), 13 (40.6%), 7 (21.9%) and 2 (6.3%) cases respectively (Table 4). On day 60, there were 30 (93.8%) cases who did not have any complications. In the remaining 2 (6.3%) had delayed donor site healing was observed as a complication.

FIG. 1: Post cellulitis raw area over volar aspect of right hand, wrist and forearm where raw area over hand was covered by GLABROUS SSG FROM INSTEP SOLE



Results of glabrous SSG is shown in figure 1. Result of dermal glabrous SSG is shown in figure 2

FIG. 2: Post burn contracture right hand little and ring finger palmar aspect released and defect covered with DERMAL SPLIT SKIN GRAFT FROM INSTEP SOLE



Technique of dermal glabrous SSG harvest is shown in figure 3 with healthy donor site healing.

Fig. 3: DERMAL SPLIT SKIN GRAFT FROM INSTEP SOLE TECHNIQUE OF HARVEST



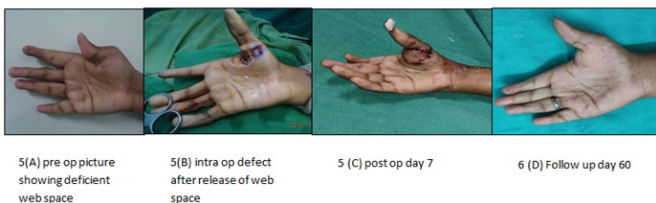
Result of thenar flap is shown in figure 4

FIG. 4: Amputated pulp of left middle finger reconstruction done using THENAR FLAP



Result of medial plantae artery free flap is shown in figure 5
Technique of medial plantar free flap harvest is shown in figure 6 with healthy donor site healing.

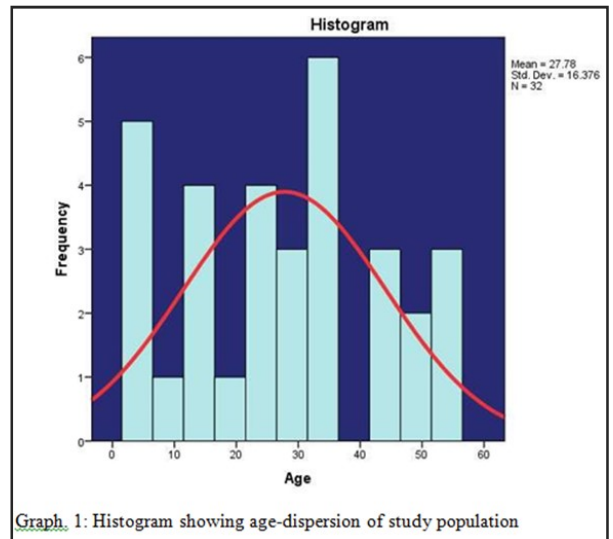
Fig. 5: Case of camptodactyly where first web space created using MEDIAL PLANTAR ARTERY FREE FLAP



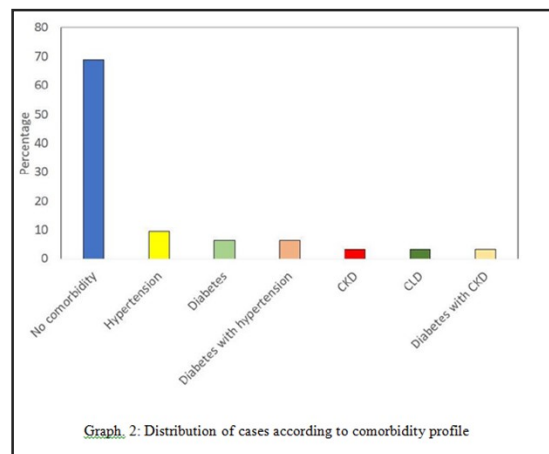
DISCUSSION

Management of palmodigitovolar defects is challenging owing to the specific structural characteristics of the skin, need to restore the skin sensitivity and resistance to friction apart from just covering the defect. Use of glabrous skin grafts for covering the palmodigitovolar defects has been reported to be a promising option that results in superior results, improved function and sensation, near normal appearance and high durability⁹.

Fig. 6: MEDIAL PLANTAR ARTERY FREE FLAP: TECHNIQUE OF HARVEST



Graph. 1: Histogram showing age-dispersion of study population



Graph. 2: Distribution of cases according to comorbidity profile

Table 1: Distribution of cases according to largest dimension of defect

SN	Largest dimension of defect	No. of cases	Percentage
1.	≤2 cm	9	28.1
2.	2-5 cm	14	43.8
3.	>5 cm	9	28.1
Mean largest dimension±SD (Range) cm ²			4.31±2.22 (1-8) [Median 4 cm]

However, despite their popularity, there are differences in terms of outcome among studies done under different environments and show a variability with patient characteristics. In the present study, we made an attempt to document our experience of glabrous skin resurfacing in cases of palmodigitovolar defects in terms of functional and esthetic outcome. In the present study, a total of 11/32 (34.4%) patients were aged ≤ 20 years.

Table 2: Distribution of cases according to Procedure Performed

SN	Type of graft/flap	No. of cases	Percentage
1.	Glabrous split skin graft from left foot sole medial plantar arch region	9	28.1
2.	Glabrous split skin dermal graft from left foot sole medial plantar arch region	4	12.5
3.	Thenar flap	7	21.9
4.	Medial plantar free flap	5	15.6
5.	Moberg flap	3	9.4
6.	Others (two groin flap prelaminated with glabrous skin from in sole of left foot, one little flap from left ring finger radial aspect and one little flap from right middle finger radial aspect)	4	12.5

Table 3: Distribution of cases according to Flap/Graft Characteristics

SN	Characteristic	No. of cases	Percentage
1.	Matching of flap texture	32	100.0
2.	Flap/Graft color matching score		
	Slightly matching	3	9.4
	Substantially matching	21	65.6
	Perfectly matching	8	25.0
3.	Flap/Graft volume		
	Adequate	26	81.2
	Bulky	6	18.8
4.	Hairiness	0	0

Table 4: Evaluation of Change in Hand Outcomes status at different follow up intervals as compared to preoperative status

SN	Characteristic	Preoperative		Median (IQR)	Statistical significance (Wilcoxon signed rank test)	
		Mean	SD		z	P
1.	Overall hand function					
	Preoperative	3.56	0.98	4 (3,4)		
	Day 7	4.75	0.76	5 (5,5)	4.010	<0.001
	Day 21	2.75	1.02	3 (2,3)	2.639	0.008
	Day 60	1.50	0.67	1 (1,2)	4.633	<0.001
2.	Activities of Daily Living (ADL)					
	Preoperative	3.28	1.51	4 (2,5)		
	Day 7	4.81	0.64	5 (5,5)	3.851	<0.001
	Day 21	2.88	1.13	3 (2,4)	1.054	0.292
	Day 60	1.22	0.53	1 (1,1)	4.339	<0.001
3.	Work					
	Preoperative	3.44	1.44	4 (2,5)		
	Day 7	4.78	0.71	5 (5,5)	3.603	<0.001
	Day 21	2.69	1.06	2 (2,3)	2.014	0.044
	Day 60	1.34	0.60	1 (1,2)	4.582	<0.001
4.	Pain					
	Preoperative	2.44	1.90	1 (1,5)		
	Day 7	2.78	0.75	3 (2,3)	0.563	0.574
	Day 21	3.59	1.10	4 (3,4.75)	2.633	0.008
	Day 60	4.66	0.65	5 (4,5)	4.122	<0.001
5.	Esthetics					
	Preoperative	3.44	0.84	3 (3,4)		
	Day 7	3.63	0.94	4 (3,4)	0.900	0.368
	Day 21	2.97	0.82	3 (2,3.75)	2.048	0.040
	Day 60	2.56	1.01	2 (2,3)	3.062	0.002
6.	Satisfaction					
	Preoperative	4.16	0.92	4 (4,5)		
	Day 7	3.47	0.95	3 (3,4)	2.685	0.007
	Day 21	2.81	1.09	3 (2,3.75)	3.753	<0.001
	Day 60	2.03	1.20	2 (1,2.75)	4.539	<0.001

However, in the study by Gu *et al.*¹⁰, the minimum age of patients was 19 years as compared to 4 years in the present study and that could have contributed to a relatively higher mean age of the patients. However, Iwuagwu *et al.*² in their study reported the mean age of patients as 40.1 years and proportion of males as 69.2%. Sen *et al.*¹¹ reported the median age as 49 years and proportion of males as 80%. In the study by Iwuagwu *et al.*² reported diabetic history in 7.7% of their patients. However, some workers preferred to exclude patients with these complications from their study. In the present study too, all the patients having a diabetic history had a controlled diabetic and hypertensive profile at the time of surgery. As such, complications like uncontrolled diabetes may interfere with wound healing and could affect the graft success^{12,13}.

Compared to our study, many other studies reported the defect size in terms of area. However, we did not do so neither all defects were perfectly rectangular nor they had any regular shape for which area estimates could be done. Keeping this in consideration, we decided to report largest dimension as the representative value. In our study, a large proportion of patients had more than one defect too, hence largest dimension of the defect seemed to be a viable choice. In the present study, more than one-quarter patients (28.1%) had involvement of multiple fingers. Moreover, there were 7 (21.9%) patients who had involvement of palm/wrist too. The source of glabrous skin can vary from various loco regional flaps or free flaps from the foot and toes⁷⁻⁹. In different study sources for glabrous skin reconstruction have shown a variability depending on case-to-case suitability. Sen *et al.*¹¹ on the other hand used free instep flaps in all their cases while, in the present study we used different sources and types of glabrous skin flat/grfts depending upon suitability.

In the present study, overall outcome at 2 months showed fair to good outcome in 71.9% cases. Average outcome in 7 (21.9%) cases and below average outcome in 2 (6.3%) cases. Outcomes in terms of overall hand function indicated achievement of full hand function, activities of daily living and work in majority of cases (Median score 1). Pain scores also showed complete relief in most of the cases (Mean score 4.66, median 5). However, esthetics and overall patient satisfaction scores showed some gaps (Median score 2 for both). Nerve sensation was also fair to good in majority (59.4%) but was also rated as below average in 12.5% cases. The present study observed the role of glabrous skin resurfacing in 32 cases (Age range 4-56 years; Mean age 27.78 \pm 16.38 years; 65.6% males; 31.2% having comorbidities) of palmodigitovolar defects. Following were the key observations made during the study:

- Matching of flap texture was seen in all (100%) cases, substantial to perfect color matching was possible in 29 (90.4%) cases. Flap/graft volume was adequate in 26 (81.2%) cases. Mean duration of surgery was 70.31 \pm 52.05 min.
- Significant improvement in outcomes was observed from day 21 follow-up itself.
- Duration of hospital stay ranged from 3 to 18 days. Mean duration of hospital stay was 7.25 \pm 4.29 days. Re-grafting was done in one case. Two others required additional procedures.

- At final follow-up (day 60), complete healing was achieved in 29 (90.6%) cases, delayed donor site healing was seen in 3 (9.4%) cases. Good to fair sensation was achieved in 19 (59.4%) cases. Overall donor site morbidity was insignificant.

CONCLUSION

As such glabrous skin resurfacing is a very safe technique and there are minimal or no postoperative complications associated with it. The purpose of the present study was not to assess the suitability of any particular source/type but to in general assess the glabrous skin resurfacing irrespective of the donor site, location or nature or type of flap/graft. Overall, the results could be termed as satisfactory, however, there was need for further improvement. The present study showed that glabrous skin resurfacing is a useful technique that has a high success rate and provides reasonably good functional and esthetic outcomes.

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