



A COMPARATIVE STUDY OF FUNCTIONAL OUTCOME OF CAPSULOTOMY AND VOLAR PLATE RELEASE IN SEVERE POST BURN HAND DEFORMITY

Surgery

Vishal Kumar Upadhyay*

PG Trainee, Department Of General Surgery, GSVM Medical College Kanpur
*Corresponding Author

Prem Shanker

Professor, Department Of General Surgery, GSVM Medical College Kanpur

R. K. Singh

Professor, Department Of General Surgery, GSVM Medical College Kanpur

ABSTRACT

Introduction: Burn injuries are a leading cause of trauma-related deaths worldwide, with significant functional and aesthetic implications, particularly when affecting the hands. Contractures and scarring from burns can severely impair joint and tissue function, causing long-term disability and deformity. This study aims to evaluate the functional outcomes of capsulotomy and volar plate release in managing severe post-burn hand deformities. **Material And Method:** This is a hospital-based prospective study conducted over 24 months at the LLR Hospital GSVM Medical College, Kanpur, including 50 patients with male and female patients of all age groups with Grade 3 and Grade 4 burn contractures. Excluded those with infection or re-contracture at the same site after previous surgeries. Functional and aesthetic satisfaction scores, Total active motion and post-operative complications were recorded. **Results:** In this study the mean TAM for all fingers of the hand was $<180^\circ$ at preoperative assessment. This is clearly a significant functional loss, and surgical reconstruction had a significant impact on the improvement in the score to 253.6° in capsulotomy and 243.2° in volar plate release group after 1 year, which is a good outcome. Functional Outcomes-Both procedures resulted in significant improvements in functional and aesthetic satisfaction, with mean scores of 4.6 ± 0.75 and 4.84 ± 0.88 for functional satisfaction, and 4.16 ± 0.78 and 4.48 ± 0.81 for aesthetic satisfaction, respectively. **Conclusion:** Both capsulotomy and volar plate release significantly improve functional and aesthetic outcomes in severe post-burn hand deformities. Early surgical intervention combined with supervised physiotherapy is crucial in mitigating the long-term impacts of burn injuries on hand functionality and appearance.

KEYWORDS

Total active motion, capsulotomy, volar place release, resurfacing procedure.

INTRODUCTION

Burns are the second leading cause of trauma-related deaths Worldwide, after vehicular accidents[1]. The most frequent types of burns are scald and flame burns, While chemical and electrical burns are less common[2]. Contractures can result in loss Of function, poor cosmetic outcomes, diminished quality of life, pain, and Psychological effects[3]. Contracture involves the abnormal deposition and maturation of Collagen, leading to impaired joint or soft tissue function and potential cosmetic Disfigurement[4]. According to McCauley et al.[5], burn scar contractures Can be classified as follows:

Table 1: Classification Of Burn Scar Contracture

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. Post-burn scarring and contractures greatly affect both the functionality And appearance of the hand, making them one of the most challenging Complications of hand burns[6]. If contractures or scarring affect The dominant hand, as they do on most occasions, the vocation And there by the economic status of the patient suffer. Appropriate Choice of procedures and timing of surgery followed by supervised Physiotherapy can be a boon for a burns survivor [7].

The focus of the present study was to evaluate the Capsulotomy and volar plate release with different resurfacing surgical Procedures for reconstruction of post-burn contractures of the hand In terms of functional and aesthetic outcome.

MATERIAL AND METHOD

This hospital-based prospective study was conducted with 50 patients who attended the Emergency and outpatient department of the Surgery of LLR Hospital, GSVM Medical College, Kanpur with severe post-burn crippled hand over 24 months from Jun 2022 to June 2024, after obtaining consent from the patients.

A detailed history was taken and clinical examination of the patients was carried out at the time of admission with special references to demographic characteristics, disease chronology, type of burn and severity of contracture. Relevant general and specific medical examination. Details of the subjects in terms of details of site of contractures and subsequent medical evaluations done were recorded. Informed consent was collected, and following information was collected to generate data for the study. We included all patients of postburn contractures of the fingers who underwent a surgical correction and had minimum follow-up of 12 months. Inclusion Criteria: 1- Proven cases of severe post burn hand contracture. 2-Both males & females were taken in this study. 3-Patients of all age group were included. 4- Grade 3 and grade 4 burn contracture. Exclusion Criteria: 1. Patients who had been operated at other hospitals for severe burn contracture of hand release came with re-contracture at same site 2. Grade 1 and 2 burn contracture. After admission type of surgery along with any complications were recorded. The goniometer was used for a range of motion and total active motion (TAM) was calculated for each finger as per the method recommended by American Society of Surgery of the Hand (ASSH). Data was analyzed by using statistical software SPSS 22. Qualitative variables were represented in form of frequency and percentage. Quantitative data was represented in form of mean $\pm$ standard deviation.

RESULTS

Total fifty patients underwent a surgical correction and functional assessment. Patients were followed up postoperatively at 3 months, 6 months, and 1-year interval.

In the capsulotomy group, 60.0% of patients were classified as Grade III A, 8.0% as Grade III B, 24.0% as Grade IV A, and 8.0% as Grade IV B. In the volar plate release group, 72.0% of patients were classified as Grade III A, 8.0% as Grade III C, 16.0% as Grade IV A, and 4.0% as Grade IV C.

Table 2: Distribution of the studied patients based on McCauley grade in both groups

McCauley's Grade	Group - Capsulotomy	Group - Volar Plate Release	p-value
Grade III A	15 (60.0)	18 (72.0)	0.175
Grade III B	2 (8.0)	0 (0.0)	
Grade III C	0 (0.0)	2 (8.0)	
Grade IV A	6 (24.0)	4 (16.0)	
Grade IV B	2 (8.0)	0 (0.0)	

Grade IV C	0 (0.0)	1 (4.0)	
------------	---------	---------	--

The mean procedural time for the capsulotomy group was 39.2±9 minutes, while for the volar plate release group, it was 39.0±11 minutes. In the capsulotomy group, 44.0% of patients received full-thickness skin grafts (FTSG), 16.0% had Groin Flaps, 8.0% had split-thickness skin grafts (STSG), and 32.0% underwent Z-plasty. In the volar plate release group, 48.0% of patients received FTSG, 20.0% had Groin Flaps, 16.0% had STSG, and 16.0% underwent Z-plasty.

Table 3: Distribution of the studied patients based on different resurfacing procedure in both groups

Resurfacing Procedure	Group - Capsulotomy	Group - Volar Plate Release	p-value
FTSG	11 (44.0)	12 (48.0)	0.541
GROIN FLAP	4 (16.0)	5 (20.0)	
STSG	2 (8.0)	4 (16.0)	
Z-PLASTY	8 (32.0)	4 (16.0)	

The study compared the total active motion (TAM) of patients in the capsulotomy and volar plate release groups at different intervals. Preoperatively, the TAM was 178.96±24.6 in the capsulotomy group and 176.6±30 in the volar plate release group, with no significant difference (p-value = 0.763). At 3 months post-operatively, the capsulotomy group had a TAM of 219.8±16.2, while the volar plate release group had a TAM of 209.0±17.6, showing a significant difference (p-value = 0.028). At 6 months post-operatively, the TAM was 231.9±15.4 in the capsulotomy group and 220.3±16.4 in the volar plate release group, with a significant difference (p-value = 0.013). At 1 year postoperatively, the TAM was 253.6±15.3 in the capsulotomy group and 243.2±14.7 in the volar plate release group, again showing a significant difference (p-value = 0.017).

Table 4: Comparison of Total active motion in both groups at different interval

Total active motion	Group - Capsulotomy	Group - Volar Plate Release	p-value
Pre-Operative	178.96±24.6	176.6±30	0.763
Post-Operative (3Month)	219.8±16.2	209.0±17.6	0.028
Post-Operative (6Month)	231.9±15.4	220.3±16.4	0.013
Post-Operative (1 year)	253.6±15.3	243.2±14.7	0.017

In the capsulotomy group, 8.0% of patients experienced 10% necrosis of the graft, 8.0% developed hypertrophic scars, and 84.0% had no complications. In the volar plate release group, 4.0% of patients experienced 15% necrosis of the graft, and 96.0% had no complications.

Table 5: Distribution patients based on Complications in both groups

Complications	Group - Capsulotomy	Group - Volar Plate Release	p-value
10% NECROSIS OF GRAFT	2 (8.0)	0 (0.0)	0.158
15% NECROSOS OF GRAFT	0 (0.0)	1 (4.0)	
HYPERTROPHIC SCAR	2 (8.0)	0 (0.0)	
None	21 (84.0)	24 (96.0)	

In the study, patients who underwent capsulotomy had a mean functional satisfaction score of 4.6±0.75, while those who underwent volar plate release had a slightly higher mean score of 4.84±0.88. The aesthetic satisfaction scores were 4.16±0.78 for the capsulotomy group and 4.48±0.81 for the volar plate release group. The total VSS (Volar Satisfaction Score) was 4.32±1.05 for the capsulotomy group and 3.88±0.95 for the volar plate release group.

Table 6: Comparison of both groups based on functional and aesthetic score and Total VSS score

Variables	Group - Capsulotomy (Mean±SD)	Group - Volar Plate Release (Mean±SD)	p-value
Functional Satisfaction Score	4.6±0.75	4.84±0.88	0.304
Aesthetic Satisfaction Score	4.16±0.78	4.48±0.81	0.161
Total VSS	4.32±1.05	3.88±0.95	0.126

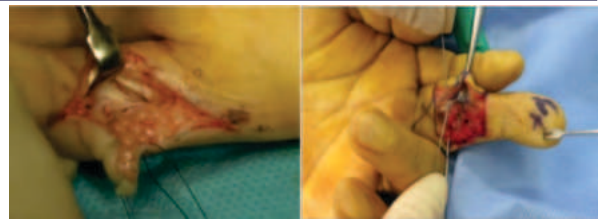


Fig1. Intraoperative image Of Capsulotomy

Fig2. Intraoperative image of volar plate release

DISCUSSION

Functional Satisfaction Score :For Capsulotomy: 4.6 suggests a level of "Satisfied" moving towards "Somewhat Satisfied". For Volar Plate Release: 4.84 is also close to "Satisfied" but leaning slightly towards "Somewhat Satisfied". Aesthetic Satisfaction Score : For Capsulotomy: 4.16 indicates a level between "Satisfied" and "Somewhat Satisfied". For Volar Plate Release: 4.48 shows a similar level, slightly closer to "Somewhat Satisfied". In both functional and aesthetic satisfaction, the values cluster around the "Satisfied" to "Somewhat Satisfied" range on the scale, indicating that participants are generally satisfied but not perfectly or extremely satisfied with the outcomes. Aesthetic and functional satisfaction score was interpret on basis of Score 1 – Perfect Satisfaction ,Score 2 – Extremely Satisfied ,Score 3 – Very Satisfied ,Score 4 – Satisfied ,Score 5 – Somewhat Satisfied ,Score 6 – Neutral ,Score 7 – Somewhat Dissatisfied ,Score 8 – Dissatisfied ,Score 9 – Very Dissatisfied Score 10 – Extremely Dissatisfied.

The response to the treatment was rated on VSS as excellent, good, mild and no response based on the following guidelines. An excellent response was given when the scar scale changed 8 or more points after treatment, a good response for an improvement of between 4 to 7 points, mild response for an improvement of between 1 and 3 points, and no response was assigned to those patients who had no change in the total VSS, Interpret total vss on basis of this.

In present study capsulotomy group, 44.0% of patients received fullthickness skin grafts (FTSG), 16.0% had Groin Flaps, 8.0% had split-thickness skin grafts (STSG), and 32.0% underwent Z-plasty. In the volar plate release group, 48.0% of patients received FTSG, 20.0% had Groin Flaps, 16.0% had STSG, and 16.0% underwent Z-plasty. Sunil NP et [8]al Found that 47% of cases were reconstructed with skin grafting, 30% with Z-plasties, and 23% with flap coverage. Good recovery of joint mobility was achieved in 43% of cases reconstructed with STSG and 75% with FTSG. Reconstructive procedures were aesthetically acceptable to 63% of patients with STSG, 75% with FTSG, and 94% with Z-plasty.Full-thickness skin grafts have shorter operation times, easier follow-up, and shorter postoperative hospitalization periods and less chance of complication like necrosis This explains why full-thickness grafting was the most preferred treatment choice[9]. Abdominal flap and groin flaps serve as reliable donor area sources for flap coverage of hand defects but carry a limitation of prolonged immobilization.[8]

Our study noted that in the capsulotomy group, 8.0% of patients experienced 10% necrosis of the graft, 8.0% developed hypertrophic scars, and 84.0% had no complications. While in the volar plate release group, 4.0% of patients experienced 15% necrosis of the graft, and 96.0% had no complications . Mehta MA et al [10] found that, with 15.7% of patients experiencing an infection, it was the most frequent postoperative complication. Recurrence, flap tip necrosis, and partial graft loss were the next most common complications”.

Prolonged periods of postoperative physiotherapy, splinting, and pressure garments were required to maximize the esthetic and functional outcome.

Our study compared the total active motion (TAM) of patients in the capsulotomy and volar plate release groups at different intervals and noted that

Preoperatively, the TAM was with no significant difference (p-value = 0.763). But at 3 months, 6 months and after one year postoperatively, the capsulotomy group had a TAM showing a significant higher in compare to volar plate release group (p-value < 0.05). “Gokalan et al[11]reported that early reconstruction results in greater improvement

in the range of motion". We simplified the data by using the TAM which was introduced by the American Society for Surgery of the Hand (ASSH). But it is open for the criticism as to whether a digit of 90° of flexion and -45° extensions can be considered the same as a digit with 45° of flexion and zero extension. In this study the mean TAM for all fingers of the hand was <180° at preoperative assessment. This is clearly a significant functional loss, and surgical reconstruction had a significant impact on the improvement in the score to 253.6° in capsulotomy and 243.2° in volar plate release group after 1 year, which is a good outcome. Barillo et al[12] in 83 hand burns found an average TAM. Barillo et al in 83 hand burns found an average TAM of 230° three months after injury. Cartotto et al.[13] reported mean TAM of 225° for patients with deep partial or full thickness hand burns that were grafted. Many studies have been made about methods of assessment of the hand function. In a study by Johnson et al, [14] to assist the range of motion they recommend Total Active Motion (TAM) score, the classification system is: poor <180°, good 180°-219°, excellent 220°-259°. Also in our study the results of range of motion assessed by TAM score according ASSH. Pre-operatively, both groups are classified as having poor TAM scores. At 3 months (with Capsulotomy Group: 219.8 ± 16 and Volar Plate Release Group: 209.0 ± 17.6) post-operatively, both groups improve to the "Good" category. By 6 months and 1 year, (at 1 year Capsulotomy Group: 253.6 ± 15.3 and Volar Plate Release Group: 243.2 ± 14.7) both groups reach the "Excellent" classification, with the Capsulotomy group showing slightly higher TAM scores than the Volar Plate Release group at each postoperative time point.

REFERENCES

- (1) Goel A, Shrivastava P. Post-burn scars and scar contractures. *Indian Journal of Plastic Surgery: Official Publication of the Association of Plastic Surgeons of India*. India; 2010:S63-71
- (2) Chipp E, Walton J, Gorman DF, Moiemens NS. A 1 year study of burn injuries in a British Emergency Department. *Burns*. 2008;34(4):516-20
- (3) Egeland B, More S, Buchman SR, Cederna PS. Management of difficult pediatric facial burns: Reconstruction of burn-related lower eyelid ectropion and perioral contractures. *J Craniofac Surg*. 2008;19(4):960-9.
- (4) Mehta MA, Ranjan V, Kulkarni AK, Sarwade P. Clinicoepidemiological study of post burn contractures at a tertiary care centre in western India. *Int Surg J* 2019;6:1896-900
- (5) McCauley RL. Reconstruction of the Paediatric burned hand. *Hand Clin*. 2009 Nov;25(4):543-550.
- (6) Germann G, Philipp K. Kozin editors Green's Operative hand surgery. 6th ed. New York: Churchill Livingstone; 2011. The burned hand. In: Scott W. Wolfe, Robert N. Hotchkiss, William C. Pederson, Scott H.
- (7) Kurtzman LC, Stern PJ. Upper extremity burns contractures. *Hand Clin*. 1990 May;6(2):261-279
- (8) Sunil NP, Ahmed F, Jash PK, Gupta M, Suba S. Study on Surgical Management of Post Burn Hand Deformities. *J Clin Diagn Res*. 2015 Aug;9(8):PC06-10.
- (9) Sabapathy SR, Bajantri B, Bharathi RR. Management of post burn hand deformities. *Indian J Plast Surg*. 2010;43(Suppl):S72-S79.
- (10) Mehta MA, Ranjan V, Kulkarni AK, Sarwade P. Clinicoepidemiological study of post burn contractures at a tertiary care centre in western India. *Int Surg J* 2019;6:1896-900.
- (11) Gokalan L, Ozgor F, Gursu G, Keçik A. Factors affecting results in thermal hand burns. *Surgery*. 1996;22(27):49.
- (12) Barillo DJ, Harvey KD, Hobbs CL, Mazingo DW, Cioffi WG, Pruitt BA Jr. Prospective outcome analysis of a protocol for the surgical and rehabilitative management of burns to the hands. *Plast Reconstr Surg* 1997 Nov;100(6):1442-1451.
- (13) Cartotto R. The burned hand: optimizing long-term outcomes with a standardized approach to acute and subacute care. *Clin Plast Surg* 2005 Oct;32(4):515-527.
- (14) Carole Johnson, RPT, Loren H. Engrav, MD, David M. Heimbach, MD, Janet A. Marvin, RN, MN. EVALUATING FUNCTIONAL HAND RESULTS AFTER DEEP DERMAL BUMS WITH TOTAL ACTIVE MOTION MEASUREMENTS: 01 November 1980; *The Journal of Burn Care & Rehabilitation*