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Original Research Article

Prospective Randomized Controlled Trial Comparing MatriDerm Plus Split-Thickness Skin Graft versus Split-Thickness Skin Graft Alone Following Post-Burn Contracture Release: Functional Recovery and Scar Quality Outcomes

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Abstract

Background: Post-burn contractures are a major cause of functional disability and cosmetic deformity following burn injuries. Although split-thickness skin grafting (STSG) after contracture release remains the standard reconstructive procedure, secondary graft contraction and hypertrophic scarring continue to compromise long-term functional and aesthetic outcomes. MatriDerm, an acellular collagen–elastin dermal matrix, has been introduced to promote dermal regeneration and improve reconstructive outcomes.

Methods: This prospective randomized controlled trial included 60 patients with post-burn contractures who were randomly allocated into two groups: MatriDerm + STSG (n = 30) and STSG alone (n = 30). Patients were followed for 12 months. The primary outcomes were scar quality, assessed using the Vancouver Scar Scale (VSS) and the Patient and Observer Scar Assessment Scale (POSAS), and functional recovery measured by joint range of motion (ROM). Secondary outcomes included graft take, wound healing, postoperative complications, contracture recurrence, and patient satisfaction.

Results: Patients treated with MatriDerm + STSG demonstrated significantly better scar quality, with lower mean VSS scores (4.3 ±1.5 vs. 6.5 ±1.8; $p < 0.001$), greater improvement in joint ROM (89.4 ±8.6% vs. 75.2 ±10.4%; $p < 0.001$), and higher graft take (97.1 ±2.8% vs. 94.5 ±4.2%; $p = 0.038$) compared with the STSG-alone group. Contracture recurrence was lower in the MatriDerm group (6.7% vs. 20.0%), while postoperative complication rates were comparable between the two groups. Patient satisfaction scores were significantly higher among patients receiving MatriDerm.

Conclusion: The addition of MatriDerm to split-thickness skin grafting following post-burn contracture release resulted in improved scar quality, enhanced functional recovery, higher patient satisfaction, and reduced contracture recurrence without increasing postoperative complications. These findings suggest that MatriDerm is an effective adjunct to conventional STSG for the reconstruction of post-burn contractures. Further multicentre studies with larger sample sizes and longer follow-up are recommended to confirm these findings.

Keywords: Post-burn contracture; MatriDerm; Split-thickness skin graft; Acellular dermal matrix; Scar quality; Functional outcome; Randomized controlled trial.

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Introduction

Burn injuries are a major cause of morbidity and long-term disability worldwide. Although advances in burn care have improved survival, many patients develop complications during the healing process. One of the most common late complications is post-burn scar contracture, which can restrict joint movement, affect daily activities, cause cosmetic deformity, and reduce quality of life. This problem is more common in developing countries such as India because of delayed treatment, inadequate rehabilitation, and limited access to reconstructive surgery [1–3]. The main aim of post-burn contracture reconstruction is to restore function and provide stable skin cover with an acceptable cosmetic outcome. Surgical release of the contracture followed by split-thickness skin grafting (STSG) is the most commonly used treatment. It is simple, cost-effective, and suitable for covering large defects. However, STSG alone has some limitations, including graft contraction,

hypertrophic scar formation, poor skin elasticity, and recurrence of contracture, especially over joints [2,4–6]. Post-burn contracture develops because of excessive collagen deposition and abnormal scar remodeling during wound healing. Loss of the normal dermal layer reduces skin elasticity and increases the risk of scar contracture. Therefore, techniques that improve dermal regeneration may help improve both functional and cosmetic outcomes [5–7].

Dermal substitutes have been introduced to improve wound healing and reduce scar contracture. They provide a scaffold for cell migration, neovascularization, and new dermal tissue formation. MatriDerm is a single-layer acellular collagen–elastin dermal matrix that can be used with STSG in a single-stage procedure. It may improve skin elasticity, reduce scar contraction, and provide better long-term outcomes [6–9].

Several studies have reported good results with MatriDerm in burn reconstruction, including improved scar quality and functional recovery. However, evidence regarding its use after post-burn contracture release is still limited, especially from India. Most studies have included small numbers of patients or retrospective data, and prospective randomized studies are few. Therefore, the present prospective randomized controlled trial was conducted to compare MatriDerm with split-thickness skin grafting versus split-thickness skin grafting alone after post-burn contracture release. The study compared scar quality, functional recovery, graft take, wound healing, postoperative complications, recurrence of contracture, and patient satisfaction during a 12-month follow-up period.

Materials and Methods

This prospective randomized controlled trial was conducted in the Department of Plastic Surgery, Patna Medical College and Hospital (PMCH), Patna, India, over a period of 24 months.

The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all patients before enrolment.

A total of 60 patients aged 18–60 years with mature post-burn contractures requiring surgical release were included in the study.

Patients with active wound infection, uncontrolled diabetes mellitus, peripheral vascular disease, connective tissue disorders, previous surgery at the same contracture site, malignancy, or those unwilling to participate were excluded. Patients were randomly divided into two groups of 30 each using a computer-generated randomization sequence. Group A underwent contracture release followed by MatriDerm and split-thickness skin grafting (STSG), while Group B underwent contracture release followed by STSG alone. After complete release of the contracture, the wound was reconstructed according to the allocated group. In Group A, a 1-mm MatriDerm sheet was applied over the wound, followed by a split-thickness skin graft (0.012–0.015 inch) harvested from the thigh. In Group B, the wound was covered with a split-thickness skin graft of the same thickness without using MatriDerm. The graft was secured with staples or absorbable sutures, and standard dressings were applied in both groups.

All patients received similar postoperative care, including antibiotics, analgesics, regular dressing changes, physiotherapy, and splinting when required. The first dressing was inspected on the fifth postoperative day to assess graft take. Patients were followed up at 2 weeks and at 1, 3, 6, and 12 months after surgery.

The primary outcome measures were scar quality, assessed using the Vancouver Scar Scale (VSS) and the Patient and Observer Scar Assessment Scale (POSAS), and functional recovery assessed by joint range of motion (ROM). Secondary outcome measures included graft take, wound-healing time, postoperative complications, recurrence of contracture, and patient satisfaction.

Statistical Analysis: Data were analysed using IBM SPSS Statistics version 29.0. Continuous variables were expressed as mean ±standard deviation (SD), while categorical variables were presented as frequencies and percentages.

Continuous variables were compared using the independent Student's t-test or Mann–Whitney U test, as appropriate, and categorical variables using the Chi-square test or Fisher's exact test. A two-tailed p value of <0.05 was considered statistically significant.

Results

A total of 60 patients were enrolled in the study, with 30 patients in each group. The baseline demographic and clinical characteristics were comparable between the two groups (Table 1).

Table 1: Baseline demographic and clinical characteristics

Variable	MatriDerm + STSG (n=30)	STSG Alone (n=30)	p value
Age (years), mean ± SD	35.8 ± 11.2	36.9 ± 10.6	0.68
Male, n (%)	19 (63.3)	18 (60.0)	0.79
Female, n (%)	11 (36.7)	12 (40.0)	
Duration since burn (months), mean ± SD	14.8 ± 5.6	15.3 ± 6.1	0.74

The mean operative time was longer in the MatriDerm group, whereas graft take was significantly higher. Wound-healing time was comparable between the groups (Table 2).

Table 2: Operative outcomes

Variable	MatriDerm + STSG (n = 30)	STSG Alone (n = 30)	p value
Operative time (min), mean ± SD	92.4 ± 10.6	81.7 ± 9.4	<0.001
Graft take (%), mean ± SD	97.1 ± 2.8	94.5 ± 4.2	0.038
Wound healing time (days), mean ± SD	14.3 ± 2.1	14.9 ± 2.5	0.314
Hospital stay (days), mean ± SD	8.2 ± 1.6	8.6 ± 1.9	0.382
Intraoperative complications, n (%)	0 (0.0)	0 (0.0)	—

Patients treated with MatriDerm showed significantly better scar quality, with lower Vancouver Scar Scale (VSS) and Patient and Observer Scar Assessment Scale (POSAS) scores than the STSG-alone group (Tables 3 and 4).

Table 3: Vancouver Scar Scale (VSS) scores during follow-up

Follow-up	MatriDerm + STSG (n = 30) Mean ± SD	STSG Alone (n = 30) Mean ± SD	p value
3 months	7.8 ± 1.6	9.2 ± 1.8	0.003
6 months	5.9 ± 1.4	7.8 ± 1.7	<0.001
12 months	4.3 ± 1.5	6.5 ± 1.8	

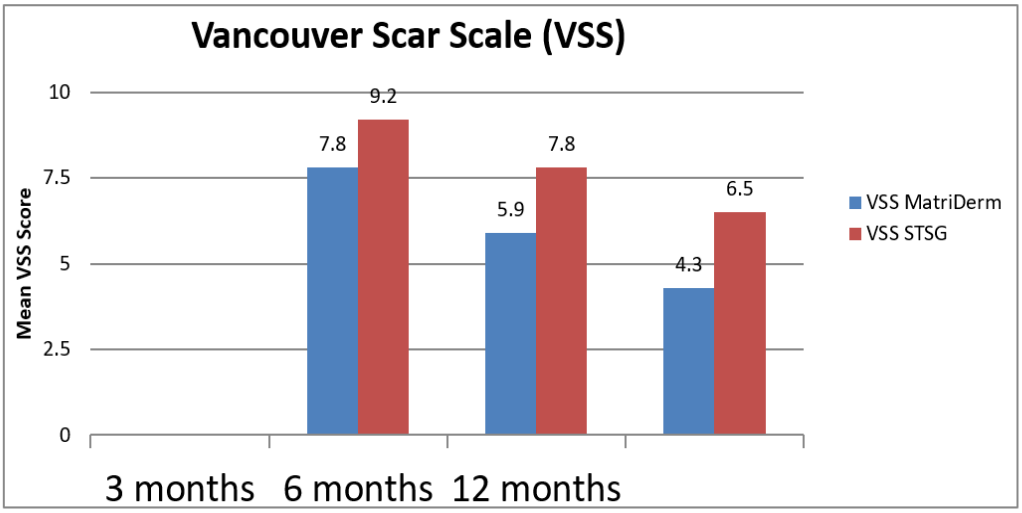

Figure 1: Comparison of Vancouver Scar Scale (VSS) scores during follow-up

Comparison of mean Vancouver Scar Scale (VSS) scores between the MatriDerm + split-thickness skin grafting (STSG) group and the STSG-alone group at 3, 6, and 12 months after surgery. Lower VSS scores indicate better scar quality. The MatriDerm group demonstrated significantly lower VSS scores at all follow-up visits ($p < 0.05$).

Table 4: Patient and Observer Scar Assessment Scale (POSAS) scores at 12 months

Parameter	MatriDerm + STSG (n = 30) Mean ± SD	STSG Alone (n = 30) Mean ± SD	p value
Pigmentation	2.1 ± 0.7	3.0 ± 0.8	<0.001
Thickness	2.3 ± 0.8	3.4 ± 0.9	<0.001
Relief	2.2 ± 0.7	3.3 ± 0.8	<0.001
Pliability	2.4 ± 0.8	3.6 ± 0.9	<0.001
Surface area	2.0 ± 0.6	2.8 ± 0.7	0.002
Pain	1.4 ± 0.5	2.0 ± 0.7	0.001
Pruritus	1.6 ± 0.6	2.3 ± 0.8	0.001
Total POSAS score	14.0 ± 2.9	20.4 ± 3.6	<0.001

Joint range of motion improved in both groups but was significantly greater in the MatriDerm group (Table 5).

Table 5: Functional outcome (Range of Motion) during follow-up

Follow-up	MatriDerm + STSG (n = 30) Mean ± SD	STSG Alone (n = 30) Mean ± SD	p value
Preoperative ROM (%)	42.6 ± 8.4	43.1 ± 9.2	0.821
3 months	68.4 ± 9.6	59.8 ± 10.2	0.002
6 months	80.7 ± 8.8	68.5 ± 9.7	<0.001
12 months	**89.4 ± 8.6**	**75.2 ± 10.4**	**<0.001**

Values are presented as mean ± standard deviation (SD). ROM = Range of Motion.

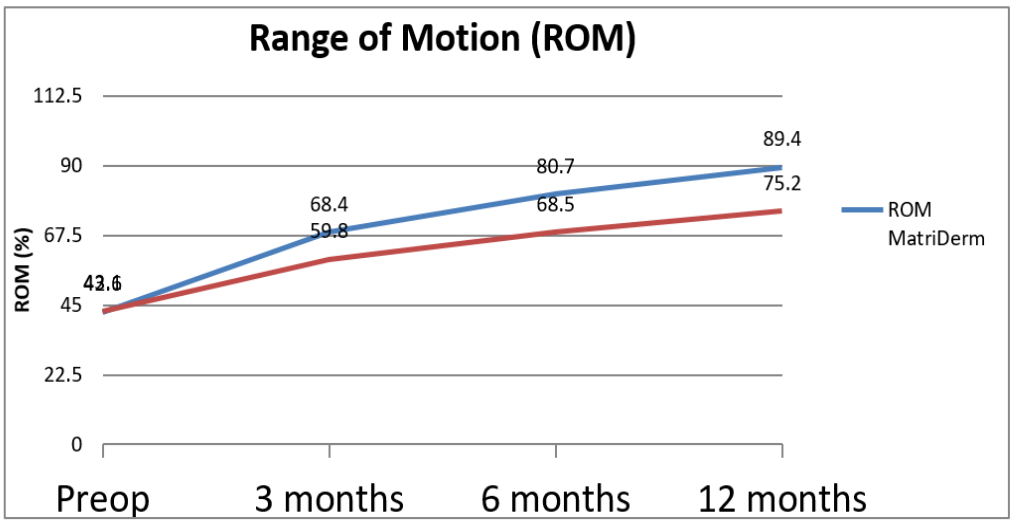

Figure 2: Comparison of Range of Motion (ROM) during follow-up

Comparison of mean joint range of motion (ROM) between the MatriDerm + split-thickness skin grafting (STSG) group and the STSG-alone group before surgery and at 3, 6, and 12 months after surgery. ROM improved in both groups, with significantly greater improvement observed in the MatriDerm group during follow-up ($p < 0.05$). Postoperative complications were low and similar in both groups, with no cases of total graft loss (Table 6).

Table 6: Postoperative complications

Complication	MatriDerm + STSG (n = 30), n (%)	STSG Alone (n = 30), n (%)	p value
Surgical site infection	1 (3.3)	2 (6.7)	0.554
Hematoma	1 (3.3)	1 (3.3)	1.000
Seroma	0 (0.0)	1 (3.3)	0.313
Partial graft loss	1 (3.3)	2 (6.7)	0.554
Total graft loss	0 (0.0)	0 (0.0)	—
Hypertrophic scar	2 (6.7)	5 (16.7)	0.228
Overall complications	5 (16.7)	11 (36.7)	0.081

Values are presented as number (%). Fisher's exact test or Chi-square test was used where appropriate.

Contracture recurrence occurred in 2 patients (6.7%) in the MatriDerm group and 6 patients (20.0%) in the STSG-alone group ($p = 0.12$). Patient satisfaction was significantly higher in the MatriDerm group (Table 7).

Table 7: Contracture recurrence and patient satisfaction at 12 months

Variable	MatriDerm + STSG (n = 30)	STSG Alone (n = 30)	p value
Contracture recurrence, n (%)	**2 (6.7)**	**6 (20.0)**	0.12
Excellent satisfaction, n (%)	15 (50.0)	8 (26.7)	
Good satisfaction, n (%)	11 (36.7)	12 (40.0)	
Fair satisfaction, n (%)	3 (10.0)	7 (23.3)	
Poor satisfaction, n (%)	1 (3.3)	3 (10.0)	
Overall patient satisfaction score (1–10), mean ± SD	**8.9 ± 0.9**	**7.3 ± 1.2**	**<0.001**

Values are presented as number (%) or mean ± standard deviation (SD). Higher satisfaction scores indicate better patient-reported outcomes.

Discussion

Post-burn contractures remain a major cause of functional disability and often require surgical

reconstruction to restore joint movement and improve quality of life. In the present study, the addition of MatriDerm to split-thickness skin grafting resulted in better scar quality, improved functional recovery, higher graft take, lower recurrence, and greater patient satisfaction compared with STSG alone.

The baseline demographic and clinical characteristics were comparable between the two groups, indicating that both groups were similar before surgery. This reduced the possibility that differences in outcomes were due to patient-related factors rather than the treatment received.

The operative time was slightly longer in the MatriDerm group because of the additional step of placing the dermal matrix. However, this increase in operative time was small and did not result in any intra-operative complications. Similar findings have been reported by Dickson et al. [3], who observed that single-stage application of MatriDerm is technically feasible and does not increase surgical risk.

One of the main findings of our study was the significantly better scar quality in patients treated with MatriDerm. Both VSS and POSAS scores were lower in the MatriDerm group at follow-up, indicating improved scar pigmentation, thickness, pliability, and overall appearance. These findings are in agreement with Dickson et al. [3], who reported improved scar quality and dermal regeneration following the use of MatriDerm in burn reconstruction. The collagen–elastin matrix provides a scaffold for tissue regeneration, which may reduce scar contraction and improve skin elasticity.

In contrast, Corrêa et al. [4] found no significant reduction in long-term graft contraction with MatriDerm compared with some other dermal substitutes. The difference between their findings and ours may be related to differences in patient selection, contracture site, postoperative rehabilitation, duration of follow-up, and methods used to assess scar quality.

Functional recovery is the primary goal of post-burn contracture surgery. In our study, patients in the MatriDerm group achieved significantly greater improvement in joint range of motion than those treated with STSG alone. Similar improvements have been reported by Buzea et al. [10], who observed better skin flexibility and hand function after reconstruction using MatriDerm with STSG. Improved dermal elasticity may help maintain joint mobility during scar maturation. Graft take was also significantly better in the MatriDerm group. Although both groups showed satisfactory graft survival, the higher graft take observed with MatriDerm is consistent with previous studies demonstrating that the collagen–elastin matrix supports early vascularization and integration of the skin graft [3,5].

The recurrence of contracture was lower in the MatriDerm group, although the difference did not reach statistical significance. Similar observations have been reported by Karakol et al. [6], who suggested that dermal substitutes may reduce secondary scar contraction and improve long-term functional outcomes. The lack of statistical significance in our study may be related to the relatively small sample size.

Patient satisfaction was significantly higher among patients who received MatriDerm. Better scar appearance, improved joint movement, and lower recurrence may have contributed to greater patient satisfaction. Similar findings have been reported in previous studies evaluating patient-reported outcomes after dermal substitute-assisted burn reconstruction [3,8].

Postoperative complications were low and comparable between both groups. No increase in infection, graft loss, hematoma, or donor-site complications was observed with MatriDerm, indicating that its use is safe when combined with standard surgical techniques. Similar safety profiles have been reported in previous clinical studies [3,9].

The present study has certain limitations. It was conducted at a single centre with a relatively small sample size and a follow-up period of one year. Larger multicentre studies with longer follow-up are required to evaluate long-term functional outcomes, scar maturation, recurrence, and cost-effectiveness of MatriDerm in post-burn contracture reconstruction.

Overall, our findings suggest that MatriDerm used in combination with split-thickness skin grafting provides better scar quality, improved functional recovery, and greater patient satisfaction than conventional split-thickness skin grafting alone, without increasing postoperative complications.

Conclusion

The present study showed that the use of MatriDerm with split-thickness skin grafting provided better scar quality, improved joint range of motion, higher graft take, and greater patient satisfaction compared with split-thickness skin grafting alone after post-burn contracture release. Postoperative complications were comparable between the two groups. MatriDerm may be a useful adjunct in the reconstruction of post-burn contractures. Further studies with larger sample sizes and longer follow-up are recommended to confirm these findings.

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