Original Article

Observational Study on Aesthetic and Functional Outcomes of Tendon Repair with Concurrent Soft Tissue Coverage in Hand Injuries

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Abstract

Background: Complex hand injuries with exposed tendons demand stable coverage at the index procedure to protect repair, preserve glide, and maintain appearance. The aim is to evaluate functional and aesthetic outcomes following tendon repair with concurrent soft tissue coverage in acute hand injuries. **Material and Methods:** This hospital-based observational study included 50 consecutive patients with traumatic hand injuries requiring primary tendon repair and simultaneous flap or graft coverage. Demographic variables, mechanism of injury, tendon involvement, timing of surgery, and reconstructive method were recorded. Functional outcome at 6 months was assessed using total active motion (TAM), grip strength compared with the contralateral hand, and the ability to return to usual activities. Aesthetic outcome was measured using a 10-point patient-reported scar and contour satisfaction score. Complications and re-interventions were documented. **Results:** The mean age was 32.8 ± 11.4 years; 76% were males. Industrial/crush injuries and dominant-hand involvement were common. Local and regional flaps were most frequently used, with free flaps reserved for complex defects; 92% of reconstructions were stable at 2 weeks. At 6 months, 48% of patients had excellent and 26% had good functional outcomes, for a total of 74% achieving excellent/good results. 68% reported high aesthetic satisfaction (score ≥8/10). Complications included superficial infection (8%), partial flap necrosis (6%), adhesions (18%), re-exploration for vascular compromise (4%), and tendon rupture (2%). **Conclusion:** Concurrent tendon repair with tailored soft tissue coverage provides dependable functional recovery with satisfactory aesthetic results in complex hand trauma.

Keywords: Hand injuries; Tendon repair; Soft tissue coverage; Flap reconstruction; Functional outcome; Aesthetic outcome.

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Introduction

Hand injuries are common in industrial, agricultural, and domestic settings, and frequently involve combined damage to skin, soft tissue, and underlying tendons. When tendons are exposed, protection of the repair, restoration of gliding function, and preservation of digital alignment become immediate priorities.[1] Inadequate coverage at the index surgery can lead to desiccation, infection, adhesion formation, and delayed rehabilitation, ultimately compromising motion and grip strength. At the same time, the hand is a visible organ of communication and livelihood; contour, scar quality, and appearance directly influence patient confidence, social interaction, and ability to return to work.[2,3]

Conventional teaching often treats tendon repair and soft-tissue reconstruction as separate decisions. However, in real-world trauma practice, both are tightly linked. The choice of flap or graft, the thickness and pliability of the cover, vascular reliability, and the timing of reconstruction all affect tendon excursion, joint mobility, and long-term functional outcome.[4] Bulky or unstable coverage can be as disabling as stiffness, while well-designed flaps can permit early mobilization and reduce adhesion-related morbidity. Despite this, limited clinical data focus specifically on outcomes when tendon repair and soft tissue coverage are planned and executed as a concurrent strategy in acute hand trauma.[5]

Understanding how immediate combined reconstruction performs in terms of motion, strength, scar acceptability, and complication profile is essential for guiding operative planning and counselling. Data from pragmatic observational cohorts can help refine flap selection, support early definitive coverage, and highlight modifiable risk factors, such as mechanism of injury, timing of surgery, and soft-tissue choice.[6,7]

In this context, this observational study evaluates the aesthetic and functional outcomes of tendon repair with concurrent soft-tissue coverage in patients with complex hand injuries. The study aims to document the spectrum of injuries and reconstructive options used, assess functional recovery and patient-reported aesthetic satisfaction at 6 months, and identify key factors associated with favourable or suboptimal outcomes.

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Materials and Methods

The study design and setting were a hospital-based observational study conducted in the Department of Orthopaedics and Plastic Surgery at KIMS & RF, Amalapuram. The study covered the period from January 2024 to May 2025.

Study population: Fifty consecutive patients presenting with acute traumatic hand injuries requiring primary tendon repair with concurrent soft tissue coverage were included. Patients aged ≥18 years with exposed flexor or extensor tendons in the hand, fingers, palm, dorsum, or wrist, in whom definitive soft tissue cover was planned at the same sitting, were eligible. Exclusion criteria were isolated soft-tissue loss without tendon repair, chronic injuries (>3 weeks), replantation cases, degloving injuries requiring staged reconstruction, associated major vascular injuries precluding standard flap coverage, and patients unwilling or unable to complete follow-up.

Preoperative assessment: Demographic data, hand dominance, mechanism of injury, wound characteristics, level and type of tendon involvement, and time from injury to surgery were documented. Baseline vascularity, sensibility, and associated skeletal injuries were recorded. Routine haematological and radiological investigations were performed as per institutional protocol.

Surgical techniques and soft-tissue coverage procedures were performed under loupe or operating microscope magnification. Standard core and epitendinous suture techniques were used for flexor tendons; extensor tendons were repaired with non-absorbable interrupted or running sutures. Choice of soft tissue coverage (local or regional flap, cross-finger or thenar flap, free flap, or skin graft over a vascularized bed) was individualized based on defect size, location, tendon exposure, vascular status, and surgeon preference. Tendon repair and definitive coverage were completed in the same sitting. Postoperatively, appropriate splintage was applied, followed by a supervised mobilization protocol tailored to the repair and flap type.

Outcome measures and follow-up. Patients were reviewed at 2 weeks, 6 weeks, 3 months, and 6 months. Functional outcome at 6 months was assessed using total active motion (TAM) of the involved digits, grip strength compared with the contralateral hand, independence in activities of daily living, and return-to-work status. Aesthetic outcome was evaluated using a 10-point patient-reported satisfaction score for scar and contour. Flap viability, wound complications, tendon adhesions, need for re-exploration, and tendon rupture were recorded.

Statistical analysis: Data were entered in a spreadsheet and analysed using descriptive statistics. Categorical variables were expressed as frequencies and percentages; continuous variables as mean ± standard deviation. Associations between clinical factors and functional outcome categories were explored using chi-square or Fisher's exact test, with $p < 0.05$ considered statistically significant.

The Institutional Ethics Committee of KIMS & RF, Amalapuram, approved the ethical considerations study protocol. Written informed consent was obtained from all participants. Patient confidentiality was maintained throughout the study.

Results

A total of 50 patients with hand injuries undergoing tendon repair with concurrent soft tissue coverage were analysed. The mean age was 32.8 ± 11.4 years, with a clear male predominance (76%). The dominant hand was involved in just over half of the cases (56%). Industrial and crush-related trauma formed the largest subset, followed by sharp glass or knife injuries and road traffic accidents. Flexor tendon involvement alone was seen in 42% of patients, extensor injury alone in 34%, and combined injury patterns in 24%. Most defects were located over the fingers and distal hand, with additional involvement of the palm, wrist, forearm region, and dorsum of the hand [Table 1]. Early definitive surgery within 72 hours was achieved in 76% of patients.

Table 1: Demographic and Injury Characteristics of the Study Population (n = 50)

Parameter	Category	Frequency (n)	Percentage (%)
Age (years), Mean ± SD	32.8 ± 11.4	-	-
Gender	Male	38	76
	Female	12	24
Involved hand	Dominant	28	56
	Non-dominant	22	44
Mode of injury	Industrial/crush	22	44
	Glass/knife	15	30
	Road traffic accident	9	18
	Agricultural/other	4	8
Type of tendon involvement	Flexor	21	42
	Extensor	17	34
	Combined flexor + extensor	12	24
Zone / site of injury	Fingers (Zones I–III)	19	38
	Palm	8	16
	Wrist/forearm (Zones IV–V)	13	26
	Dorsum of hand	10	20
Time to definitive surgery	≤24 hours	18	36
	24–72 hours	20	40
	>72 hours	12	24

Various reconstructive options were used to achieve immediate, durable coverage over the repaired tendons.

Local advancement and rotation flaps were most frequently employed, followed by cross-finger flaps, regional flaps, and selected thenar/hypothenar options. Skin grafts were reserved for well-vascularized beds, while free flaps were chosen for more complex defects. At 2 weeks, 92% of patients had a stable, well-vascularized flap without significant compromise, confirming the reliability of simultaneous tendon repair and tailored soft tissue coverage in this cohort [Table 2].

Table 2: Soft Tissue Coverage and Early Flap Status (n = 50)

Parameter	Category	Frequency (n)	Percentage (%)
Type of soft tissue coverage	Local advancement/rotation flap	18	36
	Cross-finger flap	10	20
	Thenar/hypothenar flap	4	8
	Regional flap (e.g., dorsal metacarpal, RFFF)	7	14
	STSG/FTSG over vascularized bed	6	12
	Free flap (e.g., groin/ALT)	5	10
Flap status at 2 weeks	Stable, well-vascularized flap	46	92
	Compromised/partial loss	4	8

Six months later, the combined functional results were favourable. Excellent or good outcomes were documented in 74% of patients, reflected by near-normal total active motion, acceptable grip strength, independent activities of daily living, and return to previous or comparable work. Fair and poor outcomes, together accounting for 26%, were predominantly associated with crush injuries, delayed presentation, and cases complicated by flap issues or adhesions. Aesthetic appraisal paralleled functional recovery: two-thirds of patients rated their scar and contour outcome highly (score ≥8/10), and only a small subset expressed dissatisfaction, mostly due to bulky flaps, colour mismatch, or persistent stiffness [Table 3].

Table 3: Functional and Aesthetic Outcomes at 6 Months (n = 50)

Outcome Type	Category	Frequency (n)	Percentage (%)
Functional outcome*	Excellent (TAM ≥80%, grip ≥80%, full ADL, RTW)	24	48
	Good (TAM 60–79%, mild limitation)	13	26
	Fair (TAM 40–59%, stiffness, difficulty fine tasks)	8	16
	Poor (TAM <40%, major limitation)	5	10
	Excellent + Good	37	74
Aesthetic outcome†	High satisfaction (score ≥8/10)	34	68
	Acceptable (score 6–7/10)	11	22
	Dissatisfied (score ≤5/10)	5	10
Mean satisfaction	Scar/contour score (0–10 scale), Mean ± SD	-	8.1 ± 1.3

*Based on TAM, grip strength vs contralateral hand, and functional status.
†Patient-reported scar and contour satisfaction.

Postoperative complications were limited. Superficial infection and partial flap necrosis occurred in a minority and were managed successfully with local measures or secondary procedures. Tendon adhesions were the most frequent problem, often improving with supervised rehabilitation. Re-exploration for vascular compromise was required in a few cases, and tendon rupture was rare. Some patients experienced more than one event, but overall complication rates remained acceptable for a reconstructive population of this complexity [Table 4].

Table 4: Postoperative Complications (n = 50)

Complication	Frequency (n)	Percentage (%)*
Superficial wound infection	4	8
Partial flap necrosis	3	6
Tendon adhesions (requiring rehab)	9	18
Re-exploration for vascular issues	2	4
Tendon rupture	1	2

*Some patients had more than one complication; percentages are calculated over total patients

Discussion

This series shows that repairing the tendon and covering the defect in the same sitting is a realistic and dependable option for complex hand injuries in a routine tertiary-care set-up. In our cohort, nearly three out of four patients achieved excellent or good function, and more than two-thirds were satisfied with the cosmetic result at 6 months. Taken together, these findings support a planned single-stage approach whenever the wound is cleanable, vascularity is adequate, and tissue loss can be matched with an appropriate flap. The case profile in this study is familiar: young men in productive age groups, dominant-hand involvement, and a clear predominance of industrial and crush injuries. These are unforgiving wounds often contaminated, composite, and high-energy, where any delay in stable cover exposes repaired tendons to drying, infection, and adhesions. Early definitive

reconstruction within the first 72 hours emerged as a practical turning point in our cohort.[8] Completing tendon repair and soft-tissue coverage in the same early window appears to have limited wound contamination, protected the repair, and contributed to a low rate of infection and flap-related problems. This stable environment around the repaired tendons likely supported the range of motion documented at follow-up.[9]

Flap planning followed a structured, conservative reconstructive ladder rather than an aggressive free-flap-first philosophy. Local advancement flaps, cross-finger flaps, and regional options formed the backbone of reconstruction, while free flaps were reserved for larger, complex, or atypical defects.[10] This preference for thin, dependable tissue with predictable anatomy aligns with standard hand surgery principles, helps preserve contour, and allows early mobilization with acceptable donor-site impact. The overall flap survival and limited partial necrosis suggest that selection of flap type, use of an atraumatic technique, and awareness of the vascular territory were generally sound.[11]

The observed functional outcomes extended beyond scores alone. Most patients returned to essential daily activities and work, which is the true test of success in this population. Poorer results were largely confined to cases where the odds were already stacked against recovery: severe crush patterns, delayed presentation, pre-existing or superadded infection, flap complications, or dense adhesions restricting glide.[12] Tendon adhesion was the most frequent obstacle, reinforcing several basic but critical rules: gentle handling, tension-free repair, smooth tendon beds, early protective coverage, and a supervised rehabilitation plan that starts on time and is clearly explained to the patient.

Appearance mattered more than is often acknowledged. Many patients were young, working individuals with high expectations for how their hand would look and function. Flaps that were thin, supple, and oriented along natural lines were generally accepted without concern. Dissatisfaction was most often expressed when the tissue was bulky, stiff, or mismatched in colour and texture. These responses underline the need to consider contour and aesthetics as essential elements of reconstruction, not extras.[13]

A key strength of this series is its commitment to treating tendon repair and coverage as a single, planned event rather than as disconnected stages. This integrated approach shortened the duration of exposed tendons and hardware, reduced indecision in the treatment pathway, and allowed movement protocols to begin earlier with confidence. The low rates of infection, flap failure, and tendon rupture achieved in a busy, resource-limited trauma setting suggest that coordinated orthoplastic-style care is feasible beyond highly specialized centres when principles are respected and teams work in alignment.[13,14]

At the same time, the limitations are clear. The sample size is relatively small and drawn from a single centre, which restricts wider extrapolation. The absence of a comparative group, such as staged reconstruction, graft-alone repair, or delayed coverage, means we cannot claim superiority; we can only claim feasibility and consistency. Follow-up was limited to 6 months, so late stiffness, cold intolerance, hypersensitivity, neuroma-related symptoms, and longer-term patient-reported outcomes were not fully captured. Functional assessment relied on TAM, grip strength, and categorical grading rather than validated outcome scales, and flap choice was inevitably influenced by surgeon experience and available resources.

Despite these constraints, the data align with clinical practice: in suitable patients, single-stage primary tendon repair combined with well-chosen soft-tissue coverage is safe, efficient, and yields meaningful functional and aesthetic recovery. The results reinforce that a few working rules do definitive debridement early, choose thin and dependable flaps, protect the repair with stable coverage, monitor flaps closely, and start disciplined physiotherapy without delay. Larger, multi-centre and comparative studies using standardized functional and patient-reported measures would help refine flap selection algorithms and consolidate evidence for integrated single-stage reconstruction in complex hand trauma.

Conclusion

Primary repair of divided tendons with immediate soft tissue cover proved to be a practical and reliable strategy for complex hand injuries in this series. Most patients regained useful movement, effective grip, and functional independence, with stable flap behaviour and a manageable complication rate. Choosing thin, well-vascularised local, regional, or free flaps helped protect the repair, allowed early mobilisation, and contributed to both functional recovery and an acceptable appearance of the hand.

These observations highlight the value of addressing tendon repair and coverage as a single, planned reconstructive step, rather than as separate stages. Early definitive debridement, appropriate flap selection, and a clear, supervised rehabilitation protocol emerged as key elements for success. Although confirmation from larger, comparative studies with longer follow-up is needed, the present findings support concurrent tendon repair and soft tissue coverage as a sound, limb-preserving approach that aligns with the demands of modern orthoplastic practice.

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Conflicts of interest

There are no conflicts of interest.

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