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Severe hand trauma: Clinical profile, surgical management and functional outcomes: A Retrospective Study of 24 Cases

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Abstract

Background: Severe hand trauma is a complex surgical emergency involving simultaneous damage to bone, tendon, vascular, nerve, and skin structures. These injuries disproportionately affect young working-age adults and carry major functional and socioeconomic consequences.

Objectives: To analyze the epidemiological profile, clinical features, surgical strategies, and functional outcomes, and to explore the correlation between anatomical injury severity (MHISS) and perceived functional disability (Quick-DASH).

Methods: Retrospective study of 24 patients with MHISS > 50 treated at CHU Ibn Rochd between 2020 and 2023. Functional outcomes were assessed with the Quick-DASH score. Correlation analyses used Pearson and Spearman coefficients.

Results: All 24 patients were male (mean age: 34 years). Major trauma (MHISS > 100) was found in 83.33% of cases. Leading etiologies: occupational accidents and stab assaults (34.8% each), road traffic accidents (30.4%). Amputations: 45.8%. Mean Quick-DASH: 73.4/100 (severe disability in 71.4%). Strong significant correlation: Pearson $r = 0.776$, Spearman $\rho = 0.767$ ($p < 0.001$).

Conclusion: Severe hand trauma results in major functional disability closely correlated with anatomical severity. Early multidisciplinary management, structured rehabilitation, and targeted occupational prevention are essential to improving outcomes.

Keywords: Severe hand trauma; MHISS; Quick-DASH; Microsurgery; Digital amputation; Rehabilitation; Functional outcomes; Occupational injury

1. Introduction

The hand is one of the most functionally complex organs of the human body, integrating motor precision, sensory exploration, and fine manipulation in virtually every daily activity. Its constant exposure across professional, domestic, and recreational contexts makes it uniquely vulnerable to trauma. When severe, these injuries represent a major surgical emergency and a leading cause of long-term disability, affecting both quality of life and the capacity for professional reintegration.

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Severe hand trauma is defined by the simultaneous involvement of multiple anatomical structures — bone, tendon, vessels, nerves, and skin — within the same injury event. Using the Modified Hand Injury Severity Score (MHISS), injuries scoring above 50 are classified as severe (51–100) or major (>100). Unlike isolated fractures or minor lacerations, these injuries demand a highly coordinated multidisciplinary response combining emergency resuscitation, orthopedic fixation, microsurgical reconstruction, and intensive rehabilitation.

In Morocco and similar middle-income settings, the epidemiological profile of severe hand trauma differs markedly from high-income countries, reflecting the predominance of occupational accidents in informal and industrial sectors, interpersonal violence, and road traffic injuries — often occurring in the context of under-resourced emergency surgical infrastructure. Despite this, data from the Maghreb region remain scarce in the international literature.

This study aims to contribute to this evidence gap by reporting the clinical profile, surgical management approaches, and functional outcomes of 24 consecutive cases of severe hand trauma managed at a Moroccan university hospital, while exploring the relationship between anatomical injury severity and patient-reported functional disability.

2. Materials and methods

2.1. Study Design and Setting

We conducted a retrospective cohort study at the Department of Orthopedic Surgery and Traumatology (Wing 4), Ibn Rochd University Hospital (CHU Ibn Rochd), Hassan II University, Casablanca — a tertiary referral center serving the greater Casablanca metropolitan region. The study period covered four years: January 2020 to December 2023.

2.2. Inclusion and Exclusion Criteria

- **Inclusion:** Age ≥ 18 years; MHISS > 50; initial management and follow-up at our department; complete and exploitable medical record; minimum 6 months of post-traumatic follow-up.
- **Exclusion:** MHISS ≤ 50; isolated injuries without soft tissue involvement; injuries proximal to the carpus; incomplete records; patients unreachable for functional assessment despite multiple contact attempts.

2.3. Injury Severity — MHISS

The Modified Hand Injury Severity Score (MHISS) was used to classify injury severity. This validated tool extends the original HISS by incorporating vascular injuries, proximal carpal lesions, and complex mechanisms (crush, avulsion) that the original score failed to capture. MHISS 51–100 = severe trauma; MHISS > 100 = major trauma.

2.4. Functional Outcome — Quick-DASH

Functional outcomes were assessed using the Quick-DASH (Disabilities of the Arm, Shoulder and Hand), an 11-item validated short-form version of the DASH questionnaire. Scores range from 0 (no disability) to 100 (maximum disability). At least 10 of 11 items were required for a valid score.

2.5. Statistical Analysis

Descriptive statistics were used throughout. Continuous variables are expressed as means with range; categorical variables as frequencies and percentages. MHISS–Quick-DASH correlation was analyzed using Pearson and Spearman coefficients (Jamovi software). $p < 0.05$ was considered statistically significant.

3. Results

3.1. Case Volume and Temporal Distribution

Over the four-year study period, 50 patients with complex hand trauma were treated, of whom 24 met the MHISS > 50 inclusion threshold. Annual case distribution showed: 6 cases in 2020, 2 in 2021, 2 in 2022, and 14 in 2023. The reduction in 2020–2022 coincides with Morocco's COVID-19 health emergency and associated restrictions on industrial activity and hospital access. The marked surge in 2023 likely reflects a post-pandemic rebound effect with resumed artisanal and construction sector activity.

3.2. Injury Severity (MHISS)

Major trauma (MHISS > 100) was found in 20 patients (83.33%). The remaining 4 patients (16.67%) had severe trauma (MHISS 51–100). The predominance of major-grade injuries reflects the tertiary referral nature of our center, which concentrates complex high-energy trauma transferred from peripheral facilities.

3.3. Epidemiological Profile

The mean patient age was 34 years (range: 20–73), with over 70% of patients aged 26–50. All 24 patients were male. Manual laborers accounted for 50% of the cohort, with carpenters the most represented group (20.8%). This profile reflects the structural predominance of male employment in Morocco's manual and industrial sectors.

Table 1 Occupational distribution of the 24 patients

Occupation	n	%
Carpenter	5	20.8%
No stated profession	7	29.1%
Vendor / Merchant	4	16.6%
Construction worker	2	8.3%
Welder	1	4.2%
Butcher	1	4.2%
Painter	1	4.2%
Police officer	1	4.2%
Tailor	1	4.2%
Car washer	1	4.2%

3.4. Laterality and Hand Dominance

The left hand was affected in 75% of cases. Given that 92% of patients were right-handed, the non-dominant hand was injured in 75% of cases. This pattern is characteristic of asymmetric manual tasks, in which the dominant hand guides the tool while the non-dominant hand passively stabilizes the workpiece, placing it in a structurally exposed position.

3.5. Mechanisms of Injury

The three leading injury mechanisms were evenly distributed: occupational accidents (34.8%), stab assaults (34.8%), and road traffic accidents (30.4%). A single domestic accident (circular saw injury) accounted for 4.3%. Among occupational injuries, 4 carpenters were injured by high-speed shaping tools and 2 workers by circular saws.

Table 2 Distribution by causative agent

Causative Agent	n	%
Sharp blade (knife / machete)	9	37.5%
Road traffic vehicle	7	29.2%
Circular saw	4	16.7%
High-speed shaping tool (toupie)	3	12.5%
Meat cleaver	1	4.2%

3.6. Clinical Findings at Admission

Mean time to admission from injury: 5 hours 48 minutes (range: 2–14 h). Two patients (8.3%) were admitted in hypovolemic shock requiring immediate ICU resuscitation prior to surgery.

3.6.1. Amputations

Amputations were identified in 11 patients (45.8%). Of these, 8 (72.7%) were digital amputations (3 unidigital, 5 pluridigital). No thumb amputation was recorded. Three patients had complete or subtotal hand amputations. Digital amputation levels by Tamai classification: Zone 3 (29.4%), Zone 4 (41.2%), Zone 5 (29.4%).

Zone2	0	0%
Zone3	5	29.4%
Zone4	7	41.2%
Zone 5	5	29.4
Total	**17**	**100%**

Figure 1 Subtotal amputation of the 5th digit of the left hand (Tamai Zone 4) following a stab assault in a 33-year-old male

Figure 2 Partial amputation of the left hand following a stab assault in a 27-year-old male, admitted 3 hours after injury

Figure 3 Subtotal amputation of the left hand with 3 cm of dorsal skin continuity following a stab assault in a 28-year-old male, admitted 7 hours after injury

3.6.2. Soft Tissue Injuries

Cutaneous injuries were present in 20 patients (83.3%): deep lacerations (33.3%), skin avulsion/degloving (20.8%), substance loss (29.2%), mangling (20.8%), and ring avulsion (8.3%). Macroscopic wound contamination was present in all cases. Wound margins were jagged/contused in 50%, regular in 37.5%, and necrotic in 12.5%.

Figure 4 Left hand mangling injury from a high-speed shaping tool in a 30-year-old carpenter, involving the four ulnar digits. Admitted 2 hours after injury

Figure 5 Degloving injury of the dorsal surface of the right hand with exposed extensor tendons following a road traffic accident in a 32-year-old male, admitted 6 hours after injury

Figure 6 Deep palmar laceration (~10 cm) with exposed tendon structures following a circular saw injury in a 41-year-old male, admitted 1 hour after injury

3.6.3. Fractures and Dislocations

Radiographic abnormalities were identified in 22 of 24 patients (91.6%). A total of 52 fractures were recorded: 46 open (88.5%) and 40 comminuted (76.9%), reflecting high-energy trauma mechanisms. Metacarpal fractures were most prevalent (27 in 9 patients), followed by phalangeal (P1, P2, P3) and carpal fractures. Joint dislocations were present in 5 patients (20.8%).

3.7. Surgical Management

All patients underwent emergency surgical intervention following resuscitation and systematic clinical and radiological assessment. Surgical management followed a damage-control approach: hemorrhage control, vascular reconstruction, skeletal stabilization, tendon and nerve repair, and soft-tissue coverage.

Skeletal fixation: Kirschner wires, mini-fragment plates, or external fixators depending on fracture pattern and contamination. Microsurgical revascularization was performed for critical ischemia. Digital replantation was undertaken where technically and prognostically feasible (Tamai zone, injury pattern, contamination, patient factors). Soft-tissue reconstruction: primary closure, local/regional flaps (dorsal metacarpal artery, thenar, reverse-flow), or free flaps for complex defects. Amputation was performed when replantation was contraindicated.

Figure 7 Post-operative radiograph (AP and lateral views) showing intramedullary Kirschner wire fixation of the 3rd, 4th, and 5th metacarpals with transverse pinning from the 2nd to the 5th digit. Road traffic accident with open comminuted metacarpal fractures. CHU Ibn Rochd, Wing 4

3.8. Functional Outcomes — Quick-DASH

Mean Quick-DASH at last follow-up: 73.4/100 (range: 27.3–100). Severe functional impairment (Quick-DASH > 50) was found in 71.4% of patients. A strong, statistically significant positive correlation was demonstrated between MHISS and Quick-DASH (Pearson $r = 0.776$, $p < 0.001$; Spearman $\rho = 0.767$, $p < 0.001$), confirming that greater anatomical injury severity is robustly associated with higher perceived functional disability.

Table 3 MHISS vs Quick-DASH correlation statistics

Coefficient	Value	p-value	Interpretation
Pearson r	0.776	< 0.001	Strong positive correlation
Spearman ρ	0.767	< 0.001	Strong positive correlation

4. Discussion

4.1. Epidemiological Context

The demographic profile of our cohort — exclusively male, mean age 34 years, predominantly manual workers — is consistent with comparable studies from sub-Saharan Africa and the Maghreb. Traore et al. (Mali, 2022) reported a mean age of 26.7 years with 84% male patients; Yeo et al. (Ivory Coast, 2023) found a mean age of 38.6 years with 94.4% male patients. This universal male predominance reflects the structural concentration of men in high-risk manual and industrial occupations.

The temporal distribution — with declining case numbers in 2020–2022 and a marked rebound in 2023 — parallels the trajectory of Morocco's COVID-19 health emergency. Restrictions on industrial activity and hospital access likely suppressed both the real incidence and the referral of injuries to specialized centers. The 2023 surge is consistent with post-pandemic reactivation of artisanal and construction sectors.

4.2. Injury Mechanisms and Local Specificity

The co-dominance of occupational accidents and stab assaults (34.8% each) in our cohort diverges from high-income country patterns, where domestic accidents are typically the leading cause. In Dębski et al. (Poland, 2020), occupational accidents represented 45.9% and domestic accidents 38.3%; in Atroshi et al. (Norway, 2001), domestic incidents

accounted for nearly 30%. In our population, the high proportion of assault-related injuries reflects the specific sociourban epidemiology of greater Casablanca, consistent with findings from Asséré et al. (Ivory Coast, 2024) where assaults comprised 31.4% of cases.

The high proportion of injuries caused by industrial tools (high-speed routers, circular saws) concentrated among carpentry workers underscores a persistent failure of personal protective equipment adoption and regulatory enforcement in Morocco's informal artisanal sector — a modifiable risk factor with significant preventive potential.

4.3. MHISS–Quick-DASH Correlation

Our strong and significant MHISS–Quick-DASH correlation ($r = 0.776$, $p < 0.001$) aligns with Rosberg (2014), who found significantly higher Quick-DASH scores in 'Major' versus 'Severe' or 'Moderate' MHISS patients ($p = 0.004$), and with Saxena et al. (2004; Spearman 0.718). However, not all studies confirm this association: Mink van der Molen et al. (Netherlands, 2003) found no significant HISS–DASH correlation at 6 months; Kovacs et al. reported moderate DASH scores despite severe anatomical injuries.

In our context, the strong correlation may partly reflect inadequate access to specialized rehabilitation, prosthetic devices, and psychosocial support — structural deficits that amplify the functional translation of anatomical injury severity and represent a priority target for system-level intervention.

4.4. Study Limitations

Key limitations include: small sample size ($n = 24$) limiting statistical power; monocentric design introducing referral bias; variable follow-up duration introducing heterogeneity in Quick-DASH values; and selective non-participation by some patients, potentially biasing outcomes toward greater disability. Multicenter prospective studies with standardized follow-up intervals are needed to establish more robust prognostic estimates.

5. Conclusion

Severe hand trauma represents one of the most demanding challenges in reconstructive surgery, requiring rapid multidisciplinary intervention from initial resuscitation through surgical reconstruction and long-term rehabilitation. Our retrospective series demonstrates that these injuries predominantly affect young male manual workers and result in severe functional disability robustly correlated with anatomical injury severity. The strong MHISS–Quick-DASH correlation confirms the prognostic value of early, rigorous injury severity assessment.

Beyond curative management, our results highlight a compelling imperative for primary prevention — particularly mandatory enforcement of occupational safety standards and personal protective equipment in Morocco's informal artisanal and construction sectors. Simultaneously, the high residual disability underscores the need to develop personalized, long-term rehabilitation programs and professional reintegration support for patients whose capacity for work is severely diminished.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflicts of interest.

Statement of ethical approval

Conducted in accordance with the Declaration of Helsinki. Patient data were anonymized prior to analysis.

Statement of informed consent

Informed consent for retrospective analysis was waived per institutional policy.

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