

Open Fractures in Polytrauma and Non-Polytrauma Patients: Outcomes and Predictive Factors in a Level III Trauma Center

Otevřené zlomeniny u pacientů s polytraumatem a bez polytraumatu:

výsledky a prediktivní faktory v traumacentru úrovně III

EDOARDO IPPONI, MARGHERITA SIVIERI, FRANCESCO PECCHIA, LUCA FABBRI,
STEFANO MARCHETTI, PAOLO DOMENICO PARCHI

University of Pisa, Department of Orthopedics and Trauma Surgery, Pisa, Italy

Corresponding author:

Edoardo Ipponi, MD

Via Paradisa 2

56124, Pisa, Italy

edward.ippo@gmail.com

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ABSTRACT

Purpose of the study

Open fractures represent complex injuries characterized by bone exposure, soft-tissue damage, and a high risk of infection, often requiring multidisciplinary management. In polytraumatized patients, these injuries further increase clinical complexity and hospital resource utilization. The purpose of this study was to evaluate adherence to international guidelines in the management of open fractures at a third-level trauma center and to identify clinical and organizational predictors of outcomes, complications, and hospitalization burden in polytraumatized and non-polytraumatized patients.

Material and methods

A retrospective, single-center study was conducted including all patients treated for open fractures between January 2020 and December 2023. Demographic data, injury mechanisms, fracture location, Gustilo-Anderson grade, surgical timing, treatment strategy (Early Total Care or

Damage Control Orthopedics), ICU admission, complications, and readmissions were collected. Polytrauma status was recorded. Primary outcomes included infection rate, length of hospital stay, number of admissions, and cumulative hospitalization time. Statistical analysis was performed using Student's t-test, Fisher's exact test, and Pearson correlation, with significance set at $p < 0.05$.

Results

A total of 115 patients were included, of whom 53 (46.1%) were polytraumatized. The mean age was 47.1 years, with a male predominance. Lower-limb fractures were most common, particularly involving the tibia. Grade III injuries accounted for 61.7% of cases. Surgical debridement was performed within 6 hours in 65.2% of patients. External fixation for damage control was used in 73% of cases, with a mean fixation duration of 103 days. Postoperative ICU admission was required in 27.8% of patients. Overall infection rate was 15.7%. Polytraumatized patients experienced significantly longer hospital stays and a higher number of readmissions, but polytrauma status was not associated with increased infection risk. Higher Gustilo-Anderson grade showed a strong correlation with

prolonged hospitalization and infection. Damage control strategies were associated with longer cumulative hospitalization and more frequent readmissions but not with higher infection rates.

Discussion

These findings indicate that fracture severity and local tissue damage, rather than polytrauma status itself, are the main determinants of infection risk and hospitalization burden. While polytrauma increases overall resource utilization, standardized multidisciplinary management allows comparable orthopedic outcomes. Damage control orthopedics remains essential in severe cases but implies longer and more fragmented care pathways.

Conclusions

In a high-volume trauma center adhering to international guidelines, open fracture outcomes are primarily driven by injury severity. Polytrauma influences hospitalization burden but not infection risk. Awareness of these factors is essential for optimizing trauma pathways, resource allocation, and patient counseling.

Key words: exposed fractures, infection, complication, hospitalization, reinterventions.

INTRODUCTION

Open fractures represent one of the most challenging conditions in orthopedic trauma, combining bone disruption, soft tissue injury, and contamination. Their incidence is estimated at approximately 3.2 per 100,000 persons per year, though this rate increases sharply in the context of high-energy trauma and multiple injuries (10, 31). They are associated with high morbidity, prolonged hospitalization, and a substantial risk of infection and functional impairment. Prompt and coordinated multidisciplinary management is therefore essential to reduce complications and optimize outcomes (25). From a local point of view, the severity of local damage is commonly assessed using the Gustilo-Anderson classification, which for decades has served as the most widely accepted system for determining local injury severity and guiding decisions on antibiotic prophylaxis, surgical timing, and soft-tissue coverage (16, 32). In polytrauma patients, open fractures pose an additional clinical challenge due to the coexistence of life-threatening injuries that may delay or alter orthopedic intervention (30). Management must therefore be integrated into the overall resuscitation and stabilization strategy, balancing skeletal fixation with systemic priorities such as hemodynamic control and prevention of secondary insults (13). Depending on the patient's general condition and the extent of local damage, different surgical strategies can be used to treat open fractures (30). Trauma surgeons can adopt either Early Total Care (ETC), which involves early definitive fixation, or Damage Control Orthopedics (DCO), which relies on temporary stabilization until the patient's general condition has been optimized (22, 29). The choice between these approaches requires careful evaluation of systemic and local conditions, as inappropriate timing may increase the risk of infection, organ dysfunction, and mortality. The treatment of choice, as well as its timing, influences the risk of short-term and long-term complications (29). Along with other local issues such as nerve or vessel damage, infections remain the most feared complication after an open fracture (7, 19). Evidence consistently demonstrates that early intravenous antibiotic administration, ideally within one hour of injury, and timely surgical debridement, preferably within six hours, significantly reduce infection rates and improve outcomes (5, 8, 12).

Despite technological and organizational advances, outcome variability remains high, even in referral trauma centers. While numerous studies have focused on surgical techniques or microbiological factors, fewer have explored how clinical, organizational, and timing-related variables interact to influence prognosis and resource consumption in polytraumatized patients (31). Understanding these interactions is crucial for optimizing trauma pathways, improving infection prevention, and enhancing allocation of hospital resources.

The present study retrospectively analyzes the management of open fractures in polytrauma patients admitted to a third-level trauma center, aiming to identify predictors of clinical outcomes



Fig. 1. The image of a patient with an open fracture (Grade IIIC) at his admission to our ER. On the upper left side of the picture, the tourniquet has already been activated at the root of the involved limb.

and hospital burden, with specific attention to fracture severity, surgical strategy, and timing of intervention.

MATERIAL AND METHODS

This single-center, retrospective study was conducted in accordance with the ethical standards outlined in the 1964 Declaration of Helsinki and its subsequent amendments.

Our study reviewed all patients with open fractures admitted to the Emergency Department of our institution between January 1st, 2020, and December 31st, 2023 (Fig. 1).

Our hospital is a European third-level trauma center with a total capacity of 1080 beds. Located in central Italy, our hospital is the direct referral center for its city and province, which have populations of 98.000 and 421.000, respectively. Furthermore, our center is the trauma hub that gathers complex polytraumas from three nearby provinces (890.000 inhabitants in total) located in the same region.

Inclusion criteria consisted of (1) a clinical and radiographically proven diagnosis of an open fracture, (2) primary general and orthopedic evaluation performed in our hospital's ER, and (3) limb-sparing surgical treatment to realign the fracture and achieve soft tissue coverage. Exclusion criteria included (1) initial treatment performed in an hospital other than ours and later centralized to our center, (2) the absence of surgical treatment to face the open fracture, (3) total or subtotal amputations that did not allow limb-sparing treatments according to the principles of the Mangled Extremity Severity Score (MESS) (1), and (4) a follow-up shorter than 6 months for those who completed their hospitalization in our institution.



Fig. 2. Clinical (a) and radiological (b) appearance of a G-A grade IIIB exposed fracture of the left tibia.

Demographic data, including age, gender, and registered place of residence, were noted, as well as the trauma mechanism that led to the open fracture. The diagnosis of an open fracture was made both clinically and radiologically (Fig. 2).

For each case, we recorded the bones involved in open fractures. The severity of the exposure was assessed according to the Gustilo-Anderson classification. Polytraumas were distinguished from non-polytrauma cases. The time between each patient's admission to our emergency room and their

arrival at our operating theater was registered. The treatment strategy of choice was either ETC or DCO (Fig. 3).

Antibiotic therapy was carried out according to the guidelines of the Surgical Infection Society (14).

Eventual peri-operative and post-operative hospitalizations in intensive care units were recorded. The total hospital length of stay (LOS) was considered, along with possible readmissions to complete treatment after surgical procedures that rely on temporary external fixators. For those treated with DCO, the total duration of external fixation was also



Fig. 3. A patient with polytrauma and an open ankle dislocation with a distal tibia fracture before (a) and after (b) a first damage control surgery with an external fixator.

documented. Proven local post-operative infections diagnosed during or after patients' hospitalization were reported.

Statistical analysis was performed using Stata SE 13 (Stata Corp LLC). Statistical analyses were carried out using three types of tests: Fisher's exact test, Student's t-test, and the Pearson correlation test. Fisher's exact test was used to compare proportions (i.e., the incidence of infection between polytrauma and non-polytrauma patients). The Student's t-test was applied to compare the means of continuous variables (i.e., LOS in polytrauma and non-polytrauma patients, or time from the Emergency Department to the Operating Room in later-infected and non-infected cases). Finally, the Pearson correlation test was used to look for linear relationships between continuous variables (such as ER to surgery time and final LOS). Statistical significance was set at $p < 0.05$.

The main objective was to identify predictors of adverse clinical outcomes and hospital burden in polytrauma patients with open fractures. Specifically, the analysis aimed to assess how fracture severity (Gustilo Grade), polytrauma, ICU admission, fixation strategy (ETC or DCO), and surgical timing influenced infection rates and hospitalization metrics.

RESULTS

A total of 115 patients with open fractures were included in our study. Most patients were adults (107/115, 93 %), with a mean age of 47.1 years (range 7-86). There was a clear male predominance (male-to-female ratio 1.9:1). The most frequent mechanism of injury was related to high-energy trauma, mainly road traffic accidents (58.5%), followed by work-related (13.6%) and domestic incidents (11.9%). In four cases (3.4%), injuries resulted from defenestration associated with self-harm. Most patients were residents in the four provinces that refer to our center (82.6%). Sixty-one came from our province (53.0%), and 15 lived in our city (13.0%).

Most admissions occurred during the day, between 8 AM and 8 PM, accounting for 72.2% of cases (83 out of 115), whereas the remaining 27.8% (32) were admitted at night, between 8 PM and 8 AM.

A total of 31 cases (27.0%) were hospitalized on Saturdays, Sundays, or public national holidays. The remaining 84 patients (72%) had their fractures during regular working days.

The open fracture involved the lower limb in 90 cases (78.3%), whereas the remaining 25 cases (21.7%) involved the upper limb. According to the Gustilo-Anderson severity score for open fractures, 18 cases had grade 1 lesions, 26 cases had grade 2, and 71 had grade 3. Among these latter, 35 were classified as 3A, 29 as 3B, and 7 as 3C.

Nearly half of the cases (53/115; 46.1%) were polytraumas.

Surgery was performed within 6 hours of patients' admission in 65.2% of cases. Due to the wide variability of surgical timing, time from Emergency Department admission to

surgery was reported as the median rather than the mean; the median surgical delay was 244 minutes. Concerning surgical strategy, early total care with internal fixation was performed in 23% of our patients (31/115), while external fixation for damage control was used in 73% of cases (84/115). For this latter group, the duration of fixation was highly variable, with a mean of 103 days (range 1-329 days).

Overall, 32 of 115 patients (27.8%) required postoperative ICU admission, which was associated with a longer length of hospital stay compared with non-ICU patients

The mean post-operative follow-up was 23 months (8-57). Seventeen out of 115 patients were lost to follow-up due to transfers to other hospitals after initial surgical management in our institution. All these patients had received external fixation.

On average, our patients had a first hospitalization of 15.71 (2-170) days. After their first discharge, 74 patients required one or more readmissions to our hospital to complete their therapeutic path, either to receive definitive surgery or to treat eventual complications. The average number of hospitalizations per patient was 2.47 (1-9). Considering all admissions, the mean duration of patients' stay in our hospital for open fractures and related injuries was 27.11 (2-171) days.

Patients with polytrauma showed a more demanding clinical course, characterized by a significantly higher number of hospital admissions (mean 2.76 vs. 2.28; $p = 0.045$), a significantly longer first hospitalization (31.1 vs. 14.0 days; $p = 0.00027$), and longer overall stay (39.2 vs. 18.4 days; $p = 0.00021$) according to t-tests.

The degree of local exposure, as classified by the Gustilo-Anderson classification, correlated with hospitalization outcomes. Our data highlighted a direct linear correlation between the exposition grade and both the length of stay for the first hospitalization and the cumulative length of stay across all hospital admissions during patients' therapeutic paths (Pearson's Test, $r = 0.4852$ Exposition Grade - Cumulative Length of stay, $r = 0.2661$ Exposition grade - LOS first hospitalization). Although the number of admissions was also higher for higher grades of local exposition, this correlation was slightly outside our significance cutoff ($p = 0.0527$). Therefore, greater local severity was associated with more extended hospitalization, whereas the tendency toward admission fragmentation was not statistically significant. Surgical strategy also impacted hospitalization outcomes. Among patients with complete data, those treated with external fixation had more admissions (2.88 vs. 1.52; $p < 0.00001$) and a longer total hospital stay (33.2 vs. 14.0 days; $p = 0.0012$).

Infections occurred in 15.7% of patients (18/115) and were more frequent among polytrauma cases (20.8%) compared with non-polytrauma patients (11.3%). Infections were more frequent among polytrauma patients, with 11 cases (20.8%) in 53 polytrauma patients versus 7 cases (11.3%) in 62 non-polytrauma patients.

Table 1. A schematic resume of our casuistry

VARIABLE	VALUE
Demographics	
Age, years (mean, range)	47.1 (7-86)
Adults, n (%)	107 (93.0)
Sex (male:female ratio)	1.9 : 1
Geographic origin	
Residents of referring provinces, n (%)	95 (82.6)
Residents of the same province, n (%)	61 (53.0)
Residents of the same city, n (%)	15 (13.0)
Mechanism of injury	
High-energy trauma (road traffic accidents), n (%)	67 (58.5)
Work-related injuries, n (%)	16 (13.6)
Domestic injuries, n (%)	14 (11.9)
Defenestration/self-harm, n (%)	4 (3.4)
Time of admission	
Daytime admission (8 AM-8 PM), n (%)	83 (72.2)
Nighttime admission (8 PM-8 AM), n (%)	32 (27.8)
Weekend or public holiday admission, n (%)	31 (27.0)
Injury characteristics	
Lower limb involvement, n (%)	90 (78.3)
Upper limb involvement, n (%)	25 (21.7)
Polytrauma patients, n (%)	53 (46.1)

The most commonly isolated pathogens were opportunistic nosocomial organisms, including *Acinetobacter baumannii* (MDR phenotypes and carbapenem-resistant strains) 4 cases, *Serratia marcescens* (MDR and fully susceptible strains) 4 cases, *Staphylococcus aureus* (MRSA and MSSA) 4 cases, *Enterococcus faecalis/faecium* (2), and *Pseudomonas* spp (2).

Enterobacterales with specific resistance mechanisms were also observed (e.g., *Klebsiella pneumoniae* ESBL, *Enterobacter cloacae*, ampicillin-resistant *E. coli*), along with co-isolations of coagulase-negative staphylococci (*S. epidermidis*, *S. saprophyticus*, *S. haemolyticus*, *S. lugdunensis*). Other isolates included *Clostridioides difficile*, *Moraxella osloensis*, *Corynebacterium aurimucosum*, and *Bacillus* species.

Within this cohort, only local severity (Gustilo-Anderson grade) showed a significant association with infection ($p = 0.0016$), while other factors, including polytrauma, surgical approach (ETC or DC), ICU stay, and surgical delay, did not.

VARIABLE	VALUE
Gustilo-Anderson classification	
Grade I, n (%)	18 (15.7)
Grade II, n (%)	26 (22.6)
Grade III (total), n (%)	71 (61.7)
└ Grade IIIA, n	35
└ Grade IIIB, n	29
└ Grade IIIC, n	7
Initial surgical management	
Surgery within 6 hours, n (%)	75 (65.2)
Time to surgery, minutes (median)	244
Early total care (internal fixation), n (%)	31 (27.0)
Damage control (external fixation), n (%)	84 (73.0)
External fixation duration, days (mean, range)	103 (1-329)
Hospital course	
ICU admission, n (%)	32 (27.8)
First hospitalization, days (mean, range)	15.7 (2-170)
Total hospitalizations per patient (mean, range)	2.47 (1-9)
Cumulative length of stay, days (mean, range)	27.1 (2-171)
Lost to follow-up after initial surgery, n (%)	17 (14.8)
Early outcomes	
Postoperative infections, n (%)	18 (15.7)
└ Infections in polytrauma patients, n (%)	11/53 (20.8)
└ Infections in non-polytrauma patients, n (%)	7/62 (11.3)
ICU admission related to complications, n (%)	32 (27.8)
Readmission for complications or definitive treatment, n (%)	74 (64.3)

Only four cases had aseptic nonunions, and two had soft-tissue coverage issues without an infectious etiology.

A schematic resume of our data is reported in Tables 1 and 2.

DISCUSSION

Open fractures are uncommon compared with closed fractures (2, 9). However, they remain among the most challenging injuries in trauma care as they combine skeletal damage with soft-tissue disruption and potential bacterial contamination (11). Several series consistently describe a predominance of high-energy mechanisms for these traumas, which frequently cause prolonged disability, work absenteeism, and repeated utilization of healthcare systems (2, 9, 11, 15, 27). In line with previous epidemiological profiles, our cohort was composed

Table 2. A resume of the correlations and descriptive statistics that emerged from our cohort

PREDICTOR VARIABLE	OUTCOME VARIABLE	STATISTICAL TEST	RESULT	P VALUE
Polytrauma status	Number of hospital admissions	Student's t-test	Higher in polytrauma patients (2.76 vs 2.28)	p = 0.045
Polytrauma status	Length of first hospitalization (days)	Student's t-test	Longer stay in polytrauma patients (31.1 vs 14.0)	p < 0.001
Polytrauma status	Cumulative length of stay (days)	Student's t-test	Longer total stay in polytrauma patients (39.2 vs 18.4)	p < 0.001
Gustilo-Anderson grade	Length of first hospitalization (days)	Pearson correlation	Positive correlation	p = 0.028
Gustilo-Anderson grade	Cumulative length of stay (days)	Pearson correlation	Positive correlation	p < 0.001
Gustilo-Anderson grade	Number of hospital admissions	Pearson correlation	Trend toward increase	p = 0.053
Surgical strategy (external vs internal fixation)	Number of hospital admissions	Student's t-test	Higher with external fixation (2.88 vs 1.52)	p < 0.001
Surgical strategy (external vs internal fixation)	Cumulative length of stay (days)	Student's t-test	Longer with external fixation (33.2 vs 14.0)	p = 0.001
Gustilo-Anderson grade	Postoperative infection	Chi-square test	Higher infection rate with increasing grade	p = 0.002
ICU admission	Length of hospital stay	Student's t-test	Longer stay with ICU admission	p = 0.032

mainly of adults with a clear male predominance (2, 9, 11, 15, 18). Road traffic accidents represented the most frequent mechanism of injury. This pattern mirrors recent evidence, indicating that high-energy trauma – particularly motor vehicle collisions – continues to be the principal driver of open fractures in modern trauma systems (2, 9, 11, 15, 18). At the same time, work-related and domestic injuries are other relevant contributors, especially in populations with active employment and commuting exposure. In this context, our finding that approximately one in seven injuries were work-related, including incidents occurring “in itinere”. This further underlines the public-health relevance of these injuries, as they affect patients who are frequently in their most economically productive years.

Beyond the individual clinical and social burden, our data also reflect a wider territorial and organizational dimension that is typical of hub-and-spoke trauma networks. Most of our patients did not reside in the city where our center is located. In fact, most of them came from the surrounding area and neighboring provinces, underscoring the role of Level III trauma centers as regional referral hubs for complex injuries that require multidisciplinary resources. This geographic distribution has practical implications: open fracture care does not depend solely on technical surgical expertise, but also on the capacity of referral systems to rapidly channel severe cases to facilities with orthoplastic capabilities, appropriate operating room availability, intensive care support, and coordinated medical treatments when needed (6, 20).

Consistent with prior reports, open fractures in our series frequently occurred in the setting of polytrauma, which had occurred in nearly half of the cohort. This association is well

documented in the literature and reflects how high-energy events that produce open skeletal injury often generate concomitant thoracoabdominal, neurological, or vascular trauma (30). Clinically, this has direct implications for early management priorities, as in patients with multifocal damage involving vital organs and tissues, the open fracture is only one component of a broader systemic insult. Our data support this paradigm: polytrauma patients experienced more complex and significantly longer hospital stays. These findings align with established knowledge that polytrauma drives multimodal resource utilization through staged diagnostics, intensive monitoring, rehabilitation across multiple organ systems, and eventual multiple surgical treatments (23). However, this complexity does not imply that orthopedic outcomes necessarily deteriorate in polytrauma.

The distribution of bone exposure severity in our study further highlights the complexity faced by referral centers. A large proportion of fractures were severe, being graded III according to the Gustilo-Anderson classification. Such a finding is particularly relevant, as the Gustilo-Anderson classification is a well-established marker of contamination, soft-tissue loss, and vascular compromise, and has been widely linked to infection risk, nonunion, and healthcare costs (21).

Especially in severe open fractures, timely, protocol-driven care is essential (2). The literature increasingly frames open fracture treatment as a time-dependent, multidisciplinary emergency, repeatedly emphasizing early antibiotics, urgent debridement, stabilization, and early soft-tissue management as the core of evidence-based practice (7, 20, 22-23). Although in our casuistry the surgical delay did not have a statistically significant impact on complication rates, correct

multidisciplinary management is crucial to avoid time-wasting at any time.

A substantial proportion of admissions occurred outside routine working hours, with nearly one-third presenting at night and over one-quarter occurring on weekends or holidays. As already reported by Andreani et al. (3), fractures and polytrauma can stress orthopedic trauma systems significantly, also on off-days such as weekends and public holidays. Our data reinforce the need for continuous organizational readiness, although the clinical requirement for prompt, high-quality intervention does not perfectly align with conventional scheduling patterns.

The surgical treatment of choice remains central to the management of patients with open fractures. Orthopedic trauma surgery can be performed using either Early Total Care (ETC) or Damage Control Orthopaedics (DCO). The classical trauma literature has established that ETC can be advantageous in stable patients by enabling early definitive fixation, whereas DCO prioritizes rapid stabilization and physiologic optimization before definitive reconstruction in unstable patients (13, 22, 29–30). Reflecting a pragmatic application of these principles, our cohort used extensive damage control with external fixation, particularly for more complex injury patterns. Although effective, DCO was associated with longer hospital stays at our hospital because their treatment frequently required staged revisions of both bones and soft tissues to achieve complete healing.

However, despite the higher hospitalization burden, DCO was not associated with higher rates of infections or other significant complications in our dataset. For the correct patient, staged management could therefore be clinically safe despite requiring longer and more fragmented care pathways.

Infections remain the most feared complications in open fracture care. The overall infection rate in our cohort was 15.7%. This finding is consistent with published ranges for mixed-severity populations (5, 8, 14, 19, 24). As frequently emphasized in the literature, infection risk in open fractures is multifactorial (5, 8, 14). However, local injury characteristics – particularly the extent of exposure, contamination, and soft-tissue compromise – are repeatedly identified as dominant predictors (5, 8, 14, 16, 19). Our data support this line of reasoning: Gustilo–Anderson severity was the only factor significantly associated with infection rates, reinforcing the intuitive biological relationship between external contamination and subsequent infection of bone and soft tissues despite debridement (28).

Conversely, several factors frequently considered clinically relevant did not emerge as independent predictors of infection in our cohort. Surgical delay—while clinically important and generally advocated for minimizing—did not show

a significant association with infection. While it should not be interpreted as evidence that timing is irrelevant, it may indicate that once a baseline standard of early antibiotics and timely debridement is met across the cohort, variation within the observed time range becomes less influential than local tissue severity. Similarly, ICU admission did not correlate with infection risk, despite the common perception that critical care environments increase exposure to resistant organisms (4, 8, 26). Adequate timing, standardized antibiotic prophylaxis, and sealing medications, including closed incisional negative-pressure wound therapies when necessary, could reduce the risk of local infection even in an ICU setting.

Finally, polytrauma status did not significantly impact the infection rates in our experience. While polytrauma increases systemic stress and hospitalization length (17), our findings suggest that local damage and exposure severity are more determinants of both the risk of local infection and the global duration of hospitalization than systemic injury status alone.

We acknowledge that our study has some limitations. One of them is the retrospective design, which did not allow for complete standardization of the logistic and diagnostic flows, therapeutic protocols, and post-acute follow-up. Another limitation was given by the relative rarity of exposed fractures, which limited the total number of available cases. Although our casuistry comprised more than 100 patients, larger numbers could have enabled more significant statistical analysis.

Despite these limitations, our study portrayed the burden of exposed fractures on both the individuals and the referral trauma center. Severity of exposure strongly shapes both hospitalization length and infection risk, reinforcing the central prognostic role of the Gustilo–Anderson grading system. The higher hospitalization burden observed in staged damage-control pathways should be expected and communicated to patients. However, it does not necessarily imply higher complication rates when care is delivered in accordance with standardized protocols.

CONCLUSIONS

Open fractures in polytraumatized patients led to more extended hospitalizations, but had similar outcomes compared to those who were not polytraumatized. In an institution that had substantial adherence to international recommendations, fracture severity emerged as the primary determinant of hospitalization burden and infectious complications. Although external fixation is widely used for severe injuries, it is associated with more extended hospitalization and higher reoperation rates, leading to higher costs. ■

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