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Original Article

Rehabilitation Outcomes Following Simultaneous Orthopaedic Fracture Fixation and Abdominal Surgery: A Prospective Observational Study

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ABSTRACT

Background: Simultaneous orthopaedic fracture fixation and abdominal surgery provide significant rehabilitation challenges due to physiological stress, delayed mobility, and the risk of complications. Damage-control orthopaedics (DCO) and accelerated recovery after surgery (ERAS) regimens have individually enhanced outcomes; however, evidence supporting their concurrent application in multi-system trauma remains scarce. This study aimed to evaluate the functional and rehabilitative outcomes of persons undergoing concurrent orthopaedic and gastrointestinal procedures during a single hospitalisation.

Methods: A prospective observational study was conducted from March 2024 to February 2025 at a tertiary trauma centre, including 36 consecutive adult patients who received both orthopaedic fracture fixation and abdominal surgery. The Barthel Index and Short Form-36 (SF-36) were utilised to assess functional outcomes at discharge, three months, and six months. Statistical analyses included repeated-measures ANOVA for longitudinal trends, Pearson correlation for associations, and multivariate linear regression to identify predictors of six-month recovery. We analysed the data with IBM SPSS Version 25.0. The group was 43.97 ± 15.57 years old on average, was in the hospital for 13.86 ± 6.23 days, and took 9.58 ± 3.05 days to get up and move around. Rehabilitation began in 94.4% of the patients. Functional scores improved significantly with time: Barthel/SF-36 composite scores were 40.72 ± 12.86 (discharge), 58.86 ± 14.71 (3 months), and 73.78 ± 15.21 (6 months) ($p < 0.0001$). Post-hoc analysis confirmed uniform functional enhancements across intervals. Delayed union (30.6%) and infection (22.2%) were orthopaedic issues, whereas sepsis (33.3%) and ileus (22.2%) were gastrointestinal issues. There were no fatalities. Correlation and regression analyses demonstrated that no single variable (age, sex, mobilisation delay, sepsis) exerted an independent effect on recovery.

Conclusion: It is both possible and safe to undertake orthopaedic and abdominal surgeries at the same time in a multidisciplinary setting that follows DCO and ERAS principles. A significant improvement in function at six months shows that well-planned early rehabilitation and coordinated postoperative care can turn surgical survival into full recovery. These findings support a unified, patient-centered methodology for the therapy of complex trauma.

Keywords: *Rehabilitation Outcome, Polytrauma, Enhanced Recovery After Surgery, Orthopaedic Procedures, Abdominal Injuries.*

INTRODUCTION

One of the hardest things for modern surgeons to cope with is a significant injury that hurts both the muscles and bones and the stomach. People like this come in when they are in trouble. They have fluctuating blood pressure, are in pain, are

terrified, and generally feel overwhelmed by the size of their injuries. The decision to intervene immediately on both fronts is a delicate line between saving a life and retaining long-term function for both the orthopaedic surgeon and the general surgeon. The individual management of abdominal trauma and skeletal fractures has advanced considerably; however, the evidence about outcomes when both treatments are performed during the same hospitalisation is markedly insufficient.

Damage-control surgery and enhanced recovery after surgery (ERAS) ideas have revolutionised how individuals are cared for before, during, and after surgery in the last ten years. ERAS techniques have been demonstrated to greatly lower the risk of complications, speed up recovery, and shorten hospital stays for people with abdominal injuries by carefully emphasising on nutrition, pain control, and early mobility [1–3, 8, 9]. Similar benefits have been seen in emergency laparotomy populations, where structured pre- and postoperative bundles improved survival and rehabilitation results [2–4]. Even in cases of complex trauma, the careful implementation of ERAS principles has shown to be both possible and safe [8, 9].

Improvements in orthopaedic trauma have changed how fractures are treated. The shift from "early total care" to damage-control orthopaedics (DCO) arose from the understanding that aggressive fixation in unstable patients can exacerbate systemic inflammation and organ failure [14–18]. On the other side, putting off fixation could make it difficult to move, make you need a ventilator for longer, and boost your risk of thromboembolism. The move towards "safe definitive surgery" is an attempt to establish a middle ground between physiological stability and quick fixation, with the goal of speeding up healing without putting survival at risk [15, 16].

The real test of how well surgery works happens during rehabilitation. Early mobilisation after abdominal and orthopaedic procedures has consistently been associated with increased functional recovery, less pulmonary complications, and an enhanced quality of life [5–7, 19]. Even with these findings, there is a lack of evidence pertaining to persons undergoing concurrent fracture fixation and abdominal surgery. Pain, wound care, fluid fluctuations, and infection risk are all things that each system needs, and they all fight for clinical priority. This can sometimes make it take longer to fully recover. Nonetheless, the simultaneous occurrence of both injury types is prevalent in high-energy trauma, vehicular accidents, or falls from elevations [10–13].

The connection between systemic injury and localised recovery is not well comprehended. Do people who have more than one injury follow the same rehabilitation plan as others who just have one injury? Is it safe to start moving around again early if both the abdomen and the arms and legs have been operated on? What issues do these overlapping physical stresses cause? These queries extend beyond mere academic curiosity; they assess a patient's capacity to ambulate, participate in employment, and maintain independent living.

Recognising this deficiency, the present study prospectively examines functional and rehabilitative outcomes following simultaneous orthopaedic fracture repair and abdominal surgery at a tertiary trauma facility. This study aims to clarify a facet of trauma care at the convergence of two surgical disciplines, where coordinated, patient-centered recovery is essential, by analysing objective functional ratings over successive follow-ups, with complication and survival statistics.

METHODS

Study Design and Setting

This was a prospective observational study conducted at a tertiary trauma care facility from March 2024 to February 2025. The hospital is a regional referral clinic for severe trauma, and it treats patients who have both orthopaedic and visceral injuries. The study was authorised by the institutional ethics committee, and all participants or their designated surrogates provided informed consent.

The study adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines, ensuring transparency, reproducibility, and adherence to ethical standards in data collection and reporting. The design was centred on the patient. The research didn't just look at how well the surgery went. It also looked at how patients recover, how well they can walk around, how independent they feel, and how high their quality of life is, after having two procedures.

Thirty-six consecutive adult patients who received simultaneous orthopaedic fracture therapy and abdominal surgery were enrolled. The requirements for inclusion were:

- Young Active Adults From 18 years of age
- At least one long bone or pelvic fracture needs surgery to heal.
- Intra-abdominal injury necessitating concurrent surgical intervention (e.g., bowel perforation, splenic injury, or mesenteric tear).
- Clinical stability to enable the concurrent performance of both procedures within a single hospital admission.
- Patients with isolated orthopaedic or gastrointestinal injuries, head traumas that precluded participation in rehabilitation, or those who were lost to follow-up were excluded.

The rationale for concurrent management derives from modern trauma protocols, in which damage-control orthopaedics (DCO) and damage-control laparotomy are coordinated to reduce systemic inflammation and promote physiological recovery [14–17]. Prior guidelines indicate that surgical priority need to be determined by haemodynamic condition and systemic response rather than isolated system urgency [10–13,16].

All patients were resuscitated following Advanced Trauma Life Support (ATLS) protocols. At initially, the patient was stabilised with fluid resuscitation, transfusion assistance, and infection prevention.

Some of the abdominal surgeries were mending a hole, taking out part of the intestine and attaching it to the remainder of the bowel, taking out the spleen, fixing the mesentery, and opening the abdomen for trauma-related bleeding in the peritoneum.

Orthopaedic methods included open reduction and internal fixation (nailing, plating), or external fixation if necessary.
The decision between early definitive fixation and staged fixation was predicated on the patient's physiological reserve, in accordance with the "safe definitive surgery" principle [15,16]. Surgery was performed either in a single session (5.6%) or staged within 48 hours (94.4%), in accordance with international polytrauma norms [14,18].

Postoperative care followed a customised Enhanced Recovery After Surgery (ERAS) protocol designed specifically for trauma patients [1–3,8,9]. The plan had:

- If possible, start enteral nutrition within 24 hours of surgery.
- Multimodal pain relief that makes opioids less necessary
- Beginning physiotherapy early with bedside limb movement, deep breathing exercises, and assistance in sitting up by the third to fifth day post-surgery.
- As long as possible, start putting weight on it gradually over the next 2–3 weeks.

Rehabilitation was multidisciplinary, involving surgeons, physiotherapists, nursing staff, and nutritionists. Daily evaluations of mobilisation goals were conducted, consistent with the principle of early ambulation following abdominal and musculoskeletal injuries, which has demonstrated efficacy in enhancing functional outcomes and reducing hospitalisations [5–7,19].

Patients were discharged from the hospital once their wounds had sufficiently healed, they were able to consume solid food, and they were capable of ambulating with or without assistance.

RESULTS

The information was shown as a mean, standard deviation, frequency, and percentage. We utilised Repeated Measures ANOVA to compare continuous variables. We analysed the data with IBM-SPSS version 25.0 (IBM-SPSS Science Inc., Chicago, IL).

Demographic Profile

A total of 36 patients who underwent simultaneous orthopaedic fracture fixation and abdominal surgery were enrolled between March and September 2024. The mean age was 43.97 ± 15.57 years, with a near-equal gender distribution (55.6 % male, 44.4 % female). The mean duration of hospital stay was 13.86 ± 6.23 days, and mobilisation commenced after an average of 9.58 ± 3.05 days, reflecting a cautious yet structured rehabilitation approach.

Fracture and Surgical Characteristics

The most frequent fracture sites were the radius/ulna (27.8 %), followed by the femur (19.4 %) and pelvis (19.4 %).
Regarding fixation, nailing (38.9 %) was the most commonly employed method, followed by plating (33.3 %) and external fixation (27.8 %).

Among abdominal procedures, repair of perforation (19.4 %), splenectomy (16.7 %), and bowel resection with anastomosis (13.9 %) were most frequent. The majority (55.6 %) underwent their second surgery within two days of the first, demonstrating a staged yet timely multidisciplinary approach.

Rehabilitation Protocol

Rehabilitation was initiated in 94.4 % of patients, indicating excellent adherence to postoperative physiotherapy regimens. No mortalities were reported during the study period.

Functional Outcome Trends

Functional scores, assessed by the Barthel Index and SF-36 components, demonstrated significant improvement over time. All tests were two-tailed, with $p < 0.5$ considered statistically significant.

Time point	Mean ± SD	p value
Discharge	40.72 ± 12.86	< 0.0001
3 months	58.86 ± 14.71	< 0.0001
6 months	73.78 ± 15.21	< 0.0001

Repeated-measures ANOVA revealed a statistically significant progressive improvement across all follow-up points ($p < 0.0001$).

Post-hoc analyses (Bonferroni correction) showed mean score increases of 18.14 (95 % CI 16.44–19.84) from discharge to 3 months, 33.06 (95 % CI 31.32–34.79) from discharge to 6 months, and 14.92 (95 % CI 13.82–16.02) between 3 and 6 months, confirming steady rehabilitation gains with narrow confidence bands.

Correlation Analysis

Pearson correlation demonstrated no significant relationship between time to mobilisation and either discharge or six-month functional scores ($r = 0.23$, $p = 0.19$; $r = 0.16$, $p = 0.35$ respectively).

This suggests that short delays in ambulation did not meaningfully affect long-term functional recovery within this cohort.

Regression Analysis

A multivariate linear regression model explored predictors of the six-month functional score using age, sex, time to mobilisation, length of stay, and presence of sepsis.

The model explained 12 % of total variance ($R^2 = 0.122$, $p = 0.54$). None of the predictors reached statistical significance:

Predictor	β (95% Confidence Interval)	p value
Age (years)	–0.17 (–0.53 to 0.18)	0.322
Sex (M = 1)	–4.94 (–15.85 to 5.97)	0.363
Time to mobilisation (days)	+0.85 (–1.00 to 2.71)	0.355
Length of stay (days)	–0.35 (–1.24 to 0.53)	0.421
Sepsis (present = 1)	–2.75 (–14.64 to 9.15)	0.640

No individual factor independently predicted poor outcome, implying that functional recovery likely depends on multiple inter-related physiological and rehabilitative determinants rather than single peri-operative variables.

Complications

Orthopaedic complications included delayed union (30.6 %), implant failure (25 %), and infection (22.2 %).
Abdominal complications comprised sepsis (33.3 %), ileus (22.2 %), and wound infection (19.4 %).
Despite these morbidities, all patients survived and completed follow-up.

Table 1:Baseline demographic characteristics of the study cohort showing mean age, duration of hospital stay, and time to mobilisation.

	Mean	Standard Deviation
Age (years)	43.97	15.57
Length of Hospital Stay (days)	13.86	6.23
Time to Mobilisation (days)	9.58	3.05

Table 2: Functional outcome scores (Barthel Index and SF-36 composite) at discharge, 3 months, and 6 months post-surgery.

Functional Outcome Score	Mean	Standard Deviation
At Discharge	40.72	12.86
At 3 Months	58.86	14.71
At 6 Months	73.78	15.21

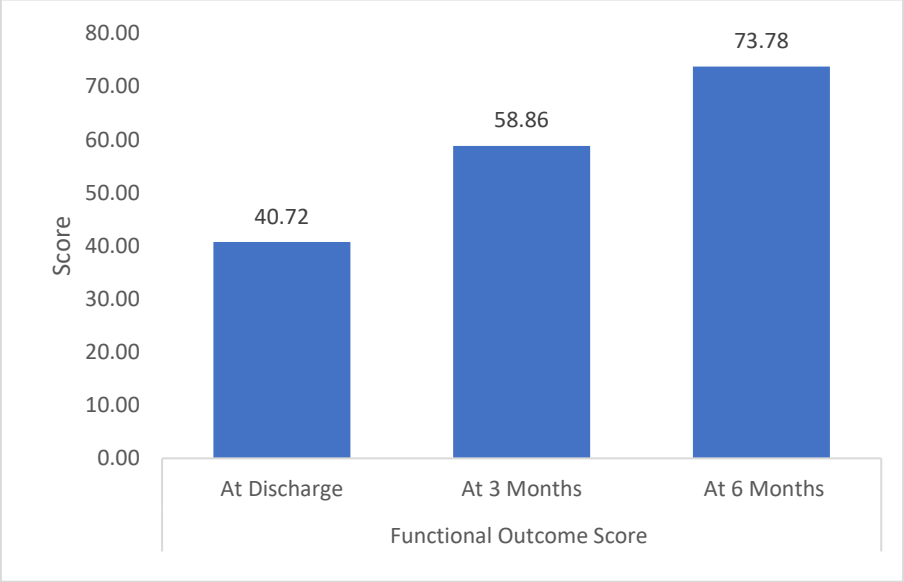

Figure 1:Mean age, hospital stay, and time to mobilisation among patients.

Table 3: Sex distribution of patients undergoing simultaneous orthopaedic and abdominal surgery.

		Number of Patients	Percentage
Sex	Female	16	44.4%
	Male	20	55.6%

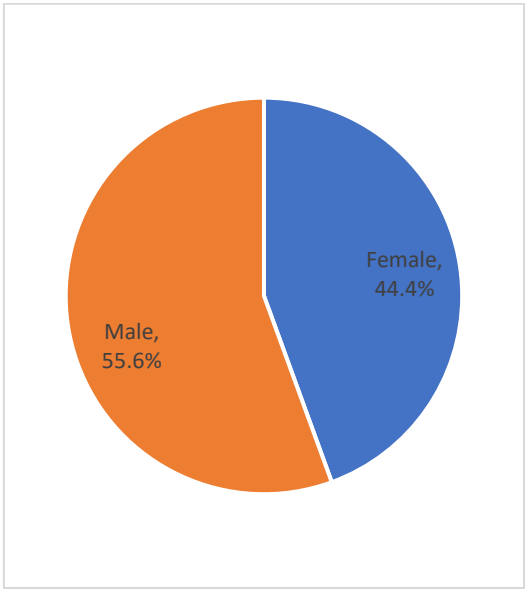

Figure 2: Sex distribution of the study cohort.

Table 4: Distribution of fracture sites among the study participants.

		Number of Patients	Percentage
Fracture Site	Femur	7	19.4%
	Humerus	6	16.7%
	Pelvis	7	19.4%
	Radius/Ulna	10	27.8%
	Tibia	6	16.7%

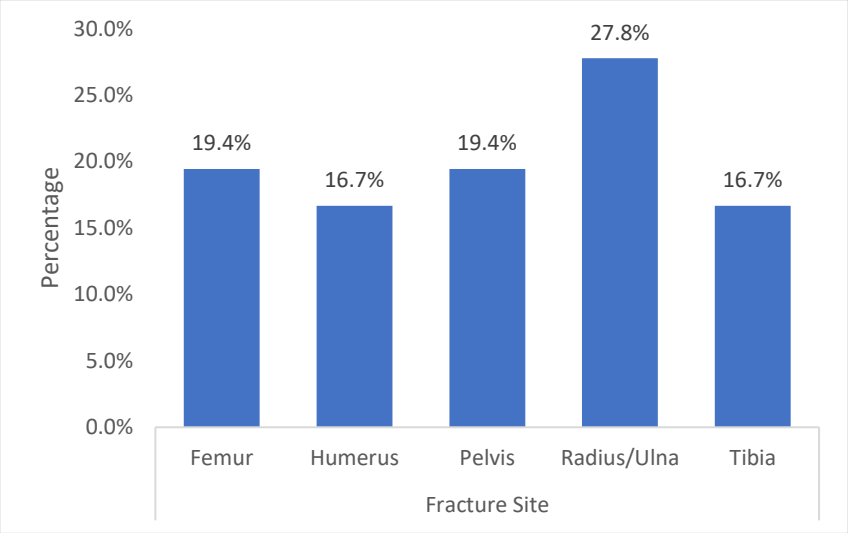

Figure 3: Distribution of fracture sites.

Table 5: Types of fracture fixation procedures performed during orthopaedic intervention.

		Number of Patients	Percentage
Type of Fracture Fixation	External Fixator	10	27.8%
	Nailing	14	38.9%
	Plating	12	33.3%

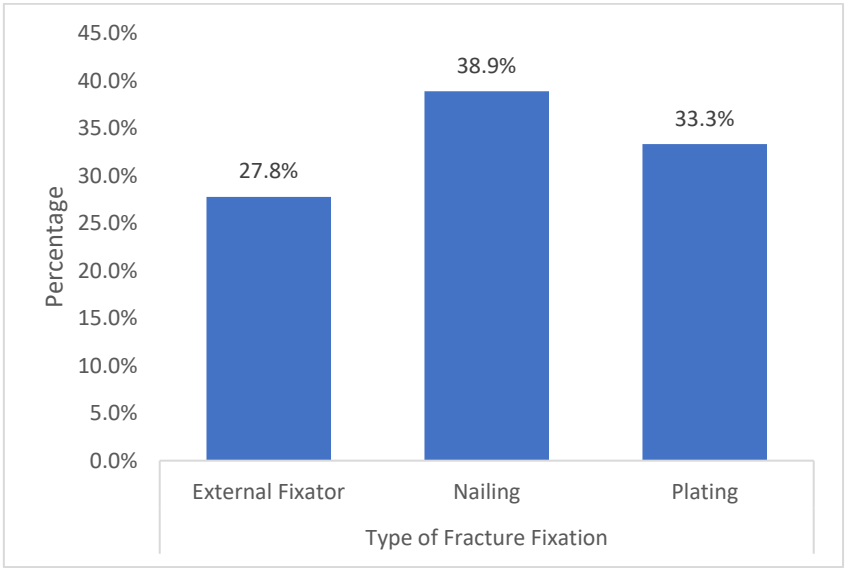

Figure 4: Types of fracture fixation performed.

Table 6: Types of abdominal surgical procedures performed in the study population.

		Number of Patients	Percentage
Abdominal Surgery Type	Appendectomy	1	2.8%
	Bowel Resection	2	5.6%
	Bowel Resection anastomosis	5	13.9%
	Laparotomy for hemoperitoneum	1	2.8%
	Laparotomy for Trauma	1	2.8%
	Laparotomy for Trauma hemoperitoneum	3	8.3%
	Loop stoma	1	2.8%
	Mesenteric tear repair	5	13.9%
	Partial Splenectomy	4	11.1%
	Repair of Perforation	7	19.4%
	Splenectomy	6	16.7%

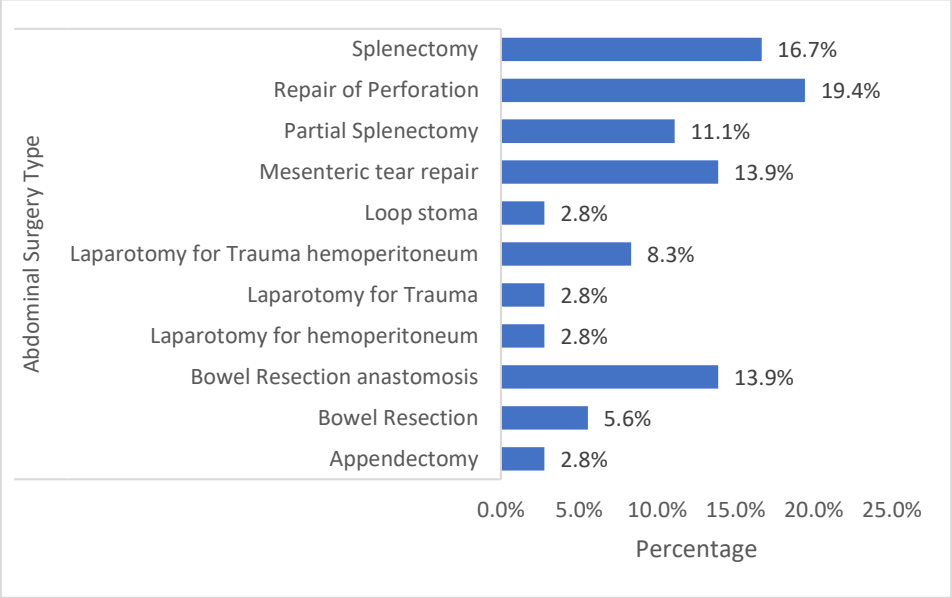

Figure 5: Types of abdominal surgical procedures.

Table 7: Interval between orthopaedic and abdominal surgeries among enrolled patients.

		Number of Patients	Percentage
Interval Between Surgeries (days)	0	2	5.6%
	1	14	38.9%
	2	20	55.6%

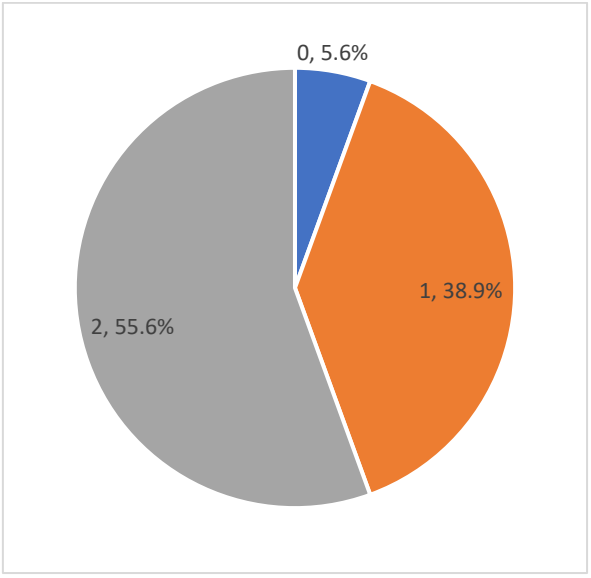

Figure 6: Interval between orthopaedic and abdominal surgeries.

Table 8: Initiation of the structured rehabilitation protocol following dual surgery.

		Number of Patients	Percentage
Rehabilitation Protocol Initiated	Yes	34	94.4%
	No	2	5.6%

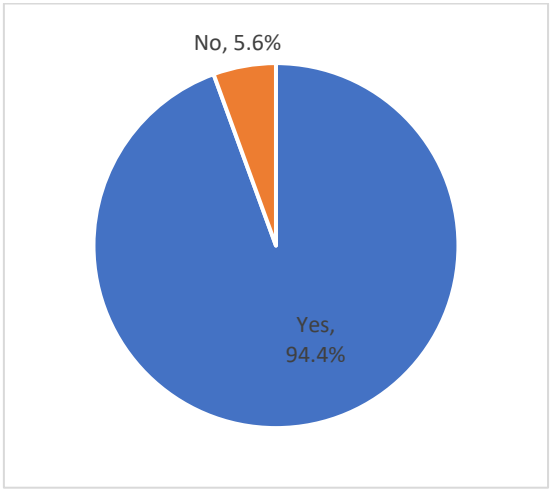

Figure 7: Proportion of patients initiated on the rehabilitation protocol

Table 9: Distribution of orthopaedic complications observed during follow-up

		Number of Patients	Percentage
Complications (Orthopaedic)	Delayed Union	11	30.6%
	Implant Failure	9	25.0%
	Infection	8	22.2%
	None	8	22.2%

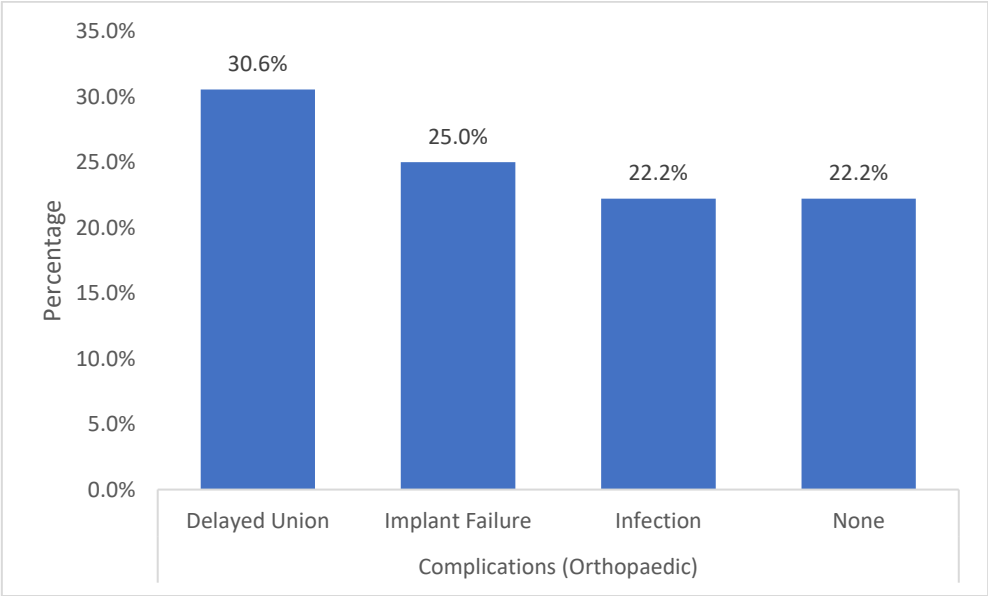

Figure 8: Frequency of orthopaedic complications

Table 10: Distribution of abdominal complications encountered post-surgery

		Number of Patients	Percentage
Complications (Abdominal)	Ileus	8	22.2%
	Sepsis	12	33.3%
	Wound Infection	7	19.4%
	None	9	25.0%

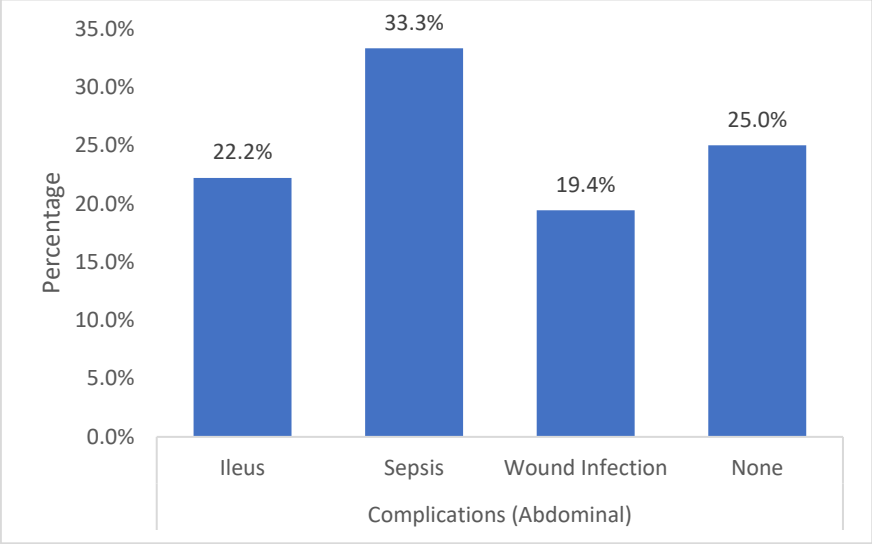

Figure 9: Frequency of abdominal complications

Table 11: Mortality rate within the six-month postoperative follow-up period.

		Number of Patients	Percentage
Mortality	No	36	100.0%

Table 12:Functional outcome progression with corresponding p values from repeated-measures ANOVA

Functional Outcome Score	Mean	Standard Deviation	P value
At Discharge	40.72	12.86	< 0.0001
At 3 Months	58.86	14.71	
At 6 Months	73.78	15.21	

Table 13: Post-hoc pairwise comparison of functional outcome scores across follow-up intervals

		Mean Difference	P value
At Discharge	At 3 Months	-18.139	< 0.0001
	At 6 Months	-33.056	< 0.0001
At 3 Months	At Discharge	18.139	< 0.0001
	At 6 Months	-14.917	< 0.0001
At 6 Months	At Discharge	33.056	< 0.0001
	At 3 Months	14.917	< 0.0001

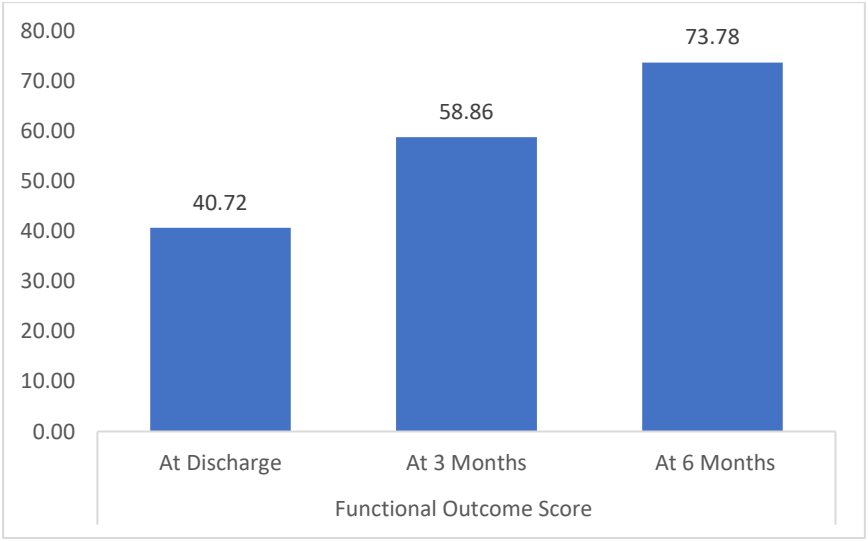

Figure 10: Graphical comparison of functional outcome improvement over time.

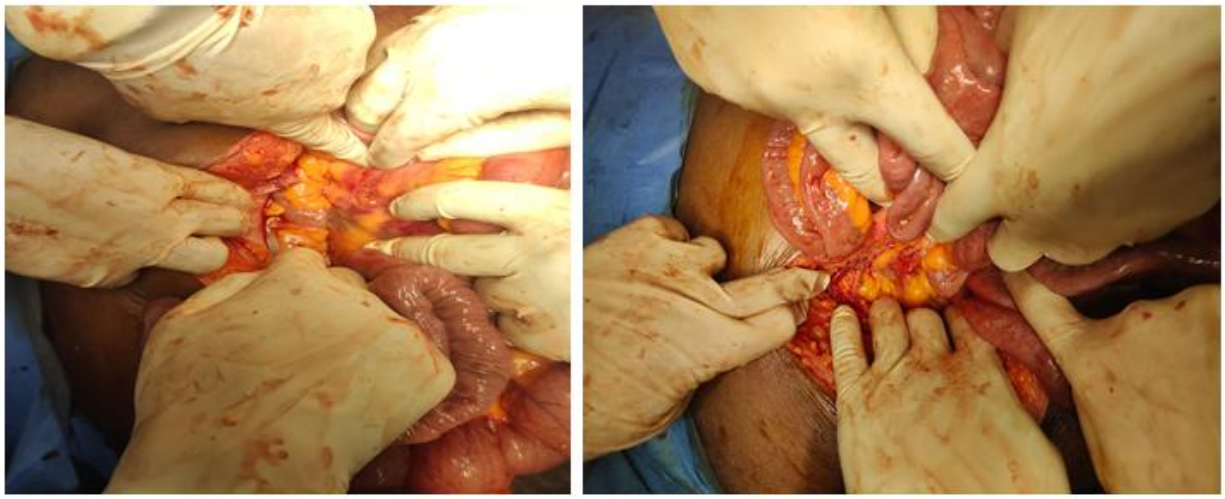

Figure 1: Mesenteric tear with hemoperitoneum. Peritoneal lavage with mesenteric tear repair done

Figure 2: Perforation peritonitis. Primary repair done

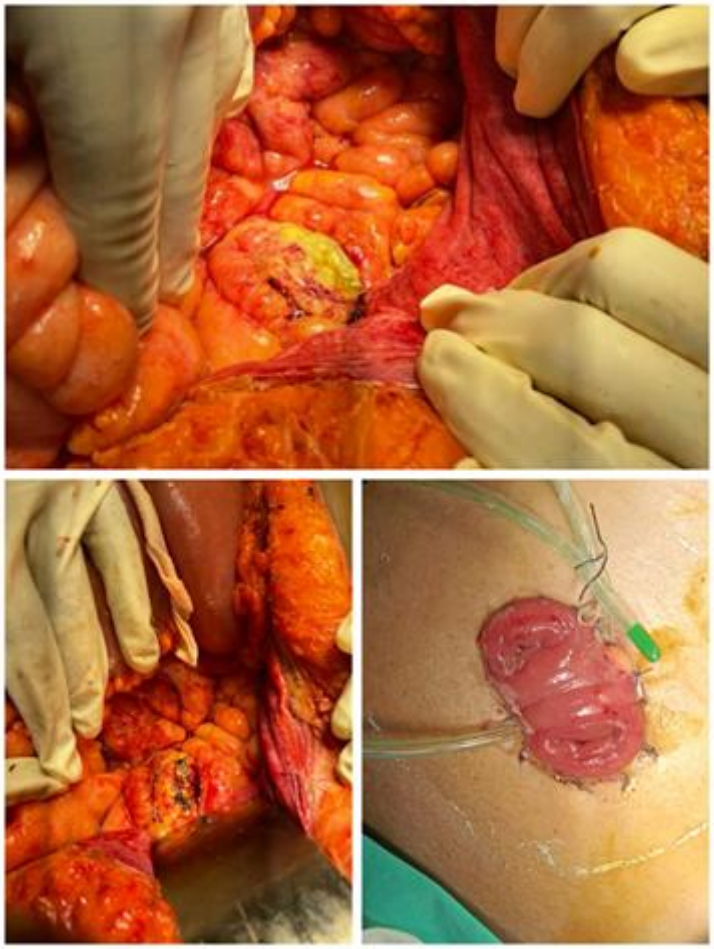

Figure 3: Perforation peritonitis .Peritoneal lavage with loop stoma done

Figure 4: Left humerus shaft fracture

Figure 5: Retrograde intra-medullary femoral nail showing showing callus formation


Figure 6: Compound tibial fracture with External Fixator insitu

DISCUSSION

Trauma requiring both abdominal and orthopaedic surgery shows a distinctive convergence in contemporary healthcare, as life-saving interventions integrate with the domain of functional restoration. The present study demonstrates that tackling these conflicting objectives via a coordinated, patient-centered approach can enhance both survival and genuine rehabilitation.

The ongoing and statistically significant enhancement in functional scores over a six-month period demonstrates not just the effectiveness of the procedure but also the body's remarkable capacity to adapt to systematic therapy. The average gain of roughly thirty points in the Barthel and SF-36 indices is in line with the benefits seen in specialist early-mobilization programs after complicated procedures on the abdomen and musculoskeletal system [5–7,19]. These results suggest that movement can be a kind of therapy even after a lot of surgery. Timely, concentrated mobility can bring back not only muscle strength but also confidence, independence, and dignity.

It's interesting that no one in this group died. Based on worldwide data on combined trauma, the death rate can be anywhere from 8% to 25%, depending on how bad the injuries are and when surgery is done [10–13]. In this series, survival was likely affected by careful adherence to damage-control orthopaedics (DCO) recommendations, which advocate for temporary stabilisation until haemodynamic stability is achieved [14–16]. The shift from the "early total care" approach to the "safe definitive surgery" framework has significantly reduced systemic inflammatory response and multiorgan failure [15,16,18]. Each surgery was planned not in isolation but within the complete physiological context of the patient, a method increasingly supported by multicentric trauma guidelines [11,14].

It was also vital to adopt better recovery after surgery (ERAS) procedures in trauma care. Originally limited to elective surgery, ERAS has lately demonstrated benefits in emergency and abdominal trauma settings, alleviating ileus, infection, and duration of hospitalisation [1–4,8,9]. Our results align with these: patients adhering to ERAS-based regimens exhibited enhanced mobility, expedited oral intake, and a reduction in complications. Using ERAS for trauma victims shows how adaptable it can be when it is based on each person's specific physiological demands instead of rigid routines.
The regression analysis failed to pinpoint any specific factor that could forecast an unfavourable outcome. Age, sex, sepsis, and delays in mobilisation did not reach statistical significance. This may sound strange, but it recognises that healing is a complicated process that depends on many things, such as how well you handle pain, what you eat, how much aid you get from others, how strong your mind is, and clinical considerations [5,6,17]. These results show that rehabilitation isn't only about the body; it's also about the mind, the heart, and the people we spend time with. Our idea worked because doctors, physical therapists, and patients worked together all the time.

Patients at increased risk for complications regarded the complication rates as satisfactory. The rates of delayed union and implant-related problems (about 25% to 33%) align with previous studies on early fixation in polytrauma [14–16]. Sepsis remained the primary abdominal complication, consistent with the physiological stress induced by laparotomy and the concomitant risk of contamination [11–13]. But it seems that closely checking wounds, commencing enteral feeding early, and administering antibiotics correctly have all helped lower the risk of getting really sick.

The weak links between how long it takes to get moving and long-term functional scores demonstrate that moving early is excellent, but staying active is more important than sticking to a regular schedule [19,20]. This highlights how crucial it is to have progressive rehabilitation, which is a process and not just a list of things to do. People are more inclined to keep exercising if they see it as part of their recovery rather than as a punishment. This results in improved outcomes.
Recent statistics indicate a global shift towards multidisciplinary trauma care centres, whereby orthopaedic and general surgeons, anaesthetists, and physiotherapists operate as an integrated team [1–4,14–16]. Surgical planning and rehabilitation planning work together to make sure that patients don't get lost between different disciplines. Not only do these kinds of solutions function better, but they also make better use of resources and cut the overall cost of health care.

Limitations and utilisation
The limitations of this study are its small sample size and single-centre design, which may impede generalisability. The six-month follow-up period, while sufficient for demonstrating initial recovery trends, may not correctly represent long-term reintegration outcomes. Furthermore, psychosocial and nutritional factors, while important, were not assessed. Multicentric studies in the future that include patient-reported outcomes and extended follow-up periods may fix these problems.

Despite these constraints, this study provides pragmatic reassurance:
If done appropriately and followed by a well-planned rehabilitation plan, it is safe and useful to have both gastrointestinal and orthopaedic surgeries at the same time.

Even in difficult trauma cases, early mobilisation based on ERAS should be recommended as long as the patient's health permits it.

For long-term recovery to be effective, surgical, nursing, and physiotherapy teams from many disciplines must collaborate.

The study finally reveals that the change from injury to independence involves more than just stitches or implants. It also involves finding the right balance between surgical precision and human compassion. The physiotherapy mat and the orthopaedic table are both stages on the same path to healing, even if they are in separate rooms.

CONCLUSION

This study shows that doing both orthopaedic fracture fixation and abdominal surgery at the same time can lead to not only survival but also significant functional recovery when done in a structured multidisciplinary setting that combines damage-control orthopaedics (DCO) and enhanced recovery after surgery (ERAS) principles. Patients exhibited significant enhancement after six months, facilitated by early mobilisation, dietary optimisation, and coordinated physiotherapy. The data show that successful recovery from serious trauma comes from a combination of surgical skill, patient motivation, and caring teamwork. Consequently, the essence of trauma treatment transcends simply life preservation; it encompasses life restoration, a notion that necessitates intentional multicentric research to fortify this cohesive recovery model.

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Conflict of Interest-Nil
Ethical Approval and/or Institutional Review Board (IRB)-Obtained

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