ORIGINAL ARTICLE

# Patient outcomes association with patient factors and care provided: trauma registry derived cohort study

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## Abstract

**Objective:** To determine the association of delay in treatment with injury-specific patient outcomes.

**Method:** This was a single-center, longitudinal cohort study on orthopaedic trauma registry. Data on patients enrolled between June 2015 and June 2018 were analyzed. Data was collected from admitted consenting patients' medical records. Definitive surgical care provided after 24 hours was considered as 'delayed surgical treatment'. Outcomes of patients were serially assessed on follow-up visits up to 12 months using injury-specific scoring system.

**Results:** A total of 789 patients, were enrolled with 856 upper or lower extremity injuries altogether; in 67 cases both extremities were involved. Surgery was done in 90% while 10% were managed conservatively. A delay in the surgical procedure was experienced by 185(23%) patients. Mortality was 3.28% (6 of 185) in the delayed treatment group and 1% (6 of 603 patients) in the early treatment group (p=0.046). In proximal femur there was a non-significant trend towards better outcomes in the early treatment group at 3 and 12 months (p=0.06), while in Tibial shaft fractures, there was a non-significant trend towards better outcomes in the delayed treatment group at 3 and 6-months (p=0.09). There was no association between treatment delay for distal radius and proximal humerus fractures and their outcomes.

**Conclusion:** Our trauma registry model provides outcomes data enabling identification of patient subsets who did not achieve good outcome, and suggests possible role of delay in surgical treatment beyond 24 hours in the outcomes.

**Keywords:** Trauma; delay in care; registry, co-morbid. (JPMA 70: S-10 (Suppl. 1); 2020)

## Introduction

Trauma is one of the leading causes of death as well as temporary or permanent disabilities worldwide. Currently the major causes of trauma include road traffic accidents, disasters and violence.[1] There is a constant need to improve trauma management in order to improve trauma care outcomes.[2-4]

Pakistan is in a critical period with an alarming increase in trauma victims due to violence, natural disasters and accidents. Treatment of trauma injuries is one of the major challenges in health care depending on the fracture type, treatment expertise and patient associated factors. The quality of treatment directly relates to final outcome.[5] Thus, considering the inadequate resources and infrastructure for pre-hospital and in-hospital trauma care in Pakistan, it is expected that a substantial number of trauma victims die or develop disabilities, outcomes which may be preventable by improving trauma care.

Due to a number of factors, treatment delay is experienced daily in almost all health care settings including stabilizing patients' clinical condition, availability of surgeon and operating room, waiting for clinical investigation report, unsuitable time of patient hospital arrival, longer operating time, patient and family decision for surgery etc.[6] Early surgical intervention reduces the risk of nosocomial infections and potential complications like poor outcomes and mortality.[7-9] Consequently, patients' length of hospital stay and treatment cost is reduced leading to better patient satisfaction.[10]

Critically assessing the current hospital care system and establishing a model system based on international best-practices in early trauma care are important elements of quality improvement process. This requires meaningful data to enable evidence-based decisions of the performance of our trauma care system as a whole as well as to highlight gaps in the care process.[11,12]

Aga Khan University in Karachi, Pakistan is a leading private health care institution ranked among the top in the country in medical research, education and health care delivery. There have been some un-sustained efforts at our institution for systematically capturing trauma data through registries. However, there has previously been no specific orthopaedic trauma

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database in our Hospital. Aga Khan University is running the registry over 3 years, sharing of analyzed registry data and planning for future utilization of data for improving outcomes. The current study aimed to identify the cause of delay in surgical treatment from time of patients' admission to delivery of definitive surgical care and to determine association between delay in surgical care provided and their injury specific outcomes. On the basis of current data, our registry may be used as a model for outcome-based clinical evidence to assist surgeons to judge their own management by patients' rate of recovery and to select optimal treatment option. Secondly, indigenous trauma registry can help in developing regional and national registries on Orthopaedic trauma in Pakistan.

## Methods

The first stage was development of departmental consensus on the need and utility of an orthopaedic trauma registry. This was done through meetings, lectures in conferences and seminars, and discussion in journal clubs. Validated outcome scoring systems to objectively assess clinical, functional and radiological outcomes were compiled for specific injuries. A single-center, longitudinal cohort study on trauma database was designed. Institutional and Ethical Review Committee approvals (reference numbers 0525-540 and 0526-541) were obtained prior to study start-up. The study started in June 2015 and prospective patient enrollment is ongoing, but in this report we present data on of patients enrolled up to June 2018. Patients of any age group and gender presenting with upper and/or lower limb fracture/dislocation due to trauma injury presenting to Aga Khan University Hospital were included in the registry. Pathological fractures were excluded. After obtaining informed written consent, data on the injury circumstances, nature, investigations and management was collected from the patients' medical record. All enrolled patients were treated according to the plan of the attending orthopaedic surgeon. Using validated injury specific scoring systems, clinical, functional and radiological outcomes were assessed at 2 weeks±5 days, 6±2 weeks, 3 months±2 weeks, 6±1months and 12±2 months after initial treatment. Definitive surgical care provided after 24 hours of arrival was considered as delay in surgical treatment. The Statistical Package for Social Sciences version 19.0 was used for data analysis. Continuous variables were expressed as mean ± standard deviation and categorical variables (gender, mortality etc.) as percentages. In this study, association of early versus delay treatment with functional and clinical outcomes of tibia shaft, proximal femur, distal radius and proximal humerus fractures at 3, 6 and 12 months are described. Quick DASH, Harris Hip Score and Johner and Wruh's criteria were used as an outcome assessment tool.[13-15] Chi-square test and Odds ratio (OR) was determined for deaths. The p-values for comparisons of outcome variables were analyzed by Fischer's exact test and chi-square test for proportions with a confidence interval of 95%. The p-value of less than 0.05 was considered as statistically significant.

## Results

A total of 789 patients with 69% males (N=5,47) and 31% females (N=242) were enrolled from June, 2015 to June, 2018. Two hundred and fifty-six patients sustained upper limb injuries. (N=187, 73% males and N=69, 27% females), lower limb injuries by 466 (N=310, 66.5% males and N=156, 33.5% females) and both upper and lower limb injuries by 67 (N=50, 75% males and N=17, 25% females). Looking at combined upper and lower limb injury distribution, 533 (62%) lower limb and 323 (38%) upper limb injuries giving a total of 856 limb injuries were registered in the database. The gender distribution shows a higher proportion of males in all injury groups. Patients

**Table-1:** Trauma treatment pattern.

| | | N (%) |
|---|---|---|
| Care Provided (for 789 patients) | Non-operated | 62 (8%) |
| | Operated within 1 day of admission | 541 (69%) |
| | Operation delayed > 1 day of admission | 185 (23%) |
| | Patient left against medical advise | 1 (0.1%) |
| | Total | 789 |

| | | Lower limb injury (N) | Upper limb injury (N) |
|---|---|---|---|
| Care Provided (for 856 injured limbs) | Non-operated | 34 (4%) | 50 (6%) |
| | Operated within 1 day of admission | 341 (40%) | 223 (26%) |
| | Operation delayed > 1 day of admission | 157 (18%) | 50 (6%) |
| | Patient left against medical advise | 1 (0.1%) | 0 |

N = Number of patients.

**Table-2:** Mortality and its relation to delay in surgical care.

| | Early treatment (N) | Delayed treatment (N) |
|---|---|---|
| Total patients | 603 | 185 |
| Expired | 6 (1%) | 6 (3.28%) |
| Expired within 2 months post-operatively | 2 (17%) | 4 (33%) |
| Expired after 2 months due to non-surgical reasons | 4 (33%) | 2 (17%) |
| Odds ratio (95% Confidence interval) | 3.33 (1.06 - 10.46) | |
| p-value (Fisher Exact Probability Test) | p = 0.04 | |

N = Number of patients.

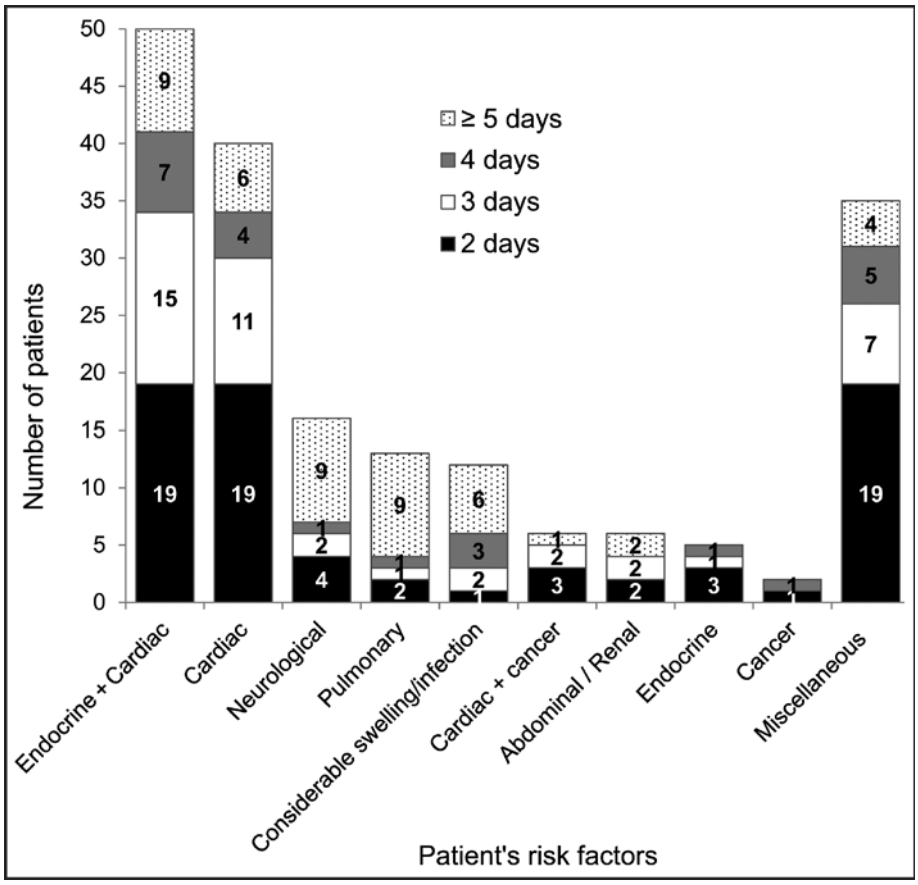


**Figure-1:** Delay in surgical care and patient's risk factors.

between 26-35 years of age sustained limb injuries primarily followed by > 65 years of age.

Road traffic accidents were the leading cause of injuries accounting for 46% (N=363), fall was the second leading cause 44% (N=344) followed by firearm injuries which accounted for 3% (N=23). Other mechanisms of injuries were blunt trauma, twisting injuries, machine injuries, firecracker, assault and blast injuries, accounting for 7% (N=59). Fractures were managed surgically in 498 (93%) lower limb and 273 (84%) upper limb.

Of the 789 patients, 240 (30.4%) arrived at our hospital after 24 hours of injury and 185 (23%) experienced surgical delay beyond 24 hours. Median delay in care was 8 days. Factors mainly contributing to delay in surgical treatment were patient's co-morbid conditions such as cardiac problems and uncontrolled diabetes, and associated serious injuries to major organs like head injury, pneumothorax, renal injury etc. followed by miscellaneous reasons like non-availability of beds, decision making by family, pregnancy and others (Table-1, Figure-1).

Functional and clinical outcomes of selective tibia shaft, proximal femur, distal radius and proximal humerus were measured. Proximal femur fractures showed a non-significant trend towards good-excellent outcomes in early treatment group at 3 and 12 months (p=0.08 and 0.06 respectively). Good-excellent outcomes of tibia shaft fractures at 3 months showed a non-significant trend towards better outcomes in delayed treatment group (p=0.09) (Figure-2). Outcomes of upper limb injuries i.e. proximal humerus and distal radius at 3, 6 and 12 months showed no significant association between early and delayed treatment groups.

At 6 months follow-up, analysis of functional and clinical outcomes of tibia shaft fractures showed the proportion of 50% for good-excellent results in early treatment group and in delayed treatment group 86%. In proximal femur fractures, the proportion of 39% for good-excellent results in early and 18% in delayed treatment group. Distal radius and proximal humerus fractures showed a proportion of good results in early treatment group from 50% to 55% and in delayed treatment 33% to 40%. The proportions for good-excellent results of combined four fractures were between 30 to 55%.

Overall 12-month mortality was 1.5% (n=12). Six patients expired in both the early and delayed groups, but the proportion was significantly different. Thus, mortality was in 1% (6 of 603 patients) in early versus 3.2% (6 of 185 patients) in delayed treatment groups (p=0.04) with OR 3.33 with higher risk of deaths in delayed treatment group. Age range for overall mortality was 48-89 years. Out of 12 patients who expired, 11 (92%) were of age between 71 to 89 years while only 1 (8%) patient was of 48 years of age belonging to delayed treatment group. Four (33% of 12) patients expired within 2 months post-procedure in delayed group and 2 (17%) in early treatment group suggesting possible surgery related cause. Six (50%) expired after 5-9 months post-operatively due to non-surgical reasons like aspiration pneumonia, urosepsis etc. (Table-2).

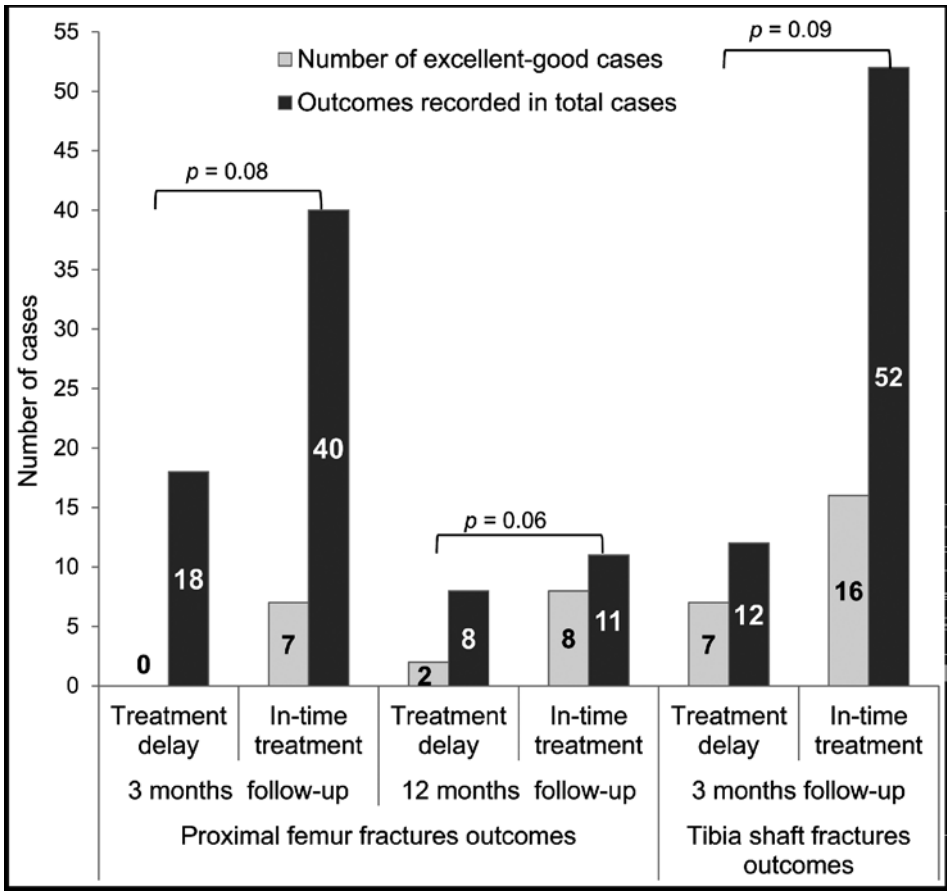


**Figure-2:** Association of functional and clinical outcomes of proximal femur and tibia shaft and delay in surgical treatment.

## Discussion

The aim of treating limb injuries in the long term is to restore function and form to the pre-injury status, hence clinical and functional outcomes are a major concern for the health care personnel providing care. The outcomes assessment in our proposed model can assist in monitoring progress of patients' functional improvement and in identifying cases where outcomes fall below expectations. The results provide objective evidence to formulate subsequent plans for change after peer-review and self-reflection. The data also enables comparison with international benchmarks, thus outcomes of trauma care at a health care facility can be compared internationally, and individual treating physician's outcomes can also be benchmarked. Moreover, our registry model enables recognition of delays in admission and surgery, identification of complications and need for re-intervention, and tracking of functional and radiological outcomes. With incorporation of the results in audits, and implementation of change of practices based on the data, it is expected that improvements in decision making, quality of trauma care, and eventually outcomes would be achieved. At our hospital we envision that this registry becomes integrated with the existing patient care related data services of our Musculoskeletal and Sports Medicine Service Line.

There are some limitations in the project. There is missing data due to patients being lost to follow-up, patient visits without pre-booking, and follow-up visits out of regular scheduled clinic hours. The burden of orthopaedic trauma patients, and hence the amount of required registry data collection, entry and analysis is substantial while we face limitation of resources including manpower. This becomes a strong justification to improve efficiency of outcomes assessments and reporting through implementation of an information technology based solution to simplify and assist in data capture, management, analysis and report generation.

In this study, the cause for delay in definitive surgical care beyond 24 hours of admission was identified, and its relation with patient's clinical and functional outcomes was analysed. The major factors responsible for delay were patients' associated comorbid conditions and major trauma to other organs/systems of the body. The registry data also highlights need for proper documentation of reasons for delays, and for addressing delays related to hospital bed availability in surgical wards, which are expected to contribute to improving overall quality of surgical care.

While analyzing the clinical and functional outcomes of the four limb injuries selected for this report, we noted a trend towards better outcomes in early treatment of proximal femur fractures compared to delayed treatment, in the outcomes assessed at 3 and 12 months follow-up visits. On the other hand, for tibia shaft fractures, outcomes were non-significantly in favour of delayed treatment at 3 months follow-up time. Distal radius and proximal humerus fractures had no difference in outcomes whether patients received early or delayed surgery.

In terms of death, among the patients who expired in the delayed treatment group two-thirds died within 2 months compared to one-third in the early treatment group. Out of 12 patients who died, 8 (67%) had proximal femur fractures and 3 (25%) had humerus (supracondylar and shaft) fractures while 1 (8%) had ankle fracture. These results suggest the need for injury-specific management of time to surgery in order to reduce mortality and improve patients' clinical and functional outcomes. Thus, care of patients with proximal femur fractures needs to flow efficiently from arrival to admission through to surgery with minimal delays. Although elderly patients with proximal femur fractures are at a considerable risk of mortality, younger patients are also prone to early mortality when they suffer poly-trauma. World Health Organization recommends use of a trauma care checklist[16] for such patients. Such a checklist ensures systematic assessment and early management of trauma patients without missing life threatening injuries, thus enabling provision of optimal care.

After successful establishment of hospital trauma registry at our hospital through a dedicated information technology solution, we intend to collaborate with other institutions in our city and other cities of the country to implement this registry at those institutions. This would entail collection of trauma data at a national level, and permit formulation of evidence based recommendations on prevention and management according to reports from the registry. Such improvement in practices is expected to lead to improvement in functional outcomes in trauma victims and decrease trauma related mortality across the country.

## Conclusions

Objective assessment of injury-specific outcomes provides data which can be used for audits, and for evidence-based decisions on prevention and care. Although an individual patient's management depends on multiple factors, on the basis of registry-based data an attempt can be made to formulate guidelines for management according to specific injuries in acute trauma patients, to achieve the best outcomes.

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