Fracture stabilisation in a polytraumatised African population—A comparison with international management practice

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ABSTRACT

Introduction: Fracture management in polytrauma patients has favoured early definitive fracture fixation with some authors advocating a staged management approach in these potentially unstable patients. We aimed to investigate the timing of surgical fracture stabilisation in polytrauma patients with significant orthopaedic injuries in a Level 1 trauma unit in South Africa (RSA) and to compare its performance with Level 1 trauma units in the USA and Europe.

Materials and methods: A retrospective review was performed extracting polytrauma patients with a New Injury Severity Score (NISS) > 15, with significant pelvic or long bone fractures managed surgically. We compared these data with recently published data from the USA and Europe.

Results: Over a 3 year period pedestrian (46.3%) and motor vehicle or motorcycle accidents (40.7%) were the predominant mechanisms of injury in the 123 eligible patients. Compared to international data, patients were significantly younger (32.41 years (SD 13.4) vs. USA 44.1 years (SD 16.39) and Germany 41.2 years (SD 15.35), p < 0.001); and had a higher NISS score (RSA 31.93 (10.3), USA 27.4 (8.65), Germany 29.4 (6.88), p = 0.007). Less definitive fixation took place in the first 24 h (RSA 37.4%, USA 57.1%, Germany 65.6%, p < 0.001), but overall definitive fixation took place earlier (RSA 3.6 days (SD 4.39), USA 5.5 days (SD 4.2), Germany 6.6 days (SD 8.7), p = 0.001).

Conclusion: In a developing country when compared to international trauma centres, less primary definitive fixation was performed in the first 24 h.

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Introduction

Fracture management in polytrauma patients has been extensively researched over the last few decades. Studies during the 1980s showed that early fracture fixation (< 24 h post injury) in polytrauma patients (Injury Severity Score (ISS) > 18) decreased the incidence of fat embolism syndrome, acute respiratory distress syndrome (ARDS), pneumonia, and days spent in ICU.1–4

As more emphasis was placed on early fracture fixation subsequent publications showed that a staged approach to fixing major fractures in polytrauma patients with significant (Acute Injury Score (AIS) > 2) chest, abdominal or head injuries resulted in improved clinical outcomes.5–8

A recent study compared current treatment strategies at Level 1 trauma centres in the USA and Germany.9 Early (< 24 h) definitive fracture stabilisation took place in 65.6% of patients in the German group and 57.1% of American patients (p-value not significant). Both groups had similar time periods to definitive fixation (5.5 days in the American group and 6.6 days in the German group, p-value not significant).

In the developing world trauma carries a significant health care and economic burden. Males between the ages of 21 and 30 are most often injured,10,11 with most injuries and related mortality being caused by road accidents11 and interpersonal violence.12 Patient extraction from rural areas is often delayed due to the poor condition of roads, and lack of available ambulances. A prospective study in Dakar showed that 77.8% of polytrauma patients were extracted without pre-hospital care and the mean time from injury to arrival at the emergency department was 8 h.11

In South Africa the average pre-hospital time ranges from 51 to 84 min in urban areas and may double in rural areas.13,14 Secondary hospitals treat most trauma patients, but due to lack of specialists and intensive care beds polytrauma patients are often transferred to tertiary hospitals for specialist and intensive
care. Based on these factors it would seem inevitable that timing to fracture fixation in a South African Level 1 trauma unit would be delayed when compared to international first world trauma units.

We wished to compare the performance of the newly established Inkosi Albert Luthuli Central Hospital (IALCH) Level 1 trauma unit with the current published international standard of care. IALCH is a quaternary hospital based in KwaZulu-Natal, South Africa. This study aimed to investigate the demographics and current treatment strategies of polytrauma patients with significant orthopaedic injuries with specific attention to the timing of surgical fracture fixation and to compare their management to current international practice. Ethics approval was obtained from the Biomedical Research Ethics Committee, University of KwaZulu-Natal (BE 207/09).

Materials and methods

A retrospective database review was performed at the Level 1 Trauma Unit of Inkosi Albert Luthuli Central Hospital (IALCH), Durban, South Africa. All polytrauma patients treated in the Trauma Unit since its opening in March 2007 until October 2010 were reviewed. Data were extracted using the hospital data management system Medicom.

The New Injury Severity Score (NISS) was used to grade injury severity. Polytrauma patients were defined as those with a NISS > 15. Within this group we selected patients with significant pelvic or long bone fractures (extremity NISS ≥ 9). We excluded children younger than 13 years, those that underwent their initial surgery at another hospital and those who did not undergo surgical fracture stabilisation. We compared our findings to a recent matched-pair analysis study which compared current treatment strategies at Level 1 trauma centres in the USA and Germany.

Statistical analysis

Standard descriptive statistics were used to describe patient characteristics, including means, standard deviations and inter-quartile ranges for continuous variables. All data analyses were performed using SPSS 15.0 for Windows (SPSS, Chicago, IL), using the χ² test for categorical data and Student’s t-test and one-way ANOVA where appropriate for normally distributed continuous data. Statistical significance was defined as a two-sided p-value <0.05.

Results

During this period 396 trauma patients with orthopaedic injuries were treated at this facility. After exclusion 123 patients were considered eligible. The mechanism of injury was via pedestrian vehicle accident (PVA) in 57 (46.3%), motor vehicle (MVA) or motorcycle (MCA) accident in 50 patients (40.7%), gunshot wound in 11 (8.9%) and fall from height in 5 (4.1%) patients. Forty patients (32.5%) were admitted from scene, with the rest being referred from other hospitals.

We grouped patients according to time to surgical fracture stabilisation with 88 patients (71.5%) undergoing fracture stabilisation within 48 h, 17 (13.8%) between 48 and 96 h and 18 (14.6%) after 96 h. In the subgroup of 40 patients who were received directly from scene 60% underwent surgery at <12 h, and 70% at 24 h.

We subsequently compared the demographics (Table 1) and the timing of our surgical fracture fixation (Table 2) with those from recently published German and US data. The mean time to definitive fixation in our group was 3.6 (standard deviation (SD) 4.39) days compared with 5.5 days (SD 4.2) in the USA and 6.6 (SD 8.7) in Germany (p = 0.001).

Discussion

We performed a retrospective database review of polytrauma patients with significant orthopaedic injuries presenting to the Level 1 Trauma Unit, Inkosi Albert Luthuli Central Hospital in Durban, South Africa, in which we investigated the demographics, primary treatment during the first 24 h, and the time to definitive fixation. Additionally we compared our results with a recent retrospective review comparing treatment strategies of major fractures in polytrauma patients presenting to comparable Level 1 trauma centres in the USA and Germany.

Although a similar male predominance existed between the studies, the average age of our patient group was significantly lower than the international patient groups. Two recent prospective studies of polytrauma patients presenting to other African teaching hospitals in Lagos10 and Dakar11 also reported a similar younger average age, 31.2 years and 30 years respectively. As

Table 1
Demographic comparison between the three Level 1 trauma centres.

<table>
<thead>
<tr>
<th></th>
<th>RSA (n=123)</th>
<th>USA (n=57)</th>
<th>Germany (n=57)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (SD)</td>
<td>32.41 (13.4)</td>
<td>44.1 (16.49)</td>
<td>41.2 (15.35)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male sex (%)</td>
<td>80 (65)</td>
<td>37 (64.9)</td>
<td>36 (63.2)</td>
<td>0.968</td>
</tr>
<tr>
<td>Mean NISS points (SD)</td>
<td>31.93 (10.3)</td>
<td>27.4 (8.65)</td>
<td>29.4 (6.88)</td>
<td>0.007</td>
</tr>
<tr>
<td>Mean ICU stay (SD)</td>
<td>14.73 (13.82)</td>
<td>10 (7.49)</td>
<td>15.6 (18.25)</td>
<td>0.06</td>
</tr>
</tbody>
</table>

RSA, Republic of South Africa; USA, United States of America; SD, standard deviation; NISS, New Injury Severity Score; ICU, intensive care unit.

* Statistically significant.

Table 2
Fracture management in the first 24 h.

<table>
<thead>
<tr>
<th>Orthopaedic management</th>
<th>RSA (n=123)</th>
<th>USA (n=77)</th>
<th>Germany (n=93)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary definitive fixation (%)</td>
<td>46 (37.4)</td>
<td>44 (57.1)</td>
<td>61 (65.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Non-invasive: traction or backslab (%)</td>
<td>34 (27.6)</td>
<td>7 (9.1%)</td>
<td>1 (1.1%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Temporising external fixation (%)</td>
<td>12 (9.8)</td>
<td>19 (24.8)</td>
<td>21 (22.6)</td>
<td>0.005</td>
</tr>
<tr>
<td>Definitive external fixation (%)</td>
<td>36 (29.3)</td>
<td>7 (9.1%)</td>
<td>10 (10.8)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

RSA, Republic of South Africa; USA, United States of America.

* Statistically significant.
young adult males make up the majority of the potential work force these findings highlight the additional economic cost of the trauma burden in Africa.

The most common mechanism of injury in our study was pedestrian vehicle accidents, followed by motor vehicle and motorcycle accidents. As reflected in this paper, road accidents are the leading cause of injury-related mortality worldwide, with more than 90% of accidents occurring in low- and middle-income countries. In developed countries such as the United States the majority of road accident fatalities are motor vehicle drivers. In contrast pedestrian vehicle accidents predominate in the developing world as shown in our data was well as data from Kenya, Ghana, Uganda, Cameroon, and Mozambique where pedestrians make up 45–70% of road accident fatalities.

The NISS has been shown to be an accurate predictor of trauma related mortality. Despite our use of a NISS > 15 as our inclusion criteria, our mean NISS was significantly higher than the international trauma centres who used a NISS > 16 as their inclusion criteria. This may be explained partly by the international paper excluding patients who died during their hospital stay whilst we only excluded patients who died preoperatively. Our mean NISS was not statistically significantly different when compared individually to the Germany population (p = 0.09) but was significantly different when compared to the US population (p = 0.004). This may reflect differences in referral patterns in the USA.

Early definitive fixation (>24 h) of fractures has been shown to be the preferred treatment in polytrauma patients resulting in the reduction of acute respiratory distress syndrome (ARDS), fat embolism syndrome and time spent in ICU. A large population-based database review of patients with femur fractures found that in severely injured patients (ISS > 15) early femur fracture fixation (>24 h) decreased mortality significantly when compared to non-surgical management (3.8% vs. 24%, p < 0.0001). The additional benefits of “early total care” include improved pain relief, ease of nursing, earlier patient mobilisation with a reduction in complications associated with immobilisation and shorter hospital stays.

We performed less primary (early) definitive fracture fixation (>24 h) than the international trauma centres with 37.4% of our patients undergoing primary definitive fixation compared with 57.1% of the American patients and 65.6% of the German patients (p < 0.001) but by 48 h 59.3% of our patients had undergone definitive fixation. This delay may reflect the higher NISS scores in our population or the manner in which the unit is run. Full 24 h cover is provided by a team of surgical, orthopaedic and anaesthetic registrars supervised by a trauma surgeon. In addition there is a dedicated trauma theatre available solely for use by the trauma unit. This availability of both the theatre and the management team removes the pressure created by limited theatre access. Definitive fracture fixation can be delayed until the patient is fully resuscitated rather than the team being pressurised into attempting definitive fixation during a surgical procedure when the patient may not be optimally resuscitated.

Certain studies have shown that a delayed or staged approach to fracture fixation is preferable in polytrauma patients with significant (AIS > 2) head, chest or abdominal injuries. The concept of damage control orthopaedic surgery has emerged as a strategy to deal with fractures in unstable or potentially unstable polytrauma patients. The strategy consists of early (>24 h) temporary external fixation of femur fractures, continued resuscitation in the intensive care unit and delayed conversion to an intramedullary nail. Primary external fixation with secondary delayed definitive fixation decreased the incidence of ARDS when compared to primary (>8 h) intramedullary femoral nailing (7.8% vs. 15.1%, p = 0.003) and decreased the incidence of multiple organ failure (11.5% vs. 16.2%, p = 0.03).

We treated significantly more patients with a non-invasive approach during the first 24 h post arrival to the unit (RSA 27.6%, USA 9.1%, Germany 1.1%, p < 0.001). This approach included traction of femur fractures and temporary back slabs for other long bone fractures to provide temporary immobilisation until resuscitation was complete and patients were stable enough for surgical fracture stabilisation.

In contrast to the international groups, most of our patients with external fixation did not have secondary conversion to an intramedullary nail and were referred back to their base hospitals upon discharge from ICU. Data regarding further fracture management at these hospitals were not available for this review. This may explain why the average time to definitive fixation in our group was significantly shorter than the international groups (RSA 3.6 days, USA 5.5 days, Germany 6.6 days, p = 0.001).

There are a few limitations to our study. This retrospectively collected data was compared to a matched-pair patient cohort population which may not accurately reflect the average patient populations in Germany and the USA. In addition the comparison paper examined individual fracture management whilst our study examined individual patient rather than specific fracture management.

Conclusion

As a dedicated Level 1 trauma unit in Africa our trauma population consists predominantly of young males involved in pedestrian motor vehicle accidents. In comparison to other Level 1 international trauma centres we performed less primary definitive fixation and managed more patients non-invasively during the first 24 h, with subsequent staged definitive fixation after a period of further resuscitation in ICU.

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Conflict of interest statement

We declare that we have no conflicts of interest.

References