



# The Journal of Bone & Joint Surgery

**Journal Club:** 10 May 2012

**Attendees:** Mr A L Khan, Mr A Rao, Mr M Mokawem, Mr T Goff, Mr W Chellam, Mr B Haughton, Mr S Harrison  
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**Theme:** Lower limb trauma – Management of open fractures

## Presented Papers:

- 1) **Spencer J, Smith A, Woods D.** The effect of time delay on infection in open long-bone fractures: a 5-year prospective audit from a district general hospital. *Ann R Coll Surg Engl* 2004;86:108-12.
- 2) **Penn-Barwell JG, Murray CK, Wenke JC.** Early antibiotics and debridement independently reduce infection in an open fracture model. *J Bone Joint Surg [Br]* 2012;94-B:107-12.
- 3) **Pollak AN, Jones AL, Castillo RC, Bosse MJ, MacKenzie EJ; LEAP Study Group.** The relationship between time to surgical debridement and incidence of infection after open high-energy lower extremity trauma. *J Bone Joint Surg [Am]* 2010;92-A:7-15.

Patients with open long bone fractures are commonly encountered as part of our everyday practice. The most recent iteration of the BOA/BAPRAS guidelines lay out the expected standards of care for these patients.

In this journal club we review some of the evidence which has influenced these guidelines, and explore how this might affect service delivery in a large teaching hospital, especially with impending “Major Trauma Centre” status.

Our prejudices include concerns that unnecessarily delaying patients with open fractures when resources and expertise are available on a 24 hour basis may be to the detriment of the patient.

## Paper 1:

**The effect of time delay on infection in open long-bone fractures: a 5-year prospective audit from a district general hospital.**

### Summary

#### 1. Purpose

Does a delay of greater than 6 hours from injury to first debridement affect the rate of infection in open long-bone fractures in a typical district general hospital in the UK?

#### 2. Methods

Prospective audit of all open fractures admitted to a DGH over a 5 year period, following a standardised protocol. The time from admission to first debridement was recorded, with an aim to debride and stabilise within 6 hours. The multiply injured or those with head injuries were excluded. Patient demographics were collected; the fracture pattern and mechanism were recorded, and graded according to Gustilo &

Anderson. Rates of subsequent infection were recorded based on clinical findings or from deep culture. Patients were followed up to union or incidence of infection.

### 3. Results

130 patients with 142 open fractures, after exclusions this fell to 103 patients with 115 fractures. 60% of patients were debrided within 6 hours, 82% within 8 hours, and 93% within 12 hours. Therefore 7% were debrided after 12 hours.

The overall rate of infection was 10.4%. No statistically significant difference was recorded in the rate of infection between patient's debrided before or after the 6 hour threshold.

### 4. Conclusions

No significant difference in the rate of infection, therefore a delay to first debridement may be justifiable on the grounds of ensuring seniority of surgical experience to create a safer environment for the patient. Early administration on antibiotics is important.

### Critique

The authors do not confidently answer the question of impact of surgical delay on rate of infection in open fractures. The null hypothesis is flawed.

### Strengths

- The authors set out clear aims and methods.
- Reflects DGH practice prior to latest BOA/BAPRAS guidelines.
- 60% within 6 hours is a good achievement for a DGH environment.

### Methodological Concerns

- Concerns about the classification of fracture severity, it is not clear whether classification occurred prior to first debridement. High number of grade II fractures which are not often encountered in our clinical practice.
- The mixture of upper and lower limb trauma also causes some concern.
- Concern about the definition of infection - wound infection vs. osteomyelitis
- Selection bias remains an issue - higher severity of injury likely to be debrided early.
- Conclusions reached are not all addressed by the research parameters, i.e the suggestion that antibiotics should be administered early has not been measured in this group.
- Should a more thorough toilet of the wound be undertaken in the emergency department if a surgical delay is anticipated?

### Paper 2:

#### Early antibiotics and debridement independently reduce infection in an open fracture model.

### Summary

#### 1. Purpose

To investigate whether early antibiotics and surgical debridement favourably affect outcome in open fractures

#### 2. Methods

Open fracture model using rat femurs, creating a defect which was contaminated with *Staphylococcus aureus* and treated with a three-day course of systemic cefazolin (5 mg/kg 12-hourly) and debridement and irrigation, both of which were initiated independently at 2, 6 and 24 hour time points. After 14 days the bone and hardware were harvested for separate microbiological analysis. Wounds were closed primarily at time of debridement. Analysis included measurement of bacterial load.

#### 3. Results

No subjects with antibiotics and debridement at 2 hours had evidence of infection at 14 days.

Delay from 2 to 6 hours for initial debridement was associated with a significantly increased infection rate ( $p = 0.047$ ). Although not statistically significant a further increase in delay beyond 6 hours was associated with increased infection rates ( $p = 0.054$ ). Delaying antibiotic administration to six or 24 hours had a profoundly detrimental effect on the infection rate regardless of the timing of surgery.

#### 4. Conclusions

Findings are consistent with the concept that bacteria progress from a vulnerable planktonic form to a treatment-resistant biofilm.

Early antibiotics decrease but don't eliminate the effect of delayed initial debridement on the rate of infection in open fractures.

#### Critique

Delaying surgery to the next scheduled list can often lead to delays to wound closure increasing the risk of nosocomial infection.

#### Strengths

- Comprehensive set of arms in the trial

#### Methodological Concerns

- All wounds closed at first debridement
- All wounds were surgical wounds (not necessarily reflective of true practice)
- All fractures were in femora - most open fractures occur in the tibia, can these results be seen as representative
- Gaps left between fracture ends (but stable) - different to typical unstable (i.e. *in vivo*) situation

#### Paper 3:

**The relationship between time to surgical debridement and incidence of infection after open high-energy lower extremity trauma.**

#### Summary

##### 1. Purpose

The purpose of the present study was to evaluate the relationship between the timing of the initial treatment of open fractures and the development of subsequent infection as well as to assess contributing factors.

##### 2. Methods

315 patients, multicentre (level I trauma centres) ages between 16-69 years, with severe high-energy lower extremity injuries (grade III). Patients were excluded if they had head injuries, burns, military exposure, psychiatric problems, or non-native language speaking. All included patients were managed according to a strict protocol - aggressive débridement, antibiotic administration, fracture stabilisation, and timely soft-tissue coverage.

Times from injury to admission and operative débridement as well as a wide range of other patient, injury, and treatment-related characteristics were recorded.

Patients were followed up for at least 3 months after injury.

Multivariate logistic regression models were used to control for the effects of potentially confounding patient, injury, and treatment-related variables.

##### 3. Results

Eighty-four patients (27%) had development of an infection within the first three months after the injury. Prehospital duration is significant in predicting likelihood of infection.

Prolonged delay in transfer to a trauma centre increased infection  $p < 0.01$

Time from injury to surgery did not impact infection rate  
Infection increased when bone loss >2cm

#### 4. Conclusions

Time from the injury to operative débridement is not a significant independent predictor of the risk of infection. Timely admission to a definitive trauma treatment centre has a significant beneficial influence on the incidence of infection.

#### Critique

Skeletal stability critical determinant of soft tissue resuscitation and consequent infection

#### Strengths

- Multicentre study
- Clear inclusion & exclusion criteria
- Reflective of modern practice
- Moderate number of patients

#### Methodological Concerns

- Definition of infection - as such high proportion of infected cases
- Short follow up time - too early to assess union
- Unclear differences between admission time and time to first debridement
- Missing data from patients transferred from peripheral hospitals
- Time of antibiotic administration not accounted for

#### Further discussion:

Should we have a standard protocol regarding definitive early closure / or use of VAC dressings when closure is not immediately achievable?

Is there a role for pre-hospital antibiotic administration for open fractures?

Should we introduce a "Major Trauma Centre" algorithm for the management of open fractures - provided that we have a 24 hour multispecialty service?

Does modern practice of transferring the multiply injured patient for urgent Trauma CT have an influence on the expedience of antibiotic delivery?