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Organiser: Mr David Russell, StR 4 West of Scotland Rotation

West of Scotland Orthopaedic Journal Club

Operative Compared with Non-operative Treatment of Displaced Intra-Articular Calcaneal Fractures

Buckley R, Tough S, McCormack R, Pate G, Leighton R, Petrie D, Galpin R.

J Bone Joint Surg [Am] 2002;84-A:1733-44

Reviewer: Mr Martin Davison, StR 3, West of Scotland Rotation

Aim

To determine whether open reduction and internal fixation of displaced intra-articular calcaneal fractures results in better general and disease specific outcomes at two years compared with non-operative management.

Study Type

Multicentre, prospective, randomised, controlled trial.

Materials and Methods

From April 1991 to December 1997, 424 patients (471 fractures) with displaced intra-articular calcaneal fractures at 4 trauma centres were randomised to either operative or non-operative treatment. Patients were between fifteen and sixty-eight years old and had a fracture with >2mm displacement of the posterior facet on CT. Operative treatment consisted of open reduction and fixation by one of the 6 participating surgeons.

Patients were followed up at 2, 4, 6, 12 and 26 weeks, then at 1 and 2 years postoperatively. Patients completed a general health outcome form (SF-36) and a visual analogue scale at 1 and 2 years.

Results

Patients were followed up for 2-8 years. There was no difference in overall outcome between the two groups of patients. Patients not receiving Workers' Compensation ($p=0.001$) or females ($p=0.015$) had significantly higher satisfaction scores when managed operatively. Patients *not receiving* compensation had a better surgical outcome, compared to non-operative, if they met one of the following criteria:

- Young patients (<29y)
- Lower Bohlers angle (0 to 12 degrees)
- Comminuted fractures
- Light workload
- An anatomical reduction, or less than 2mm step-off

Patients managed conservatively were 5 times more likely to have further surgery in the form of a subtalar fusion

Conclusions

Stratification of patients through careful history and individual assessment shows that certain groups, particularly those not receiving compensation, have significantly better outcomes after open reduction and internal fixation of displaced intraarticular calcaneal fracture compared with non-operative management.

Study Critique**Strengths**

- Multicentred
- Randomised
- Power calculation, and subsequent amendment at interim analysis
- Large numbers
- Significant results even after stratification

Weaknesses

- Multiple p values, higher risk of spurious results
- Multicentre and 'multi surgeon' but 73% operations by lead author
- No comment on smoking, BMI and social circumstances
- No comment on radiological secondary degenerative change
- Fixation with variety of devices, no use of specific calcaneal plates

Clinical Relevance

This study can aid decision making when assessing suitability of patients for surgery. In terms of surgery, it highlights the importance of an anatomical reduction. It supports the use of the Sanders classification as an important tool in the assessment of the severity of the fracture. Sanders IV may be considered 'unreconstructable', with no improvement demonstrated after fixation. Primary subtalar fusion for these patients is an option for surgeons.

Compartment Monitoring in Tibial Fractures; the pressure threshold for decompression

M.M. McQueen, C..M. Court-Brown

J Bone Joint Surg [Br] 1996;78-B:99-104

Reviewer: Mr David Russell, StR 4, West of Scotland Rotation

Aim

Test the hypothesis that decompression should be performed when compartment pressure rises to within 30mmHg of the diastolic blood pressure.

Study Type

Prospective Cohort Study

Materials and Methods

116 patients admitted with diaphyseal tibial fractures underwent anterior compartment monitoring using a slit catheter. 100 Closed and 16 open fractures included in the study. 90 of the

116 were treated with IM nail, 15 external fixation, 7 plaster cast and 4 with plate and screws. Compartment pressure was recorded continuously on the observation chart along with other routine observations. The difference between diastolic and anterior compartment pressure (ΔP) was also noted. Mean follow-up 15 months (6-59), complications reported.

Results

In the first 12 hours of monitoring, mean compartment pressure was 30mmHg (range 5 to 55), and 25 (range 5 to 75) for the second 12 hour period.

There were three cases of acute compartment syndrome requiring fasciotomy. Compartment pressures for these patients were 45 mmHg, 65 mmHg and 75 mmHg. ΔP was 15 mmHg, 10 mmHg and 15 mmHg prior to fasciotomy. All of these patients had compartment pressures of 45 mmHg in the first 12 hours of monitoring. No patients had sequelae of compartment syndrome (e.g. contracture, nerve damage) at final review indicating no missed diagnoses. In the remaining patients, ΔP was found to have a statistically significant negative correlation with fracture grade. No significant difference in pressures was observed between open and closed fractures.

Conclusion

Absolute compartment pressures appear to be unreliable as an indicator for surgical decompression.

Had an absolute measure of 30 mmHg or 40 mmHg been used, as quoted in other studies, 43% and 23 % of patients respectively would have undergone unnecessary surgery.

Study Critique

Strengths

- Aim clearly stated
- Prospective
- Clear methodology adhered to
- Highlights importance of ΔP and effect of patient blood-pressure

Weaknesses

- A major weakness was the lack reporting of clinical findings to potentially correlate with ΔP and / or absolute pressure. Classic symptoms and signs of compartment syndrome are universally taught; an analysis on the correlation between pain and passive stretch test with compartment measurements would have provided additional useful information.
- No comparison / control group. For example a cohort of patients diagnosed clinically could have been run in parallel, with comparison of rates of surgical intervention and clinical outcome.

Clinical Relevance

This is a useful study targeting a difficult area in clinical diagnosis with potentially life threatening consequences. Use of ΔP , especially in reduced GCS patient, may aid in determining whether fasciotomy is required.

Reamed versus unreamed intramedullary nailing of the femur: Comparison of the rate of ARDS in Multiple Injured Patients

Canadian Orthopaedic Trauma Society
J Orthop Trauma 2006;20:384-87.

Reviewer: Mr James Fraser-Moodie StR 6, West of Scotland Rotation

Aim

Investigate if rates ARDS differed between patients randomised to reamed vs unreamed nails for femoral fractures.

Study design

Prospective, randomised, multicentre, clinical trial.

Method

315 adults with 322 femoral shaft fractures with time to surgery <24hrs, exclusion criteria included some high grade open fractures. Injury severity score (ISS) >18 used as definition for multiple injuries, with patients stratified in analysis accordingly. ARDS was diagnosed according to established criteria, and in addition arterial blood gas sampling was carried out pre- and post-operatively.

Results

3 patients in reamed group and 2 patients in unreamed group developed ARDS (no significant difference). There were 2 deaths in each group, not related to ARDS. 1 patient with an ISS <18 developed ARDS. 46 of the 147 patients treated with an unreamed nail had an ISS >18, compared to 63 of the 168 patients receiving a reamed nail. Neither the chest abbreviated injury score nor ISS were predictive for the development of ARDS.

Conclusion

No difference in ARDS rates if reamed or unreamed intramedullary nail used in acute femoral fractures.

Study Critique

Strengths

- Level 1 evidence
- Well-designed study with good volume femoral fractures
- Outcomes and conclusions clearly defined

Weaknesses

- No documentation regarding the number of patients not recruited, and the proportion excluded
- The exclusion of some specific high grade injuries could represent an important higher energy trauma patient group with a more severe initial insult and higher risk for ARDS
- Existing evidence suggests those with significant chest injury most at risk for ARDS. The authors commented that they found no link between chest trauma score and ARDS
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development, however the absolute number of patients with significant chest trauma, and the severity, was not given.

Clinical relevance

Provides evidence that choice of surgical technique for femoral nailing (reamed vs. unreamed) does not appear to influence development of ARDS in polytrauma patients. The only note of caution voiced, though not substantiated, is that there may still be a role for unreamed nails in selected patients with severe chest trauma as part of a “damage limitation” approach.

Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses

Gustilo RB, JT Anderson

J Bone Joint Surg [Am] 1976;58-A:453-8.

Reviewer: Andraay Hon-Chi Leung, StR 1, West of Scotland Rotation

Aim

To determine whether the following variables in treatment convey benefits when managing open fractures: primary versus secondary closure, use of primary internal fixation, and the use of antibiotics.

Study type

There were two studies in this paper: a retrospective study and a prospective study.

Materials and Methods

In the retrospective study, 673 fractures were identified over 14 years. 87% of these were followed-up for a minimum of one year. A standardised management protocol were followed which included debridement, irrigation, primary closure where possible and antibiotics post-operatively. Internal fixation was optional.

In the prospective study, 352 long bone open fractures were identified over 4 years. They were classified into Type I to III injuries. A standardised management protocol was followed, this included wound culture, peri-operative antibiotics, debridement and irrigation, and primary closure for Type I and II injuries.

Results

In the retrospective study, an overall of 6.5% of wounds became purulent, with *Staphylococcus aureus* being the commonest pathogen. Infection rate was much higher in those with internal fixation, and those with secondary closure. With regards to the injury, a higher rate of infection was associated with segmental fractures, extensive soft-tissue lacerations and traumatic amputation.

In the prospective study, most injuries were Type I and II (81%). The infection rate was 2.4%, and when compared with the retrospective study this was statistically significant reduction. Infection rate in Type III injuries were also lower than those in the retrospective study. 70% of subjects had positive wound swab cultures from time admission.

Conclusion

These studies demonstrated that Type I and II open fractures should undergo primary closure while Type III injuries should undergo delayed primary closure. Internal fixation should be avoided, and skeletal traction should be used for open fractures associated with arterial injury. Peri-operative antibiotics, in particular cephalosporins, should be administered.

Study Critique***Strengths***

- Clearly stated aims
- Large patient cohorts
- A standardised management protocol for each study which was largely adhered to

Weaknesses

- Management protocols were different between the studies
- Short follow-up period
- Data presentation was difficult to follow, and also some important data were not disclosed (e.g. number of Type III injuries in the retrospective study)

Clinical Relevance

This paper was written 30 years ago and much of the evidence has been superseded. However, it provides an interesting insight into the work of Gustilo and Anderson, which has since led to the open fracture classification system in their namesake.