2017 SPECIALTY DAY

MARCH 18, 2017 | SAN DIEGO, CALIFORNIA

Session I:
This Paper Will Change Your Practice – It Changed Mine. New Information That You Need to Know

7:30 am – 8:40 am

Moderators: Michael D. McKee, MD and Mohit Bhandari, MD, PhD, FRCSC

7:30 am – 7:37 am	FAITH Trial (Hip fracture) *Marc F. Swiontkowski, MD*
7:37 am – 7:42 am	Nonunion *Donald A. Wiss, MD*
7:42 am – 7:49 am	Elbow *David C. Ring, MD, PhD*
7:49 am – 7:56 am	Shoulder *Kyle J. Jeray, MD*
7:56 am – 8:03 am	Pelvis/Acetabulum *Paul Tornetta, III, MD*
8:03 am – 8:10 am	Ankle *Kenneth A. Egol, MD*
8:10 am – 8:17 am	Basic Science *Theodore Miclau, III, MD*
8:17 am – 8:40 am	Discussion

A Trial of Fracture Fixation in the Operative Management of Hip Fractures

Fixation using Alternative Implants for the Treatment of Hip fractures (F.A.I.T.H) Investigators*

*The Writing Committee members are as follows:

Mohit Bhandari (Chair), PJ Devereaux, Gordon Guyatt, Lehana Thabane, Stephen D. Walter, Martin J. Heetveld, Kyle J. Jeray, Susan Liew, Emil H. Schemitsch, Paul Tornetta III, Gregory J. Della Rocca, Richard E. Buckley, Robert McCormack, Todd M. Oliver, Michiel J.M. Segers, Amar Rangan, Martin Richardson, Sheila Sprague, Gerard P. Slobogean, Taryn Scott, Julie Agel, Alisha Garibaldi, Qi Zhou, Diane Heels-Ansdell, Helena Viveiros, Stephanie M. Zielinski, Esther M.M. Van Lieshout, Herman Johal, Birgit C. Hanusch, and Marc Swiontkowski.

The author affiliations are as follows:
Division of Orthopaedic Surgery, Department of Surgery (M.B. MD, S.S. PhD, H.J. MD), Department of Health Research Methods, Evidence, and Impact (M.B. MD, P.J.D MD, A.G. MSc, G.G. MD, D.H.A. MSc, T.S. MSW, S.S PhD, L.T. PhD, H.V. BSc, S.D.W. PhD, Q.Z. PhD), Department of Medicine (P.J.D. MD, G.G. MD), Population Health Research Institute (P.J.D. MD), McMaster University, Hamilton, ON, Department of Surgery (M.J.H. MD), Spaarne Gasthuis, Haarlem, The Netherlands, Department of Surgery (S.M.Z. MD, E.M.M.V.L. PhD), Erasmus MC, University Medical Center Rotterdam, Rotterdam, The Netherlands, Department of Orthopaedic Surgery (K.J.J. MD), Greenville Health System, Greenville, SC, Department of Orthopaedic Surgery (S.L. MBBS), The Alfred, Melbourne, VIC, Australia, Department of Surgery (E.H.S. MD), University of Western Ontario, London, ON, Department of Orthopaedic Surgery (P.T.III MD), Boston University School of Medicine, Boston, MA, Department of Orthopaedic Surgery (G.J.D.R. MD), Duke University, Durham, NC, Division of Orthopaedic Trauma Surgery (R.E.B. MD), Foothills Medical Centre, Calgary, AB, Department of Orthopaedic Surgery (R.M. MD), University of British Columbia, Vancouver, BC, Boone Hospital Center (T.M.O. MD), Columbia Orthopaedic Group, Columbia, MO, Department of Surgery (M.J.M.S. MD), St. Antonius Ziekenhuis, Utrecht, The Netherlands, Department of Orthopaedic Surgery (A.R. ChM, B.C.H. MRCS), The James Cook University Hospital, Middlesbrough, UK, Department of Surgery (M.R. FRACS), University of Melbourne, Melbourne, VIC, Australia, Department of Orthopaedics (G.P.S. MD), University of Maryland, Baltimore, MD, Department of Orthopaedic Surgery (J.A. MA, M.S. MD), University of Minnesota, Minneapolis, MN

Correspondence to:

Dr. Mohit Bhandari
Division of Orthopaedic Surgery, McMaster University
293 Wellington Street N. Suite 110,
Hamilton Ontario, Canada, L8L 8E7
bhandam@mcmaster.ca

ABSTRACT

Background

Reoperation rates are high after surgery for hip fractures. We investigated the effect of a sliding hip screw versus cancellous screws on the risk of reoperation and other key outcomes.

Methods

For this international, multicentre, allocation concealed randomised controlled trial, we enrolled patients aged 50 years or older with a low-energy hip fracture requiring fracture fixation from 81 clinical centres in eight countries. Patients were assigned by minimisation with a centralised computer system to receive a single large-diameter screw with a side-plate (sliding hip screw) or the present standard of care, multiple small-diameter cancellous screws. Surgeons and patients were not blinded but the data analyst, while doing the analyses, remained blinded to treatment groups. The primary outcome was hip reoperation within 24 months after initial surgery to promote fracture healing, relieve pain, treat infection, or improve function. Analyses followed the intention- to-treat principle. This study was registered with ClinicalTrials.gov, number NCT00761813.

Findings

Between March 3, 2008, and March 31, 2014, we randomly assigned 1108 patients to receive a sliding hip screw (n=557) or cancellous screws (n=551). Reoperations within 24 months did not differ by type of surgical fixation in those included in the primary analysis: 107 (20%) of 542 patients in the sliding hip screw group versus 117 (22%) of 537 patients in the cancellous screws group (hazard ratio [HR] 0·83, 95% CI 0·63–1·09; p=0·18). Avascular necrosis was more common in the sliding hip screw group than in the cancellous screws group (50 patients [9%] vs 28 patients [5%]; HR 1·91, 1·06–3·44; p=0·03. However, no significant difference was found between the number of medically related adverse events between groups (p=0·82; appendix); these events included pulmonary embolism (two patients [<1%] vs four [1%] patients; p=0·41) and sepsis (seven [1%] vs six [1%]; p=0·79).

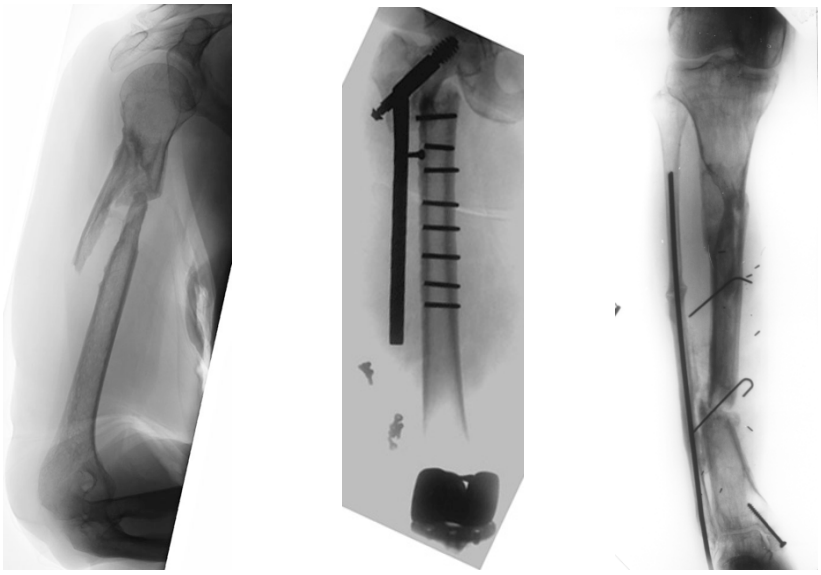
Interpretation

In terms of reoperation rates the sliding hip screw shows no advantage, but some groups of patients (smokers and those with displaced or base of neck fractures) might do better with a sliding hip screw than with cancellous screws.

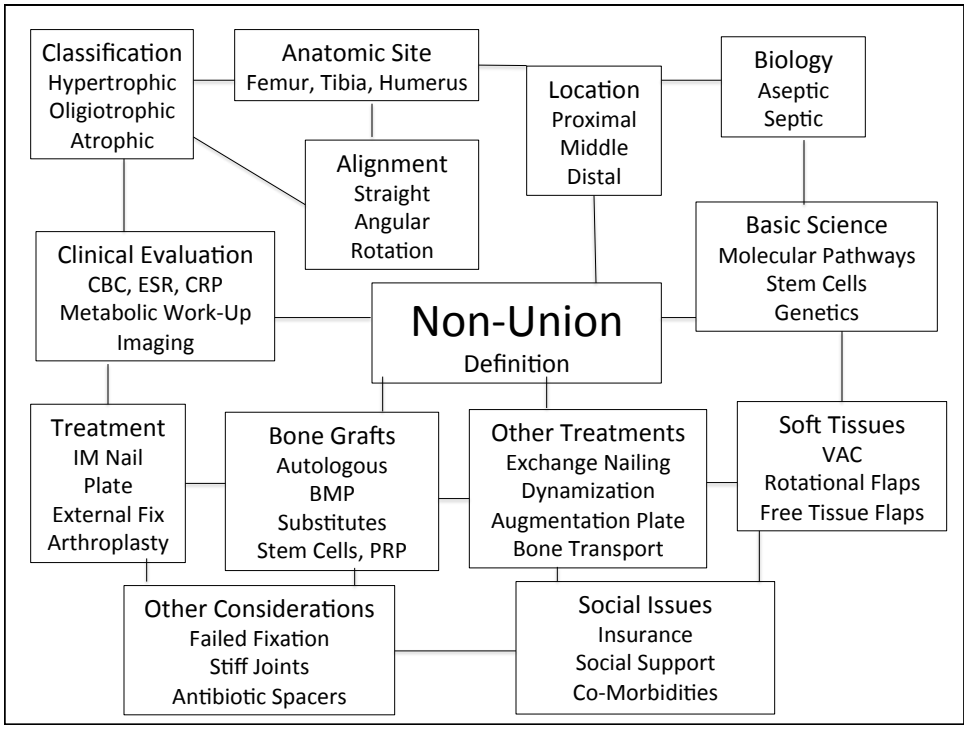
Funding

National Institutes of Health, Canadian Institutes of Health Research, Stichting NutsOhra, Netherlands Organisation for Health Research and Development, Physicians' Services Incorporated.

Non-Union Research That Will Impact Your Practice



Donald A Wiss Cedars-Sinai Medical Center Los Angeles, California



This Paper Will Change Your Practice: Elbow

David Ring MD PhD

Lindenhovius AL, Linzel DS, Doornberg JN, Ring DC, Jupiter JB. Comparison of elbow contracture release in elbows with and without heterotopic ossification restricting motion. J Shoulder Elbow Surg. 2007 Sep-Oct;16(5):621-5. PubMed PMID:17644008.

- Surgery for stiffness is MORE effective when there is heterotopic ossification restricting motion

Lindenhovius AL, Doornberg JN, Brouwer KM, Jupiter JB, Mudgal CS, Ring D. A prospective randomized controlled trial of dynamic versus static progressive elbow splinting for posttraumatic elbow stiffness. J Bone Joint Surg Am. 2012 Apr 18;94(8):694-700. doi: 10.2106/JBJS.J.01761. PubMed PMID: 22517385.

- No difference in splints
- Not clear that a splint is better than exercises on your own
- People improved for more than 12 months
- In the absence of HO, ulnar neuropathy, errant implants, malunion, etc. the capsule can be stretched

Teunis T, Bot AG, Thornton ER, Ring D. Catastrophic Thinking Is Associated With Finger Stiffness After Distal Radius Fracture Surgery. J Orthop Trauma. 2015 Oct;29(10):e414-20. PubMed PMID: 25866942.

- Protectiveness creates stiffness
- Not an elusive pathophysiology

Teunis T, Thornton ER, Guitton TG, Vranceanu AM, Ring D. Coaching of patients with an isolated minimally displaced fracture of the radial head immediately increases range of motion. J Hand Ther. 2016 Jul-Sep;29(3):314-9. doi:10.1016/j.jht.2016.02.003. PubMed PMID: 27496986.

- Coaching that stretching helps creates immediate gains in motion

1: Chan K, Faber KJ, King GJ, Athwal GS. Selected anteromedial coronoid fractures can be treated nonoperatively. J Shoulder Elbow Surg. 2016 Aug;25(8):1251-7. PubMed PMID: 27233484.
2: Desloges W, Faber KJ, King GJ, Athwal GS. Functional outcomes of distal humeral fractures managed nonoperatively in medically unwell and lower-demand elderly patients. J Shoulder Elbow Surg. 2015 Aug;24(8):1187-96. PubMed PMID: 26189804.
3: Chan K, MacDermid JC, Faber KJ, King GJ, Athwal GS. Can we treat select terrible triad injuries nonoperatively? Clin Orthop Relat Res. 2014 Jul;472(7):2092-9. PubMed PMID: 24549776; PubMed Central PMCID: PMC4048392.
4: Duckworth AD, Bugler KE, Clement ND, Court-Brown CM, McQueen MM. Nonoperative management of displaced olecranon fractures in low-demand elderly patients. J Bone Joint Surg Am. 2014 Jan 1;96(1):67-72. doi: 10.2106/JBJS.L.01137. PubMed PMID: 24382727.

- Selected distal humerus, elbow fracture-dislocations, and olecranon fractures can be treated nonoperatively

Dubberley JH, Faber KJ, Macdermid JC, Patterson SD, King GJ. Outcome after open reduction and internal fixation of capitellar and trochlear fractures. J Bone Joint Surg Am. 2006 Jan;88(1):46-54. PubMed PMID: 16391249.

- Beware the apparent capitellum fracture. It's often much more complex

HANDOUT COMING SOON

Injury, Int. J. Care Injured 47 (2016) 1569–1573

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Zone 2 sacral fractures managed with partially-threaded screws result in low risk of neurologic injury

Amir Herman [a,b,*], Emily Keener [a], Candice Dubose [a], Jason A. Lowe [a]

[a] The Orthopaedic Trauma Unit, Division of Orthopaedics, University of Alabama at Birmingham, United States
[b] Talpiot Medical Leadership Program, Sheba Medical Centre, Israel

ARTICLE INFO

Article history:
Accepted 9 April 2016

Keywords:
Trans-sacral screws
Sacroiliac screws
Partially threaded screws

ABSTRACT

Background: Zone 2 sacral fractures account for 34% of sacral fractures with reported neurological deficit in 21–28% of patients. The purpose of this study was to examine the risk factors for neurological injury in zone 2 sacral fractures. The authors hypothesized that partially thread iliosacral screws did not increase incidence of neurologic injury.

Methods: A retrospective review of consecutive patients admitted to a level 1 trauma center with zone 2 sacral fractures requiring surgery from September 2010 to September 2014 was performed. Patients were excluded if no neurologic exam was available after surgery. Fractures were classified according to Denis and presence/absence of comminution through the neural foramen was noted. Fixation schema was recorded (sacral screws or open reduction and internal fixation with posterior tension plate). Any change in post-operative neurological exam was documented as well as exam at last clinic encounter.

Results: 90 patients met inclusion criteria, with zone 2 fractures and post-operative neurological exam. No patient with an intact pre-operative neurologic exam had a neurological deficit after surgery. 86 patients (95.6%) were neurologically intact at their last follow-up examination. Four patients (4.4%) had a neurological deficit at final follow-up, all of them had neurological deficit prior to surgery. 81 patients were treated with partially threaded screws of which 1 (1.2%) had neurological deficit at final follow-up.

Fifty-seven fractures (63.3%) were simple fractures and 33 fractures (36.7%) were comminuted. All four patients with neurological deficit had comminuted fractures. The association between neurologic deficit in zone 2 sacral fracture and fracture comminution was found to be statistically significant (p-value = 0.016). No nonunion was observed in this cohort.

Conclusions: The use of partially threaded screws for zone 2 sacral fractures is associated with low risk for neurologic injury, suggesting that compression through the fracture does not cause iatrogenic nerve damage. The low rate of sacral nonunion can be attributed to compression induced by the use of partially threaded compression screws. There is a strong association between zone 2 comminution and neurologic injury.

Introduction

Sacral fractures occur in 23–45% of all pelvic ring injuries, and when found to be unstable, require operative stabilization [1–3]. Sacral fractures are classified according to Denis: extra foraminal (Zone 1), involving the neural foramina (Zone 2) or involving the neural canal (Zone 3) [3]. Zone 2 sacral fractures are reported to range between 34 and 47.5% of all sacral fractures. Denis originally described the influence of fracture zone on neurological deficit and prognosis, with zone 2 fractures characterized by injury to the L5 through lower sacral nerve roots. Other authors reported the incidence of neurologic damage to be as high as 21–28% of the patients with most patients recovering at least one functional level [4,5].

Several fixation methods for of zone 2 sacral fractures have been examined: posterior plating [6,7], triangular fixation using pedicular screws [8] and sacroiliac or trans-sacral screws [9–13]. Percutaneous fixation with trans-sacral or sacral screws has become a popular method of fixation owing to, low complication rates and good clinical outcomes [12,13]. In addition, the

* Corresponding author at: The University of Alabama at Birmingham, Department of Surgery, Division of Orthopaedic Spine and Trauma Faculty, Office Tower 901, 510, 20th Street South, Birmingham, AL 35294, United States.
E-mail address: amirherm@gmail.com (A. Herman).

http://dx.doi.org/10.1016/j.injury.2016.04.004
0020–1383/

biomechanical properties of the sacral screws show 80–85% return of pelvic biomechanical rigidity after instrumentation [14,15].

One potential concern with partially threaded screws is the potential for compression and narrowing of the neural foramen particularly through comminuted fractures, which may result iatrogenic neurologic injury [16,17]. Fully threaded screws represent an alternative to partially threaded screws as a means to avoid this potential complication [18,19].

The purpose of this study was to define the incidence of post-operative neurologic injury and identify risk factors for neurological deficit after zone 2 sacral fractures. The authors hypothesized that partially threaded posterior screws (trans-sacral, sacral) would not result in iatrogenic neurologic injury, and that fracture comminution through the neural foramen would predict injury-related neurologic compromise.

Methods

Following institution IRB approval, a retrospective review of all pelvic ring fractures and fracture dislocations fixed at a single level 1 trauma academic center from September 2010 to September 2014 was performed using CPT and ICD-9 codes. Patient inclusion criteria included: age > 18 years at the time of injury and closed zone 2 sacral fracture according to Denis. Exclusion criteria were: lack of neurological examination after surgery, patients that did not have neurologic examination prior to surgery and had a neurologic deficit after surgery, open fractures, and any patient transferred after fixation to an outside facility.

We extracted patient demographic data including age and gender; as well as injury profiles (mechanism of injury, abbreviated injury score (AIS) and the injury severity score (ISS)). Neurological status at arrival, first available neurologic exam after surgery and last clinical follow-up neurological examination were obtained from consult, post-operative, in-patient progress, and clinic notes, respectively. Further data collection included: comminuted vs simple fractures, the surgical intervention of open vs closed reduction, and posterior tension band plate fixation versus percutaneous screws, as well as screw type (partially threaded vs fully threaded), and screw number.

Neurologic deficit at final follow up was defined as motor strength of less than five (out of five) of the injured extremity.

Statistical analysis

Statistical analysis was performed by an experienced biostatistician (A.H.) using SPSS © 23.0 (Chicago, IL, USA). Categorical data are presented as count (percent). Continuous data are presented as mean (±standard deviation). The data were divided to patients with intact and deficient neurological examination at final follow-up. All the collected variables were compared between these two study groups. Comparisons between continuous variables were done by the Wilcoxon–Mann–Whitney rank sum test. Comparisons between categorical data were done with chi-square test or the Fisher exact test. The later test was used if expected count was less than five in any cell. All *p*-values reported are two-sided.

Results

Initial data review included 100 patients with zone 2 sacral fractures. After reviewing the patients' data, seven patients were excluded because of lack of neurological examination at follow-up. These included one patient that died shortly after admission, five patients that were transferred intubated and followed at another hospital and one patient that had an above knee amputation the same side as the sacral fracture. Three additional patients were excluded because they did not have a neurological examination prior to surgery and had a neurologic deficit after surgery.

The study population included 90 patients, mean age was 39.10 (±15.03). Of the 90 patients, 36 patients (40.0%) were male and 54 patients (60.0%) were female. The most common cause of injury was motor vehicle accident – 52 patients (57.8%) followed by fall from height – 12 patients (13.3%). There was no statistically significant difference in the demographic characteristics between neurologically intact and deficient patients (Table 1).

Of the 90 patients, 86 (95.6%) had no neurological deficit at any time point. Four patients (4.4%) had a neurological deficit at final follow-up. None of the four patients with final neurological deficit had an intact examination at time of admission. These four patients presented with weak but present initial motor exam defined as 2–3/5 motor strength in the tibialis anterior, extensor hallucis longus, flexor hallucis longus or gastrocnemius–soleus complex. No patient presenting with an initially intact neurologic exam developed a neurologic deficit following operative fixation (Table 2).

Table 1
Demographic and injury related data.

	Neurologically intact PostOp (*N* = 86)	Neurological deficit PostOp (*N* = 4)	*P*-value
Age	39.21 (±15.22)	36.75 (±10.43)	0.887
Gender			
Male	34 (39.5%)	2 (50.0%)	
Female	52 (60.5%)	2 (50.0%)	0.676
Mechanism of injury			
Assault	1 (1.2%)	00 (00%)	
Crush Injury	5 (5.8%)	00 (00%)	0.931
Fall from height	12 (14.0%)	00 (00%)	
Fall from horse	2 (2.3%)	00 (00%)	
MCC	5 (5.9%)	00 (00%)	
MVC	48 (55.8%)	4 (100.0%)	
Pedestrian vs MV	10 (11.6%)	00 (00%)	
Tornado	3 (3.5%)	00 (00%)	
AIS–Abdomen	2.38 (±0.61)	3.33 (±1.53)	0.226
AIS–Extremities	3.02 (±0.88)	3.25 (±0.96)	0.595
AIS–Injury severity score	22.34 (±10.62)	30.5 (±8.34)	0.087

AIS = Abbreviated Injury Score; MVC = Motor vehicle collision; MCC = motor cycle collision; MV = motor vehicle.

Table 2
Pelvic injury and surgery related data.

	Neurologically intact PostOp (*N* = 86)	Neurological deficit PostOp (*N* = 4)	*P*-value
Side of zone 2 fracture			
Left	42 (48.8%)	2 (50.0%)	
Right	33 (38.4%)	2 (50.0%)	0.886
Bilateral	11 (12.8%)	0 (00.0%)	
Fracture pattern			
Simple	57 (66.3%)	0 (0.0%)	
Comminuted	29 (33.7%)	4 (100.0%)	0.016
Fixation method			
ORIF and plate	5 (5.8%)	2 (50.0%)	
CRPP and screw	81 (94.2%)	2 (50.0%)	0.001
Type of screws			
Sacroiliac screws	35 (43.2%)	0 (00.0%)	
Trans-sacral screws	46 (56.8%)	2 (100.0%)	0.506
Number of screws			
1 screw	48 (59.3%)	2 (100.0%)	
2 screws	25 (30.9%)	0 (00.0%)	0.717
3 screws	5 (6.2%)	0 (00.0%)	
4 screws	3 (3.7%)	0 (00.0%)	
Type of screw threads			
Partially threaded	80 (98.8%)	1 (50.0%)	
Fully threaded	1 (1.2%)	1 (50.0%)	0.049

Table 3
Neurological examination of patients with neurological deficit.

	First available examination				Last follow-up examination			
	TA	EHL	FHL	GS	TA	EHL	FHL	GS
Patient 1	3	3	4	4	4	1	5	5
Patient 2	2	2	NA	NA	2	2	5	5
Patient 3	3	NA	NA	3	4	1	4	5
Patient 4	3	3	3	3	4	4	4	4

NA = Not available. TA = Tibialis anterior, EHL = Extensor hallucis longus, FHL = Flexor hallucis longus, GS = Gastrocnemius-Soleus.

Of the four patients with deficit at final follow-up all had Tibialis Anterior (TA) and extensor halucis longus (EHL) motor strength of less than five (out of five). Two patients had either flexor hallucis longus or Gastrocnemius-soleus complex with strength of four or less (of five). One patient also experienced a sensory deficit. Most patients had some recovery of their initial examination (see Table 3).

Correlation of associated injuries and neurologic deficit after sacral fracture was performed using the abbreviated injury score (AIS, Table 1). For the entire patient cohort the mean AIS – abdomen was 2.43 (±0.689). The mean ISS for the entire patient cohort was 22.72 (±10.63). There was a statistical trend for higher ISS in neurologically deficient patients (p-value = 0.087).

Fifty seven patients (66.3%) had simple pattern fractures (Fig. 1) and 33 patients (36.7%) had comminuted fractures (Fig. 2). All four patients with neurological deficit had a comminuted fracture pattern. Of the 86 patients without neurological deficit, 29 patients (33.7%) and 57 (66.3%) had comminuted or simple fracture patterns, respectively. The association between comminuted fractures and neurological deficit was found to be statistically significant. (p-value = 0.016, Table 2).

Of patients with comminuted fracture those with neurological deficit were more commonly fixed open reduction and internal plate fixation (two patients 50.0%) than patients that were neurologically intact (five patients, 5.8%). This difference was found to be statistically significant (p-value = 0.001).

Sacroiliac screws alone were used to fix the sacral fractures of 35 patients (42.16%). In 48 patients (58.84%), trans-sacral screws were used for fracture fixation, either combined with sacroiliac screws or as sole fixation. No statistically significant difference was found between these two groups (p-value = 0.506, see Table 2). Percutaneous screw fixation was performed in 83 patients and partially threaded screws were used in 81 (97.6%) of these. Only one (1.2%) of these 81 patients had neurological deficit at final follow-up, but this deficit was present pre-operatively. There were no nonunions recorded in this cohort.

Discussion

The data presented supports a higher incidence of neurologic injury with comminuted zone II fractures than simple fractures. Surgical fixation with partially threaded sacral and trans-sacral screws did not result in iatrogenic neurologic injury even in communited fractures.

Previous works described the incidence of neurological injury after sacral fractures to be as high as 21–28% [2,5]. The most common injury pattern described was a sensory-motor deficit [5]. Zone 2 sacral fractures are mostly associated with sciatic-like nerve injury and drop-foot – injury to the L5-S1 nerve roots. In this series, the incidence of neurologic injury (4.4%) is lower than previously reported.

It has been reported that all patients show improvement of at least one grade of muscle function and 53% have complete

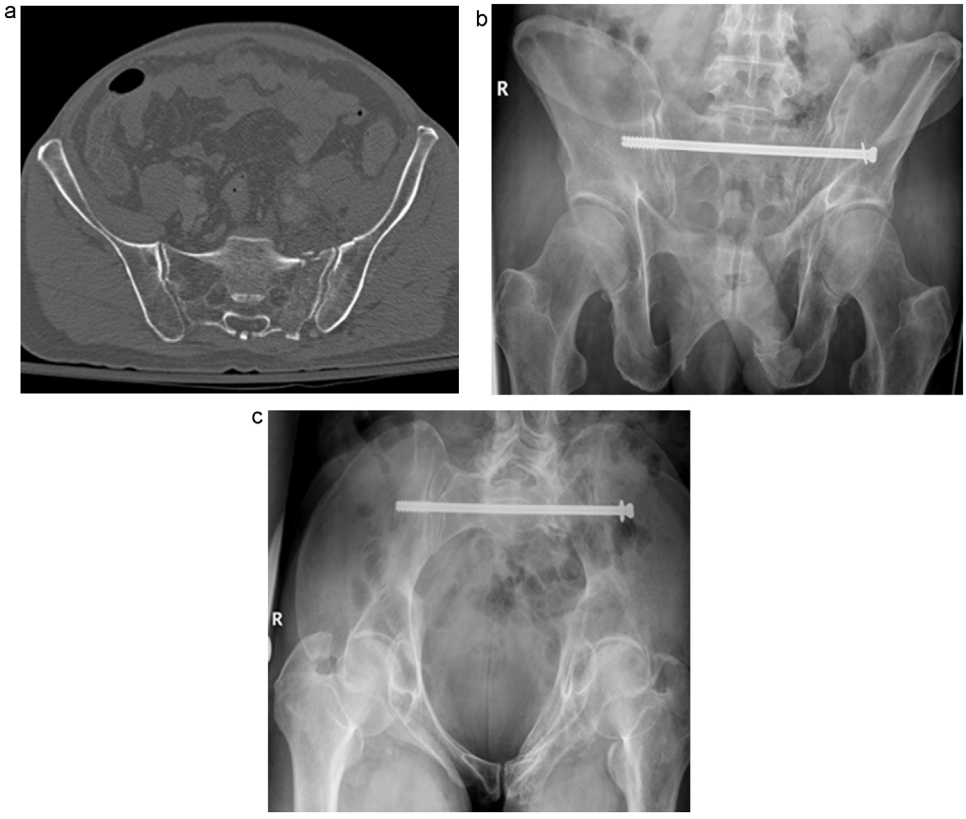


Fig. 1. A CT of a 54-year-old male that was injured falling from 10 feet. He had a zone two simple fracture – the foraminal involvement was not comminuted although some comminution exists in zone 1. He was treated by closed reduction and internal fixation using a transacral screw that produced fixation. (b) (c) present the six months follow-up pelvis outlet and inlet x-rays. Both compression across the fracture and union can be seen. At this time, he is neurologically intact and pain free.

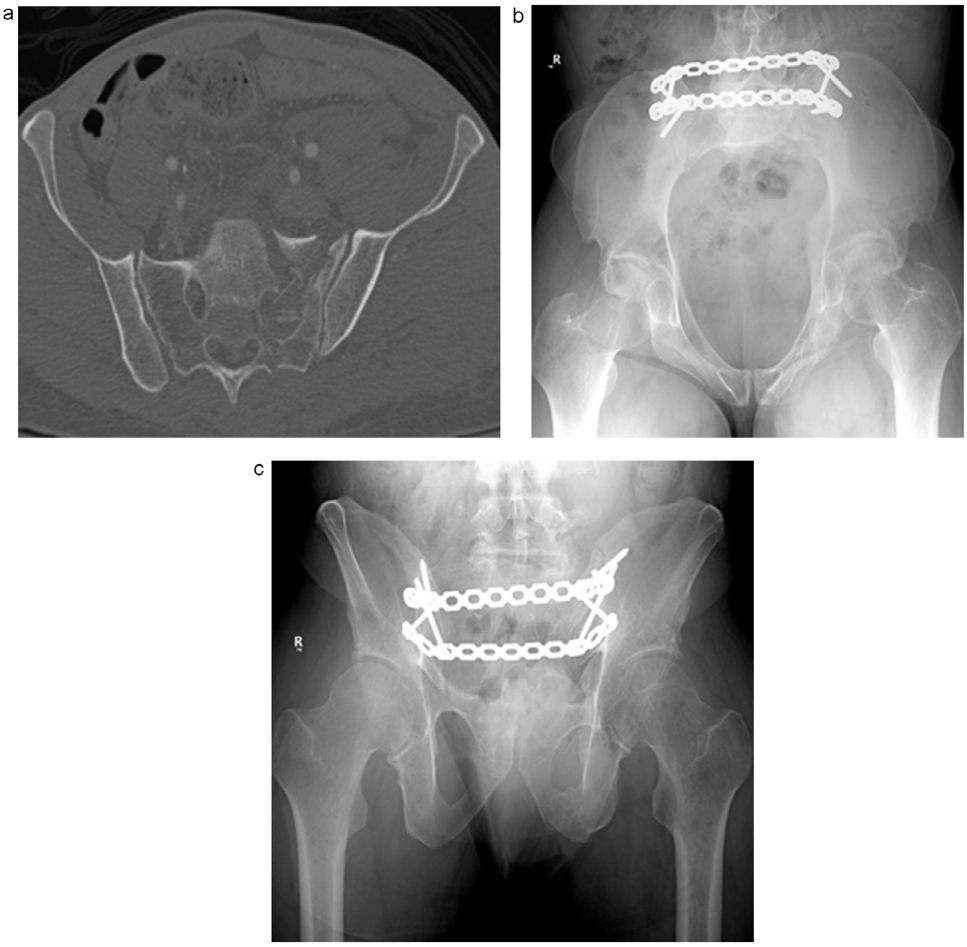


Fig. 2. A 39-year-old male that was injured in a motor vehicle collision. (a) an axial CT in which the comminution involves the neural foramin can be seen with a fragment in the foramina. He initially presented with motor function of three out of five in TA, EHL, FHL and GS. He was treated by open reduction, decompression laminectomy and internal fixation by two tension bands. (b) and (c) presents his inlet and outlet pelvis x-ray at 1 year follow-up. He recovered to four out of five in TA, EHL, FHL and GS but remained 0/5 in peroneal strength.

neurological recovery [5]. In our patient, cohort one patient had neurological recovery and that after he had sacral laminectomy and decompression during his open reduction and internal fixation (Fig. 2).

Vaccaro et al. and Routt et al. have suggested that zone 2 sacral fractures should be fixed using fully threaded sacral screws to avoid neuroforaminal compression generated by partially threaded screws and resultant iatrogenic nerve injury [16,17]. Concise scientific study of this assertion is lacking. Data presented in this cohort does not support these prior concerns as no patient with comminution developed a postoperative neurologic injury. Additionally, this series supports that surgical stabilization with partially threaded sacral and trans-sacral screws yielded 100% union rate.

Min et al. reported on 35 patients with Zone 2 sacral fractures that were treated with partially threaded sacral screws. They did not find any new neurological deficit that could be attributed to the compression screws [20]. They did not study other risk factors such as comminution and they had a small cohort of 35 patients that had Zone 2 sacral fracture.

Our data suggest that neurologic deficit is injury related and that it depends on the comminution of the fracture that is determined at injury. Strengthening this conclusion is the fact that neurologically injured patients had higher scores of abdomen AIS and ISS. This suggests that these were more severely injured patients. We did not recognize a single patient that had an intact neurological examination upon admission and had a neurological deficit after surgery.

Our study has several drawbacks; the first is that it is a retrospective study based on clinical records some of which some records might be incomplete or biased. Several patients were intubated upon arrival which makes it impossible to determine their neurological status at arrival. However, intubation upon arrival is inherent to a population of severely injured patients at a referral trauma center. These patients cannot be excluded if a true representation of the sacral fracture population is to be considered.

Further studies are required to confirm our results. More specifically, we would be interested in a randomized trail comparing the results between partially threaded and fully threaded screws, focusing both on neurologic status and union rate after surgical fixation of zone 2 sacral fractures.

Conflicts of interest

None declared.

References

[1] Gansslen A, Pohlmann T, Paul CH, Lobenhoffer PH, Tscherne H. Epidemiology of pelvic ring injuries. Injury 1996;27(Supp 1):13–20.
[2] Mehta S, Auerbach J, Born C, Chin K. Sacral fractures. J Am Acad Orthop Surg 2006;14:656–65.
[3] Denis F, Davis S, Comfort T. Sacral fractures: an important problem. Retrospective analysis of 236 cases. Clin Orthop Rel Res 1988;227:67–81.
[4] Gibbons K, Soloniuk D, Razack N. Neurological injury and patterns of sacral fractures. J Neurosurg 1990;72:889.

[5] Reilly M, Zinar D, Matta JM. Neurologic injuries in pelvic ring fracture. Clin Orthop Rel Res 1996;329:28–36.
[6] Pohlemann T, Angst M, Schneider E, Ganz R, Tscherne H. Fixation of transforaminal sacrum fractures a biomechanical study. J Ortho Trauma 1993;7(3):107–17.
[7] Suzuki T, Hak D, Ziran B, Adams S, Stahel PF, Morgan SJ, et al. Outcome and complications of posterior transiliac plating for vertically unstable sacral fractures. Injury 2009;40:405–9.
[8] Sagi C, Militano U, Caron T, Lindvall E. A comprehensive analysis with minimum 1-year, follow-up of vertically unstable transforaminal sacral fractures treated with triangular osteosynthesis. J Ortho Trauma 2009;23(5):313–21.
[9] Gardner MJ, Morshed S, Nork SE, Ricci WM, Rout ML. Quantification of the upper and second sacral segment safe zones in normal and dysmorphic sacra. J Ortho Trauma 2010;24(10):622–9.
[10] Rout ML, Simonian PT, William J. Iliosacral screw fixation: early complications of the percutanous technique. J Ortho Trauma 1997;11(8):584–9.
[11] Rout Ml, Nork SE, Mills WJ. Percutaneous fixation of pelvic ring disruption. Clin Orthop Rel Res 2000;375:15–29.
[12] Gardner MJ, Routt ML. Transiliac–transsacral screws for posterior stabilization. J Ortho Trauma 2011;25(6):378–84.
[13] Templeman D, Schmidt A, Freese J, Weisman I. Proximity of Iliosacral screws to neurovascular structures after internal fixation. Clin Orthop Rel Res 1996;329:194–8.
[14] Comstock CP, van der Meulen MCH, Goodman SB. Biomechanical comparisons of posterior internal fixation techniques for unstable pelvic, fractures. J Ortho Trauma 1996;10(8):517–22.
[15] Yinger K, Scalie J, Olson SA, Bay BK, Finkemeier CG. Biomechanical comparison of posterior pelvic ring fixation. J Ortho Trauma 2003;17(7):481–7.
[16] Vaccaro AR, Kim DH, Brodke DS, Harris M, Chapman JR, Schildhauer T, et al. Diagnosis-and-managemetn-of-sacral-spine-fractures. Instr Course Lect 2004;53:375–85.
[17] Routt ML, Simonian T, Wiss DA. Posterior pelvic ring disruptions: iliosacral screws. In master techniques in orthopaedic surgery, factures. Philadelphia: Lippincott Raven Publishers; 1998. p. 595–612.
[18] Keating JF. Early fixation of the vertically unstable pelvis: the role of iliosacral screw fixation of the posterior lesion. J Ortho Trauma 1999;13(2):107–33.
[19] Reilly MC, Bono CM, Litkouhi B, Sirkin M, Behrens FF. The effect of sacral fracture malreduction on the safe placement of iliosacral screws. J Ortho Trauma 2003;17(2):88–94.
[20] Min W, Chambers M, Leslie MP, Lee MA, Ferguson TA. The clinical efficacy of compressive transacral screw fixation for unstable pelvic ring injuries. In: Orthopaedic Trauma Association conference; 2011. presented paper #42.

This Paper Will Change Your Practice, It Changed Mine: New Information That You Need to Know
OTA Specialty Day March

Kenneth A. Egol, M.D.

NYU Langone MEDICAL CENTER

Hospital for Joint Diseases • Department of Orthopaedic Surgery

I (and/or my co-authors) have something to disclose.

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Closed Contact Casting Vs Surgery for Initial Treatment of Unstable Ankle Fractures in Older Adults: Arandomized Clinical Trial

- Randomized Clinical Trial
- Published IN JAMA
- Took place at 24 centers in the UK

Research

JAMA | Original Investigation

Close Contact Casting vs Surgery for Initial Treatment of Unstable Ankle Fractures in Older Adults

A Randomized Clinical Trial

Keith Willett, MB,BS, FRCS; David J. Keene, DPhil; Dipesh Mistry, PhD; Julian Nam, MSc; Elizabeth Tutton, PhD; Robert Handley, FRCS; Lesley Morgan; Emma Roberts; Andrew Briggs, DPhil; Ranjit Lall, PhD; Timothy J. S. Chesser, FRCS; Ian Pallister, FRCS; Sarah E. Lamb, DPhil; for the Ankle Injury Management (AIM) Trial Collaborators

IMPORTANCE Ankle fractures cause substantial morbidity in older persons. Surgical fixation is the contemporary intervention but is associated with infection and other healing complications.

OBJECTIVE To determine whether initial fracture treatment with close contact casting, a molded below-knee cast with minimal padding, offers outcome equivalent to that with immediate surgery, with fewer complications and less health resource use.

DESIGN, SETTING, AND PARTICIPANTS This was a pragmatic, equivalence, randomized clinical trial with blinded outcome assessors. A pilot study commenced in May 2004, followed by multicenter recruitment from July 2010 to November 2013; follow-up was completed May 2014. Recruitment was from 24 UK major trauma centers and general hospitals. Participants were 620 adults older than 60 years with acute, overtly unstable ankle fracture. Exclusions were serious limb or concomitant disease or substantial cognitive impairment.

INTERVENTIONS Participants were randomly assigned to surgery (n = 309) or casting (n = 311). Casts were applied in the operating room under general or spinal anesthesia by a trained surgeon.

MAIN OUTCOMES AND MEASURES The primary 6-month, per-protocol outcome was the Olerud-Molander Ankle Score at 6 months (OMAS; range, 0-100; higher scores indicate better outcomes and fewer symptoms), equivalence prespecified as ±6 points. Secondary outcomes were quality of life, pain, ankle motion, mobility, complications, health resource use, and patient satisfaction.

RESULTS Among 620 adults (mean age, 71 years; 460 [74%] women) who were randomized, 593 (96%) completed the study. Nearly all participants (579/620; 93%) received allocated treatment; 52 of 275 (19%) who initially received casting later converted to surgery, which was allowable in the casting treatment pathway to manage early loss of fracture reduction. At 6 months, casting resulted in ankle function equivalent to that with surgery (OMAS score, 66.0 [95% CI, 63.6-68.5] for surgery vs 64.5 [95% CI, 61.8-67.2] for casting; mean difference, −0.6 [95% CI, −3.9 to 2.6]; *P* for equivalence = .001). Infection and wound breakdown were more common with surgery (29/298 [10%] vs 4/275 [1%]; odds ratio [OR], 7.3 [95% CI, 2.6-20.2]), as were additional operating room procedures (18/298 [6%] for surgery and 3/275 [1%] for casting; OR, 5.8 [95% CI, 1.8-18.7]). Radiologic malunion was more common in the casting group (38/249 [15%] vs 8/274 [3%] for surgery; OR, 6.0 [95% CI, 2.8-12.9]). Casting required less operating room time compared with surgery (mean difference [minutes/participant], −54 [95% CI, −58 to −50]). There were no significant differences in other secondary outcomes: quality of life, pain, ankle motion, mobility, and patient satisfaction.

CONCLUSIONS AND RELEVANCE Among older adults with unstable ankle fracture, the use of close contact casting compared with surgery resulted in similar functional outcomes at 6 months. Close contact casting may be an appropriate treatment for such patients.

TRIAL REGISTRATION isrctn.com Identifier: ISRCTN04180738

JAMA. 2016;316(14):1455-1463. doi:10.1001/jama.2016.14719

Editorial page 1451

Supplemental content

CME Quiz at jamanetworkcme.com

Author Affiliations: Author affiliations are listed at the end of this article.

Group Information: The Ankle Injury Management (AIM) Trial Collaborators members are listed at the end of this article.

Corresponding Author: Keith Willett, MB,BS, FRCS, Kadoorie Centre for Critical Care Research and Education, Level 3, John Radcliffe Hospital, Oxford, OX3 9DU, United Kingdom (keith.willett@nhs.net).

Design

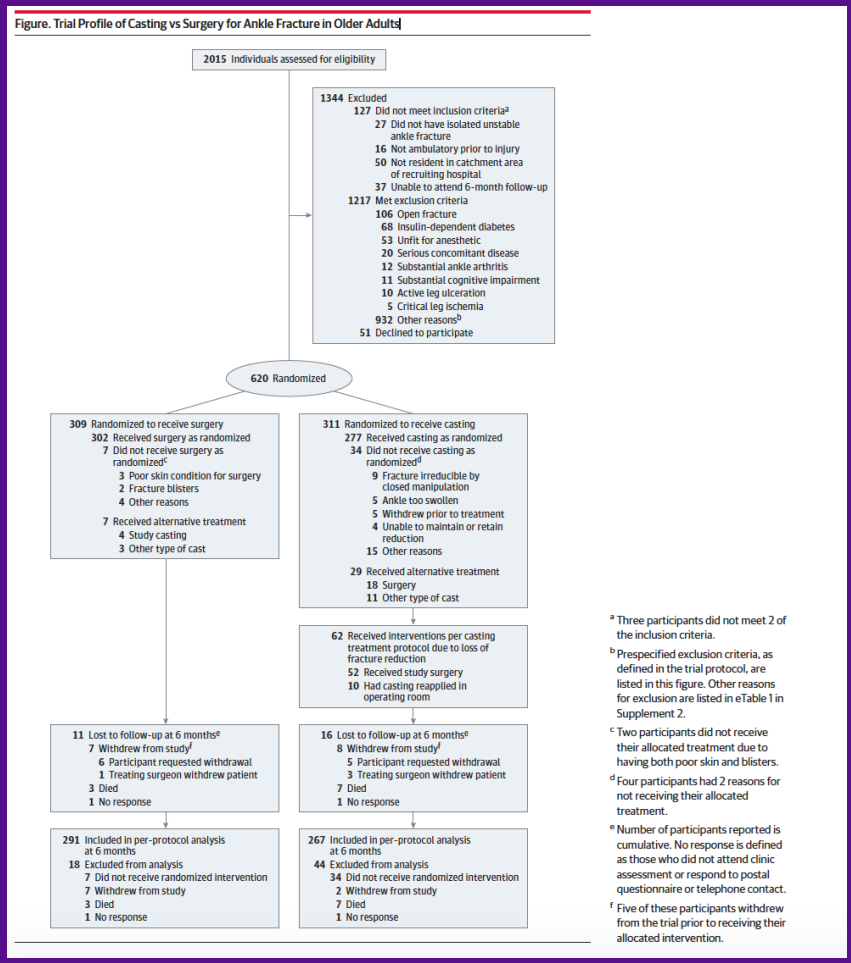
- Patients over 60
- Randomized to receive cast or surgery
  - Via telephone 24 hrs a day
- 6 week assessments not blinded all others were
- Min 6 months FU

Intervention

- ORIF
  - Standard Principles
  - Post op care per surgeon
- Close Contact Cast
  - IN OR under anesthesia
  - Specific protocol
  - All had 1 hour training session

Outcomes

- 620 patients randomized
  - Over 300 in each group
- Follow up at 6 weeks and 6 months
- Olerud -Molander Score
- SF-12
- Euro-Quol 5
- Pain from subscales of OM



Outcomes

- Patient reported time to WB
- Timed get up and go test at 6 mos
- Radiographic
  - Union
  - Ankle mortise

- Complications recorded

Results

- Baseline demos demonstrated equivalent groups
- 19% of casted patients were converted to ORIF due to loss of reduction
- 4% re-casted (second anesthetic)

Table 1. Baseline Demographic and Clinical Characteristics of Randomized Participants by Treatment Group

Characteristic	Surgery (n = 309)	Casting (n = 311)
Age, mean (SD), y	69.8 (6.9)	71.4 (7.6)
Sex, No. (%)		
Male	82 (26.5)	78 (25.1)
Female	227 (73.5)	233 (74.9)
Ankle fracture classification, No. (%)		
Infrasyndesmotic/trans-syndesmotic	272 (88.0)	270 (86.8)
Suprasyndesmotic	37 (12.0)	41 (13.2)
Olerud-Molander Ankle Score, preinjury, mean (SD)[a,b]	89.8 (17.0)	87.7 (17.7)
SF-12 mental score preinjury, mean (SD)[a,c]	53.7 (8.1)	54.5 (7.5)
Missing data	2	0
SF-12 physical score preinjury, mean (SD)[a,c]	51.2 (8.8)	49.6 (10.3)
Missing data	2	0
EQ-5D score preinjury, mean (SD)[a,d,e]	0.91 (0.16)	0.87 (0.19)
Missing data	31	30
EQ-5D score day of randomization, mean (SD)[d,e]	0.04 (0.26)	0.07 (0.26)
Missing data	49	47
Mini-Mental State Examination score, mean (SD)[d]	28.2 (2.1)	27.9 (2.3)
Missing data	32	31
Medical history, No. (%)		
Heart disease	38 (12.3)	44 (14.1)
Hypertension	126 (40.8)	140 (45.0)
Asthma/chronic obstructive pulmonary disease	46 (14.9)	39 (12.6)
Non-insulin-dependent diabetes	31 (10.0)	26 (8.4)
Parkinson disease	0	0
Epilepsy	4 (1.3)	5 (1.6)
Renal disease	5 (1.6)	7 (2.3)
Liver disease	2 (0.7)	4 (1.3)
Cerebrovascular accident/transient ischemic attack	14 (4.5)	21 (6.8)
Peptic ulcer	5 (1.6)	13 (4.2)
Malignancy	37 (12.0)	36 (11.7)
Venous thromboembolism	10 (3.2)	19 (6.2)
Osteoarthritis	84 (27.2)	100 (32.4)
Rheumatoid arthritis	12 (3.9)	14 (4.5)
Depression	35 (11.3)	38 (12.3)
Dementia	1 (0.3)	0
Current smoker, No. (%)	25 (8.1)	32 (10.4)
Alcohol consumption per week, median (IQR), units[f]	4 (0-45)	2 (0-42)
Admitted from own home, No. (%)	302 (97.7)	297 (96.0)
No walking aid used before injury, No. (%)	271 (87.7)	258 (83.5)

Abbreviations: EQ-5D, EuroQol 5 dimensions questionnaire; IQR, interquartile range; SF-12, 12-Item Short Form Health Survey.

[a] Participants recalled preinjury status.

[b] Range 0-100, with higher scores indicating better ankle function.

[c] Range 0 to 100, with higher scores indicating better functioning.

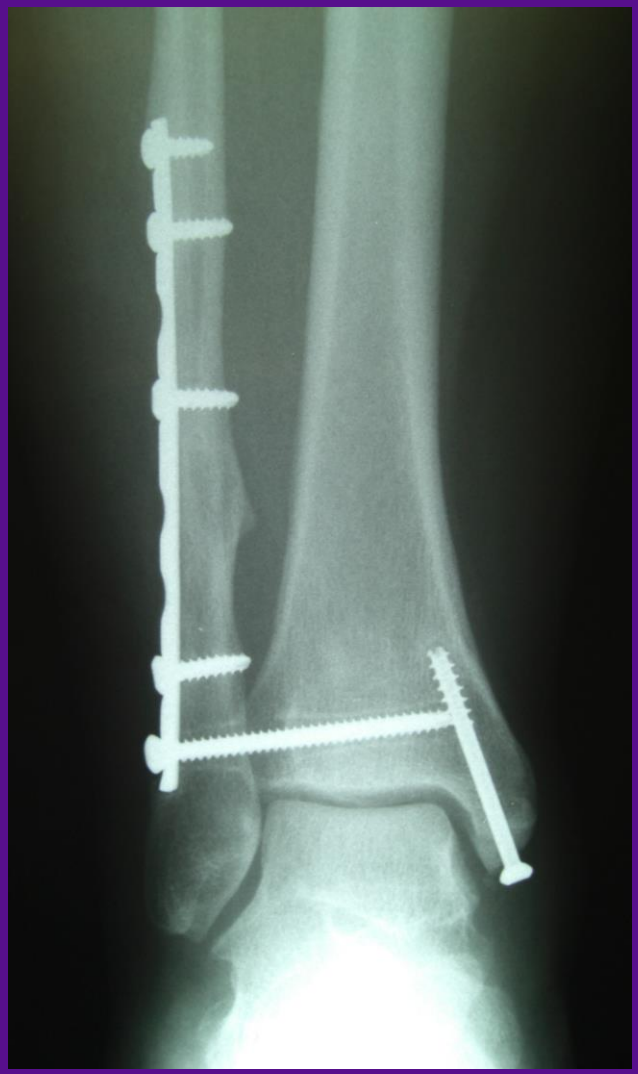
[d] The majority of missing scores relate to early study participants before the measure's being introduced.

[e] Range typically from 0 (death) to 1 (perfect health); negative scores can be obtained, reflective of a patient's quality of life being worse than death.

[f] One unit of alcohol in the United Kingdom is 10 mL, or 8 g of pure alcohol. Equivalent public estimates are 250 mL of beer, 76 mL of wine, and 25 mL of whisky.

Results

- At 6 months successfully casted and ORIF had equivalent outcomes
- 10% of ORIF patients had a wound problem or infection (1% in cast)



Limitations

- 6 months follow up
- Definition of Older?
- Learning curve to casting
- Ankle fractures are a wide range of injury
- A reduced mortise at healing is the key- not new

So Why is it Important?

- Provides level 1 evidence to what we know
- Provides treating surgeons with information to discuss with patients and families
- Provides cover from malpractice attorneys

Conclusion

- In properly selected older patients with unstable ankle fractures
- Casting with a reduced ankle mortise can be successful 75% of the time
- If this treatment is chosen, patients need close follow up

Thank You

This Paper Will Change Your Practice – It Changed Mine. New Information That You Need to Know: Basic Science

Theodore Miclau, MD
Department of Orthopaedic Surgery, University of California, San Francisco
UCSF/ZSFG Orthopaedic Trauma Institute, San Francisco, USA

The burden of musculoskeletal disease has surpassed cardiovascular disease as the major health burden in the world, and bone fractures contribute substantially to the overall burden of musculoskeletal disease. In the US, there are over 600,000 fractures per year with a substantial number of these fractures exhibiting delayed healing or non-union. The gold standard to stimulate bone union been autologous bone grafting, which although generally good, remains problematic due to limited graft supply, donor site morbidity, and potential complications. Therefore, understanding mechanisms of normal fracture healing to develop effective therapies to treat patients is imperative.

Generally, fracture repair occurs through two processes: direct bone (intramembranous ossification) and the formation of bone through a cartilage intermediate (endochondral ossification). With the exception of an initial inflammatory process, adult healing is similar to that observed during bone development. Previous work suggested that in adult repair, stem cells in the periosteum and endosteum give rise to chondrocytes that form the soft callus during endochondral ossification, and subsequently, during vascular invasion of the cartilage callus, osteoprogenitor cells are delivered to the fracture site to form new bone.

Recent findings, however, challenge this assumption. This presentation will summarize an article (Hinton et al., 2017) that reviews data suggesting that suggests that a significant number of bone cells are derived directly from the transformation of chondrocytes. They discuss other recent findings that show demonstrate this concept (see other references below).

These finding are potentially paradigm-shifting. Traditionally, strategies for stimulating bone repair seek to stimulate the process of direct bone formation. However, given that the majority of long bone fractures heal with some degree of callus formation (with the exception of those treated with absolute stability) and bone is formed directly through the transformation of chondrocytes, successful fracture repair therapies might target the endochondral rather than intramembranous ossification process. These findings have the potential to affect the way fracture healing, bone incorporation, and bone tissue engineering strategies are developed and employed.

Reference:

Hinton RJ, Jing Y, Jing J, Feng JQ. Roles of Chondrocytes in Endochondral Bone Formation and Fracture Repair. J Dent Res. 2017 Jan;96(1):23-30. doi: 10.1177/0022034516668321.

Other references:

1) Yang, L., et al., Hypertrophic chondrocytes can become osteoblasts and osteocytes in endochondral bone formation. Proceedings of the National Academy of Sciences of the United States of America, 2014. 111(33): p. 12097-102.

2) Yang, G., et al., Osteogenic fate of hypertrophic chondrocytes. Cell Res, 2014. 24(10): p. 1266-9.
3) Zhou, X., et al., Chondrocytes transdifferentiate into osteoblasts in endochondral bone during development, postnatal growth and fracture healing in mice. PLoS Genet, 2014. 10(12): p. e1004820.
4) Bahney CS, Hu DP, Taylor AJ, Ferro F, Britz HM, Hallgrimsson B, Johnstone B, Miclau T, Marcucio RS. 2014. Stem cell-derived endochondral cartilage stimulates bone healing by tissue transformation. J Bone Miner Res. 29(5):1269–1282.
5) Jing, Y., et al., Chondrocytes Directly Transform into Bone Cells in Mandibular Condyle Growth. J Dent Res, 2015. 94(12): p. 1668-75.
6) Park, J., et al., Dual pathways to endochondral osteoblasts: a novel chondrocyte-derived osteoprogenitor cell identified in hypertrophic cartilage. Biol Open, 2015. 4(5): p. 608-21.