Managing type II and type IV Lauge-Hansen supination external rotation ankle fractures: current orthopaedic practice

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ABSTRACT

INTRODUCTION Differentiating supination external rotation (SER) type II and IV ankle injuries is challenging in the absence of a medial malleolar fracture or talar shift on radiographs. The accurate differentiation between a stable SER-II from an unstable SER-IV injury would allow implementation of the appropriate management plan from diagnosis. The aim of this study was to ascertain the practice of orthopaedic surgeons in dealing with these injuries.

MATERIALS AND METHODS A postal survey was undertaken on 216 orthopaedic consultants from three regions.

RESULTS In the presence of medial-sided clinical signs (tenderness, swelling, ecchymosis), 22% of consultants would perform surgical fixation. 53% would choose non-operative treatment and the majority would monitor these fractures through serial radiographs. The remaining 25% of consultants would perform an examination under anaesthesia (EUA; 15%), request stress radiographs (9%) or an MRI scan (1%). Without medial-sided signs, 85% would advocate non-operative treatment and, of these, 74% would perform weekly radiographs. Interestingly, 6% would perform immediate surgical fixation. Stress radiographs (6%) and EUAs (2%) were advocated in the remaining group of consultants. Foot and ankle surgeons utilised stress radiographs more frequently and were more likely to proceed to surgical fixation should talar shift be demonstrated.

CONCLUSIONS Clinical practice is varied amongst the orthopaedic community. This may lead to unnecessary surgery in SER-II injuries and delay in diagnosis and operative management of SER-IV injuries. We have highlighted the various investigative modalities available that may be used in conjunction with clinical signs to make a more accurate diagnosis.

KEYWORDS

Ankle fracture – Lauge-Hansen – Supination external rotation – Management

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The Lauge-Hansen classification system¹ for ankle fractures is well used and the supination-external rotation (SER) injury is the commonest type, accounting for up to 85% of all ankle fractures.² The sequence of injury in a SER fracture is anterior tibiofibular ligament disruption (SER-I), oblique fibula fracture (SER-II), rupture of posterior tibiofibular ligament or posterior malleolus fracture (SER-III) followed by deltoid ligament rupture or medial malleolus fracture (SER-IV). Differentiation between a SER-II and SER-IV injury is crucial as the former injury is 'stable' whereas the latter injury is 'unstable'. As a result, SER-II injuries are generally treated non-operatively whereas SER-IV injuries are typically treated operatively to restore ankle stability. It is a challenge to distinguish the two if the SER-IV injury involves rupture of the deep deltoid ligament as opposed to a medial malleolar fracture.

The question remains as to what is the best method to differentiate the two if it is not apparent from standard ankle radiographs. With clinical findings of medial-sided tenderness, swelling or ecchymosis being unreliable in detecting deep deltoid incompetence,³ there are advocates of proceeding to examination under anaesthesia (EUA), magnetic resonance imaging (MRI),⁴ ankle arthroscopy⁵ or stress radiographs.^{6,7} The early accurate differentiation between a stable SER-II from an unstable SER-IV injury can potentially ease pressure on the already over-burdened fracture clinics and allow earlier return of function.

The aim of this study was to ascertain the practice of orthopaedic surgeons in dealing with these injury patterns and to establish whether there was a consensus in the management of this condition.

Materials and Methods

A postal survey was sent to 216 consultant orthopaedic surgeons in three regions – London Pan-Thames, East Midlands (South) and East Midlands (North). Consultants were identified through various searches from regional records and website resources. The questionnaire was designed to identify treatment pathways of SER-II and SER-IV injuries. Two scenarios were presented in keeping with the injury patterns being investigated. In addition, information regarding whether correspondents had a subspecialty interest in foot and ankle surgery was obtained. The data were analysed using statistical software (SPSS v16.0 for Windows; SPSS Inc., IL, USA).

Results

A total of 118 questionnaires were returned (55% response rate). Eighteen of the replies were from consultants who were no longer involved in trauma work and declined participation. Of the 100 questionnaires analysed, 18% of respondents were consultants who had specialist interests in foot and ankle surgery.

In definite SER-II injuries, the preferred treatment was non-operative in a cast/splint (85%). The remaining 15% would perform open reduction and internal fixation (ORIF). In definite SER-IV injuries, ORIF was the preferred treatment option among 82% of the consultants.

Scenario 1: distal fibula fracture (SER mechanism) without talar shift and no clinical signs over the medial malleolus

Of consultants, 85% would treat this patient non-operatively in a cast (93%) or boot (7%). Overall, 28% would allow full-weight-bearing (FWB), 14% partial-weight-bearing (PWB) and 58% non-weight-bearing (NWB). Of these consultants, 74% would perform serial weekly radiographs and proceed to ORIF should talar shift develop; however, the remaining 26% would not perform serial radiographs. Interestingly, 6% of consultants would perform immediate ORIF and 2% would perform an EUA. Of the consultants surveyed, 6% would request stress radiographs at presentation. If the stress radiographs demonstrated talar shift, 91% would proceed to ORIF but the remaining 9% would manage the patient non-operatively NWB in a cast.

Scenario 2: distal fibula fracture (SER mechanism) without talar shift but with positive clinical signs over the medial malleolus

Of consultants, 53% would have treated this patient non-operatively (70% NWB, 19% PWB, and 11% FWB). Overall, 92% of these consultants would continue to monitor these fractures through serial radiographs. Conversely, 22% of

consultants would perform ORIF at presentation. Only 15% mentioned that they would perform an EUA and would proceed to ORIF should there be evidence of talar shift. Also, 9% would request stress radiographs and one consultant would request an MRI. If the stress radiographs demonstrated talar shift, 95% would proceed to ORIF but the remaining 5% would manage the patient non-operatively NWB in a cast.

Foot and ankle specialists versus other subspecialty consultants

When comparing the practice of consultants with specialist interests in foot and ankle surgery to other subspecialties, some interesting variations were noted. In scenario 1, the majority of consultants from both groups would treat the injury in a non-weight bearing cast with serial weekly radiographs. However, foot and ankle surgeons were more likely to request stress radiographs (17% vs 2%; $P = 0.013$) and potentially undertake an EUA (6% vs 1%; $P = 0.236$). Should stress radiographs demonstrate talar shift, all foot and ankle surgeons would proceed to ORIF, but 14% of consultants from other subspecialties would have continued managing the patient in a NWB cast ($P < 0.001$).

When presented with scenario 2, a third of foot and ankle surgeons would have performed stress radiographs to assess stability compared to consultants of other subspecialties who would have treated the injury in a NWB cast with serial weekly radiographs (40%). In the presence of clinical signs on the medial malleolus, foot and ankle surgeons were more likely to assess the stability of the ankle through stress radiographs (33% vs 4%, $P < 0.001$). Should stress radiographs demonstrate talar shift, all foot and ankle surgeons would proceed to ORIF but 8% of consultants from other subspecialties would have continued managing the patient in a NWB cast ($P < 0.001$).

Discussion

In a SER-type ankle injury, it is important for clinicians to ascertain whether the ankle is stable. The intact deltoid ligament in a SER-II injury stabilises the ankle mortise and the absence of this in an SER-IV injury makes it an inherently unstable injury. Perhaps as a result of this, SER-II injuries can be managed non-operatively with comparable results to operative management.^{8–10} Interestingly, 15% of consultants in our survey would operate on SER-II fractures, perhaps resulting in surgery in patients who would otherwise have done just as well non-operatively.

A small proportion of surgeons (7%) mentioned that the degree of displacement of the fibula fracture would influence their decision. However, indications for operative treatment of ankle fractures solely based on the lateral malleolus is not substantiated.¹¹ The rationale that open

reduction and internal fixation is required for patients with SER-II ankle fractures with 2 mm or more fibula displacement^{12,13} was based on the cadaveric studies of Ramsey and Hamilton¹⁴ and of Lloyd *et al.*,¹⁵ suggesting high intra-articular contact pressures with talar displacement. A talar shift of 1 mm or 3° external rotation of the distal fibula resulted in 40% decrease in tibiotalar contact area.^{14,15} Shortening of the fibula by 2 mm has also been shown to reduce the tibiotalar contact area by up to 14%.¹⁶

In displaced fibula fractures without deltoid ligament injury, the distal fibula has generally been considered to be externally rotated. However, studies have demonstrated that the displacement at the fibula fracture is caused by medialisation and internal rotation of the proximal fragment and that the relationship between the talus and the distal fibula remains intact.^{11,17,18} Therefore, the ankle mortise remains unaffected and congruent. If this is indeed correct for all SER-II fractures, this would mean the 2 mm cut-off point for fracture displacement does not lead to incongruence of the ankle mortise and this indication for surgery not necessarily being valid. More recent biomechanical studies have shown that, in the absence of medial injury, the talus remains centred and the joint has normal kinematics and loading characteristics despite having a displaced fibula fracture.¹⁹⁻²¹ The talar position in a loaded ankle model is very insensitive to the position of simulated fibula displacement.^{22,23} Previous studies without physiological loading or when the talus was constrained such as those carried out by Ramsey and Hamilton¹⁴ do not closely simulate the true clinical condition. These studies have questioned the need for reducing the fibula fracture in the absence of a medial injury.

SER-IV injuries fare better with operative intervention.²⁴ This survey demonstrates that the majority of clinicians would perform ORIF for SER-IV injuries. Rupture of the deep deltoid ligament, not the superficial deltoid ligament, confers a SER-IV injury.²⁵ Recent evidence suggests that medial-sided signs such as tenderness, swelling and ecchymosis are unreliable in predicting deep deltoid ligament rupture and thus should not solely be used as an operative indication.^{3,6,26} These symptoms alone and in combination yielded sensitivities of 20–56% and specificities of 71–97% for screening for a positive ankle stress radiograph.⁶ The positive predictive value of moderate and severe medial tenderness in predicting instability was only 47%, and the value for severe ecchymosis was only 33%.²⁶ Despite this, in a recent poll at a meeting of orthopaedic surgeons carried out by Gill, over half of the audience stated that they used these clinical findings as an operative indication.²⁷ In our survey, just under a quarter of clinicians would operate in such a scenario.

There are increasing advocates for the use of manual stress or gravity stress ankle radiographs in these scenarios, especially when there are medial clinical signs.^{6,7,10,25} These authors demonstrate that stress radiographs are more reli-

able than clinical signs in determining the integrity of the deep deltoid ligament and treatment guided by use of stress radiographs leads to satisfactory outcome.^{6,26} Stress radiographs are well tolerated by patients and easy to perform. The manual stress radiograph is made with the leg stabilised and an external rotation force is applied to the ankle.²⁶ The gravity stress radiograph is made with the patient in the lateral decubitus position on the side of the injured ankle, allowing the distal half of the leg to be dependent off the end of the table.⁷ A standard mortise view is then taken. A gravity stress radiograph is thought to have added benefits of being more comfortable for the patient, potentially not requiring physician supervision in obtaining and no physician radiation exposure.⁷

Undoubtedly, there are still shortcomings with the use of these techniques. The amount of medial clear space widening indicative of a positive external rotation stress or gravity-stress test has been somewhat variable in the literature.^{26,27} Generally, a medial clear space of 4 mm or greater, with that value being at least 1 mm greater than the superior tibiotalar space, seems to be accepted to represent an incompetent deep deltoid ligament in these scenarios.^{26,27} The amount of force required for a manual stress radiograph is also ill-defined and variable in the literature. Despite these shortcomings, stress radiographs are probably more reliable than clinical signs in aiding the diagnosis of an unstable ankle. The survey has certainly demonstrated that foot and ankle surgeons utilised stress radiographs more frequently.

Other proposed methods of investigations include MRI and, in a recent study, the authors were able to identify partially torn deep deltoid as opposed to a completely torn ligament in patients who had a positive manual stress radiograph.²⁸ Patients with partially torn deltoid ligaments were successfully treated non-operatively with no evidence of residual medial clear space widening in a preliminary report. This would suggest that not all patients with positive stress radiographs have a completely torn ligament and that a partially torn deep deltoid ligament may be treated non-operatively with good outcome. The potential value of MRI in these scenarios is highlighted, however cost and convenience would be an issue.

Arthroscopic evaluation is another option but it is not a practical diagnostic modality. However, arthroscopic evaluation has been used to demonstrate that radiographic widening of the medial clear space on a mortise radiograph is not a reliable indicator of deep deltoid rupture.⁵ There has been no study that compares arthroscopic findings to stress radiographs.

Conclusions

It is clear from the survey that practice is varied amongst the orthopaedic community. This may lead to surgical inter-

vention in SER-II cases where outcome would be equivocal if managed non-operatively. Conversely, there may be a delay in diagnosis and thus operative management of SER-IV injuries.

This study has also highlighted the various investigative modalities available that perhaps should be used in conjunction with clinical signs to make the diagnosis of an unstable ankle more accurate. The indication for surgery should be based on a combination of parameters.

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Errata

Ann R Coll Surg Engl 2010; **92**: 437 (Technical note - July)

Hip arthrodesis in the paediatric and young adult patients: the use of hip resurfacing reamers

RUSSELL HAWKINS, AMIRSHAHRIAR ARIAMANESH, ARESH HASHEMI-NEJAD

Please note that the last author listed above was regrettably omitted from the above. Mr Hashemi-Nejad is a consultant orthopaedic surgeon at the same hospital.

Ann R Coll Surg Engl 2010; **92**: 503–505 (September)

Internal or external wall diameter for abdominal aortic aneurysm screening?

A THAPAR, D CHEAL, T HOPKINS, S WARD, J SHALHOUB, SW YUSUF

Please note the correct spelling of the fifth author's name; as given above. This error was not spotted in the proof.

Ann R Coll Surg Engl 2010; **92**: 533 (Technical note - September)

Seton sutures for leg ulcers associated with fistulous tracts

TRISTAN RA LANE, JOSEPH SHALHOUB, IAN J FRANKLIN

We apologise for the incorrect spelling of Mr Franklin's first name. The correct name is 'Ian' as given above.