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The use and efficacy of intra-operative stress tests in supination-external rotation IV ankle fracture fixation

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ABSTRACT

This study examines stress radiograph use in SER IV ankle fracture fixation; the efficacy of external rotation (ERST) and lateral hook (LHST) stress tests with incidence of subsequent fixation failure secondary to syndesmotic diastasis.

154 skeletally mature patients were admitted to our unit with ankle fractures in 12 months. 42 non-SER fractures and 32 SER fractures treated without ORIF were excluded, as were 14 which featured a syndesmotic screw in the primary ORIF. The remaining 66 SER IV fixations were included in the final sample (17 men, 49 women; median age 49 years).

No stress test was performed in 51.5% of cases without a single subsequent failure in these fixations. ERST was the more commonly performed test (incidence 30.3%); negative predictive value (NPV) 0.95. Incidence of LHST was 18.2%; NPV 0.83. Both tests were performed in 6.1% of cases; NPV 0.75. The incidence of failure secondary to syndesmotic diastasis was 6.1% (4/66).

Notably, there were no failures in the cases where no stress test was performed. Use of either or both external rotation and lateral hook stress tests resulted in failures to detect syndesmotic diastasis with consequent failure of fixation. This study suggests that syndesmotic injuries are not missed due to an absence of a stress test but that stress tests are not sufficiently sensitive or correctly interpreted. Clinical judgement in cases where syndesmotic injury is not present appears accurate. If syndesmotic injury is clinically suspected, apply caution and insert a syndesmotic screw rather than relying on stress test results.

Introduction

Ankle fractures constitute a significant proportion of the workload of the modern orthopaedic unit.[1,2] The Lauge-Hansen classification is the most comprehensive and commonly used ankle fracture classification system in current orthopaedic practice. The Lauge-Hansen system defines types of ankle fracture by describing the position of the foot at time of injury (the first component of the fracture type) and

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the direction of the deforming force acting upon the foot (second component of the fracture type).[3] The differing types of injury are recognised and differentiated based upon their radiographic patterns and signs. Based upon his cadaveric study, Lauge-Hansen describes four subtypes of ankle fracture: supination-external rotation, supination-adduction, pronation-external rotation and pronation-abduction. The most common subtype of ankle fracture is the supination-external rotation (SER) injury.[4–6] This type of injury begins laterally, with rupture of the anterior tibio-fibular ligament (stage I), and proceeds externally, producing the classic short oblique fracture of the lateral malleolus (stage II), rupture of the posterior tibio-fibular ligaments or posterior malleolus fracture (stage III), and finally involving medial structures, with an avulsion-type fracture of the medial malleolus or rupture of the deltoid ligament (stage IV).[3] Understanding of the step-wise nature of SER injuries is useful clinically. SER-II injuries are amenable to non-operative management. The intact medial structures stabilise the ankle mortise and splinting of the lateral fracture can be achieved with plaster cast. However, in SER-IV injuries, the ankle mortise is unstable and operative fixation is recommended as it allows for accurate fracture reduction and more direct and stable constraint of the injury.

Although not described explicitly in Lauge-Hansen's original paper, SER ankle fractures can produce a syndesmotic injury.[3,7–9] Failure to detect disruption of the syndesmosis can result in pain, ankle instability and a predisposition to osteoarthritis caused by the changes in the areas of contact at the tibio-talar joint.[6,10,11] If found to be disrupted, the accepted wisdom is to reduce and stabilise the diastasis with screws placed across the syndesmosis.

Several previous studies and texts have discussed different methods of intra-operative radiographic stress tests which examine the integrity of the syndesmosis at time of operative fixation. The two most commonly used are the external rotation stress test and the lateral hook stress test.[7] An external rotation stress test (ERST) is traditionally produced by taking a mortise fluorograph of the ankle, in a plantigrade position, whilst applying an external rotation-torque. This stress fluorograph is then compared to a mortise fluorograph of the ankle, in a neutral plantigrade position, without a rotational torque. A visible increase in the distance between the lateral cortex of the tibia and the medial cortex of the fibula (tibio-fibula clear space)[7] or increase of the medial tibio-talar clear space[12] is interpreted as evidence of syndesmotic injury.[4] The lateral hook stress test (LHST) is performed by taking a mortise fluorograph with the ankle in a plantigrade position and subjecting the fibula to a lateral distraction force by grasping it with a bone hook and pulling laterally. Diastasis is detected by an increase in the tibio-fibula clear space or the medial clear space.[4,7] Interpretation of these tests can be subjective. Jenkinson et al. suggested that using a standardised force of 7.5 Nm via a torque wrench may increase sensitivity of the results and reduce interpretation variation when employing the ERST.[8] This assertion was corroborated by the results of Pakarinen's study comparing the sensitivity, specificity and inter-observer reliability of the external rotation and lateral hook stress tests. This prospective study concluded that inter-observer agreement for both the ERST and LHST was high but that the sensitivity of either test was insufficient to reliably detect instability of the syndesmosis.[7]

There is variation in use of intra-operative stress radiographs and evidence that they are flawed tools for detection and subsequent management of syndesmotic injury in SER IV ankle injuries.[7] Therefore, at present, there is no robust intra-operative tool for detection of syndesmotic injury. Pre-operative magnetic resonance imaging (MRI) scans would be more sensitive in detecting syndesmotic diastasis but the cost and time factors of MRI in the context of the volume of these injuries make this solution impractical. What no previous study has determined is the rate of fixation failure and requirement for revision fixation secondary to missed syndesmotic injury. That is, what is the impact of the limitations of these tests, for patients and orthopaedic units.

Aims & objectives

Our study set out to examine three questions:

1) In our orthopaedic trauma unit, how often are these intra-operative stress radiographs used for the diagnosis of syndesmotic disruption during SER IV ankle fracture fixation?
2) Does the use of intra-operative stress tests prevent subsequent failure of fixation due to syndesmotic diastasis when failure is defined as revision fixation surgery?
3) In our orthopaedic trauma unit, what is the failure rate of SER IV ankle fracture fixation secondary to unrecognised syndesmotic disruption and subsequent diastasis and failure of fixation?

Materials and methods

For this study, we retrospectively identified all patients admitted to our orthopaedic unit with an ankle fracture during a 12 month period, between February 2011 and January 2012. This period is recent and, therefore, reflects current practice within our unit but also allowed sufficient follow up time post-operatively for the detection of failure of fixation secondary to syndesmotic diastasis. (Data collection performed January–March 2013.) All patients under 16 years of age or those older but with radiographic skeletal immaturity (open distal tibial or fibula physes) were excluded. The remaining 154 ankle fractures were classified by the lead author (SG) using the Lauge-Hansen system based on the pre-operative radiographs. This was done prior to and without knowledge of subsequent management. PER, SAD and PAB type fractures were excluded. All SER II ankle fractures were excluded, as were all SER IV fractures managed conservatively (due to surgeon preference and patient factors) or with primary hindfoot fusion or external fixation, illustrated in Table 1.

A case note review was performed for each of the remaining 80 SER IV fractures managed with open reduction internal fixation. From the operation note, the grade of operating surgeon (consultant or registrar), documented use of

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