Ankle syndesmotic injury: Tightrope vs screw fixation, A clinical academic survey

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ARTICLE INFO

Keywords:
Tightrope
Syndesmotic screws
Injury
Surgeon preference

ABSTRACT

Objective: The goal of the study is to find out the treatment of choice for ankle fractures involving syndesmotic injury based on level of experience of orthopaedic surgeons.

Methods: A survey was undertaken to analyse the management used for ankle fractures with syndesmotic injuries AO 44c in a 35-year-old patient. Surgeons attending an orthopaedic course were invited to take part in a survey sorted into groups: junior surgeons middle grades, and experienced. Pictures of an x ray were shown to the participants and treatment options were asked.

Results: 100 surgeons from 20 nations took part in the event. Juniors made up 39%, registrars made up 38%, and experienced doctors were 29%. Screws, were reported by 93% for syndesmosis fixation. 66% of surgeons who used screws for syndesmosis fixation favoured a single screw over two screws. 3-4 cortices were virtually evenly divided in choice, with 54% preferring three and 46% preferring four cortices. Only 22% of the time did they utilise a washer with their screws. With 52% of patients, the most typical time for permitting them to weight bear was 4–6 weeks after surgery. At 1–2 months postoperatively, 34% preferred to remove the screw, and at 2-3 months postoperatively, 29% preferred to remove the screw.

Conclusion: Data show that the majority of junior level doctors handle their patients according to AO principles. The majority prefer one 3.5 mm screw positioned between 2 and 4 cm above the ankle joint, with three cortices being somewhat preferred. Despite the lack of data to support one procedure, the majority of people remove their screws within 1–3 months

1. Introduction

Ankle fractures with syndesmotic injuries are an important part of any trauma surgeon’s practise. The benefits and drawbacks of several treatment approaches for an ankle injury with diastasis have been recorded in randomized trials and review articles, and treatment modalities range based to local policy and surgeon experience. (see Figs. 1a–d, 2a–g and 3a)

A survey of orthopaedic surgeons of various nations, backgrounds, and experience who participated in an international AO course was used to review current practise for ankle fractures with syndesmosis injuries.

2. Aims and objectives

Unstable syndesmotic injury of the ankle requires surgical management in the form of screw or tightrope fixation. However, the superiority of one technique over the other remains a subject of ongoing debate. The aim of this study is to identify the fixation of choice in unstable ankle...
syndesmotic injury based on the level of experience of orthopaedic surgeons. (see Fig. 3c).

3. Materials and methods

Surgeons attending an international AO methods and osteosynthesis course in Graz, Austria, were asked to complete a questionnaire about treatment options for an ankle fracture with diastasis. The questionnaire revealed an ankle fracture with diastasis in a healthy 35-year-old and suggested two treatment options: screws or tightrope/endobutton. The number of screws/tightropes used was then requested. The number of cortices, use of washer, plate participation, and screw size were all questioned about when it came to screw fixation. The question of where the fixation mechanism should be placed above the tibial plafond was then raised. The weight-bearing status, as well as the subject of removing the syndesmosis fixation and, if so, at what time, were all discussed post-operatively.

4. Results

4.1. Demographics of survey group

A total of 100 people responded to the survey. Participants came from 20 countries, including both European (Austria, Germany, Poland, Ukraine, Switzerland, Finland, France, Croatia, Italy, Ukraine, Kosovo, Russia, Romania, Slovenia, Portugal, and the United Kingdom) and non-European (Austria, Germany, Poland, Ukraine, Switzerland, Finland, France, Croatia, Italy, Ukraine, Kosovo, Russia, Romania, Slovenia, Portugal, and the United Kingdom) countries (including Iraq, Saudi Arabia, India, Qatar). Males made up 82% of the population.

The bulk of the participants were expected to come from neighbouring countries and have an excellent command of English, given the course was held in Austria but in English. It’s worth noting that the centre offers a German course on alternating weekends. The bulk of those who took part were from first-world countries or countries with robust economies. The age of the group ranged from 20 to 55 years.

The largest age groupings were 30–35 years old (37%) and 25-30
Fig. 1c. Shows the level of training of the doctors.

Fig. 1d. Shows the experience of doctors in years.

Fig. 2a. Shows the method of fixation.
Fig. 2b. Shows the preference for the number of screws.

Fig. 2c. Shows the number of cortices used for screw fixation.

Fig. 2d. Shows the size of the screw.
years old (25-30 years old) (38%). The senior age groups of 45–50 years and 55 and older account for fewer than 5% of the total population. The participants’ age was mirrored in their level of training. The majority were junior at 39% or registrar at 38%. Only 23% were actual consultants. This is echoed by the years of experience with 37% with 1–3 years, 13% with 4–5 years and 28% with 6 years or more experience. 22% of the respondents did not mention their level of experience. The majority of the participants are less experienced. The reason for this is that the course is designed for trainees, and the bulk of those who attend are interested in learning for the goal of operating or passing exams. Stipends for training are also provided by training programmes in European or Middle Eastern countries. Many of the older attendees were people who had to revise their techniques and maintain their abilities up to date on their own dime.

It’s also worth noting that the year of experience is frequently tied to age, rather than their level of training. Some doctors are senior but do not necessarily hold the designation of consultant, even though they practise as one. Alternative titles, such as associate specialist, may exist, however these may differ from country to country. Due to differences in training programmes between nations, age can vary. For example, in the United States, a medical degree is a postgraduate degree, whereas in the majority of European countries, it is an undergraduate degree. Getting into a training programme in some countries can be challenging, and applicants are frequently required to conduct more study, such as a PhD, before being accepted. As a result, the age of the doctor varies depending on his or her level of training.

5. Method of fixation

5.1. Screw vs endobutton/tight rope

The most popular method for operative fixation of the ankle fracture with syndesmosis injury was for screw fixation (selected by 97%), whereas 7% used endobutton/tightrope. The use of the endobutton is relatively new, and not widespread. Only the younger age bracket 25-35 used the endobutton. Endo buttons can be more expensive and technically challenging. Also its use is not widely taught. The majority of participants (82%) attended the AO Basic Principles of Fracture management course, where the participants are taught only on screw fixation. Also, the majority of attendees are in...
training, and subsequently emulate their seniors, who have used screws. Also the evidence for it is mixed [26]. It may be in subsequent generations, that this trend may change.

5.2. Number of screws

The preference of number of screws to use for syndesmosis fixation was almost even, with 66% preferring 1 screw over 2 screws.

Again this preference may be due to the fact that the AO course method is open to either 1 or 2 screws syndesmosis screw fixation. Syndesmosis screws can be technically challenging, as well as placing two syndesmosis screws correctly parallel even more so. The additional screw may make removing it more work. The addition of another screw may have more risk of complications such as breakage or backing out. The evidence shows that both methods have similar result [7].

5.3. Cortices used

The numbers of cortices used for screw fixation was evenly divided between 54% for three contices.

This again is an equal mix reflected by AO teaching and the fact the).

The evidence shows no superiority of either method [14].

5.4. Screw size

The overwhelming majority (77%) preferred to use 3.5 mm screws over 4.5 mm screws.

AO is open to either screw size, and the preference may be relative to what is more commonly available. 4.5 mm screws may often be considered to be too large for some fibulas and/or the stock of 3.5 mm screw used for the fibula fixation is more available. The evidence does not prefer one method over another [20].

5.5. Placement of screw

The major preference for screw placement was 2 cm (33%) and 3 cm (29%) above tibial plafond.

This is consistent with AO principles. A small number of participants would place the screw at 4 or 5 cm above the ankle joint. Placement of the screws above 4 cm can have complications of calcification and can be difficult for accurate placement, as the fibula become a more posterior structure. In addition, the evidence advises against this [11].
5.6. Use of washer with screw

77% participants would not use a washer with the syndesmosis screw.

The use of washer for the screw has shown to allow for more compression. With the syndesmosis fixation, there is a concern of over compressing the fixation, which may lead to increased stiffness. Again AO does not normally advise the use of washers with syndesmosis screws.

5.7. Screw through plat

The use of a screw through the plate was evenly divided.

Biomechanical studies [4] in general suggest greater torsional stability for screws inserted through the plate. General teaching advice shows no preference for one over the other, and may vary due to the placement of the fracture and plate fixation.

6. Postoperative management

6.1. Weight bearing post-operatively

Weight bearing after syndesmosis fracture is controversial with some surgeons preferring to wait until the screw is removed before allowing the patient to bear weight. Although the majority of our survey participants allowed their patients to bear weight at 4-6 weeks post-operatively a sizeable minority waited 7 weeks plus, awaiting screw removal. The general recommended advice is weight bearing at 6 weeks post-operatively [22].
6.2. Removal of syndesmosis screws

The vast majority of our participants preferred to remove syndesmosis screws. Fig. 3b. Although the benefit of removal screw is not clear, the AO advice is inclined to remove it [16]. The removal of the syndesmosis screws can be influenced by many other reasons including financial, lack of resources, theatre time, and patient preference. The timing of screw removal for our participants was with preference to earlier months between 1 and 2 months (34%) and 2-3 months (29%). AO recommendations are for removal for screws at 3 months. The trend for earlier removal may be due to fact certain participants wish to remove the screws before allowing patients to bear weight or to allow early full movement that can be limited by syndesmosis fixation. Early removal may also be preferred in order to prevent the screw eroding a track through the fibula as normal tibiofibular motion occurs.

7. Discussion

Ankle fractures are very common injuries faced by orthopaedic surgeons, with a global incidence of 187 per 100,000. This number is likely to increase with more people participating in athletics and an increase size of the elderly population [8]. Obesity is a growing problem interest in terms of fixation and outcome by the surgical and research community.

Surgical treatment for ankle fractures differs according to many factors, some of which relate to the patient and some relating to the surgeon training and experience, and country. Fixation of ankle fracture with syndesmosis injuries is controversial in the literature. There have been several published surveys undertaken for syndesmosis fixation in ankles at the local level: England and Scotland [24], England [13], Netherlands [19] and the USA [1]. These all have been local to a specific region or country. Our survey constructed a global opinion on the management of syndesmosis ankle fracture management.

7.1. Screws vs tight rope/endobutton(suture)

Our study shows an overwhelming favour of screws over Tightrope/ endobutton. This is consistent with Bava et al. [1] USA survey which showed only 7% using Tightrope. Despite recent advances in the syndesmosis technology, this has not been adopted. The evidence does not favour one over the other. Zhang et al. [26] undertook a systematic review of suture-button vs screw fixation for syndesmosis injuries. They found no difference in terms of functional outcomes, but that endobutton can lead to an earlier return to work and better objective range of motion. Degroot et al. [5] noted a 25% complication rate where the suture button had to be removed due to local irritation although Naqvi et al. [15] developed a method to overcome this. Overall Zhang et al. noted there was less need to remove implants in suture button, but noted there was a lack of high quality randomized controlled trials to give a strong final judgement. Adoption of a new technology must show proven superiority, technical ease and a cost efficiency. At this moment, endobutton does not show this, which is consistent with our survey.

7.2. How many screws would you use?

Our study showed a slight preference for one screw (66%) over two screws. The evidence shows no superiority of one over the other. Xenos et al. [25] cadaveric study found that repair with 2 screws inserted through 3 cortices provided significantly more stability than 1 screw. If the screw only engages 3 cortices, the normal external rotation of the fibula during dorsiflexion will not be affected. Heiness et al. [7] undertook a randomized controlled trial comparing tricortical (two 3.5 mm screws, three cortices) to quadricortical syndesmosis fixation (one 4.5 mm screw, four cortices) in ankle fractures. They found that fixation with 2 tricortical screws is safe and improves early function, however after 1 year there are no significant differences between the groups in terms of pain and function.

Interestingly our results slightly differ with a previous local survey in the Netherlands [19]. It is noted that none of our participants were originated from there. The majority of trauma (79.3%) and orthopaedic (83.7%) in that local survey preferred one screw over two screws. The survey in the USA [1] showed no preference for 1 or 2 screws. This may reflect local practice, whereas our survey has an international representation of 20 nations, and therefore the difference in practice may have diluted our results.

7.3. How many cortices would you use?

Our participants were almost equally divided about the number of cortices to place the screw. This is consistent with the evidence. Moore et al. [14] also undertook a randomized controlled trial of 120 patients comparing 3.5 mm screw fixation with either three or four cortices fixation. There was no difference in terms of loss of reduction, screw breakage, or need for hardware removal. Wilkeroy et al. [23] followed 48 patients after either three or four cortices, with an average follow up at 8.4 years. They found no difference between the two groups.

In the Netherlands [19], the preference was more for three cortices with trauma (62.8%) and orthopaedic surgeons (65.1%). Our survey group had a slight preference for three cortices as well (54%). In the England and Scotland survey, Wood et al. [24] found a similar preference at 68% preference in Scotland whereas in England it was 51%. In another survey of England, Monga et al. found a similar trend with 58.7% in favour of three cortices. The USA survey [1] result was different from the European survey with 57% preferring 4 cortices. Although a majority with a small margin prefer three cortices, there is no overwhelming favoured practice, and the AO teaching allows for both methods.

7.4. Size of screw used

Our group overwhelming favoured 3.5 mm screws over 4.5 mm screws (77%). This is similar to Schepers et al. [19] survey finding 89.3% of trauma and 81.4% of orthopaedic surgeons also favour 3.5 mm screws. Bava et al. found that in their USA survey most preferred 3.5 mm screw [1]. Studies have shown no superiority of one over another. Thompson et al. [20] undertook a cadaveric study comparing 4.5 mm vs 3.5 mm screw for syndesmosis fixation in 12 paired specimens. After subjecting the screw to mechanical stress, they found no advantage of one screw size over another. Therefore the favouring of 3.5 mm screws may be due to convenience of availability, and apprenticeship practice.

7.5. Level of the screw

The majority of our respondents in our survey preferred placing the syndesmosis screw 2–3 cm above the tibial plafond. This is consistent with the Netherlands local survey [19] where 74.4% of trauma and 79.1% of orthopaedic surgeons preferred between 2.1 and 4 cm. In the UK study [13], 56.6% preferred 2-4 cm, but a sizeable minority of 25.5% preferred to place above 4 cm. Although a small minority did select 4 cm and above, the majority of surgeons do not physically measure the actual size, but use judgement to select where to insert the screws. Our opinion is that if we had actually presented x-rays to our participants, the majority would select an image with a screw at between 2 and 4 cm, as to one inserted 4 cm above the plafond.

The placement of the screw is important for stable fixation of the ankle. If too low, it can pass through the distal tibio-fibular articulation, which can lead to localized calcification and pain. If the screw is too high it may cause the tip of the fibular to toe outward. McBryde et al. undertook a cadaveric study which found screws placed at 2 cm above the
tibiotalar joint does better than that a 4 cm [11]. Schepers et al. [18] undertook a clinical study over 7 years of 122 patients treated for syndesmotic injuries. They found that only screws placed 4.1 cm above the tibial plafond negatively influenced outcome.

### 7.6. Syndesmosis through plate

In our survey there was no preference to place the screw through the plate. The evidence seems to favour screw placement through the plate. Clanton et al. [4] undertook a cadaveric study of 10 pairs of specimen. They found that placing the trans-syndesmotic screw gave increasing torsional stiffness. Gardner et al. [6] also undertook a cadaveric study with six specimen pairs and found that a 2 hole locking plate with 3.2 mm screw provides greater stability of the syndesmosis to torques as compared to 2 4.5 mm quadrilocortical screw fixation. Although biomechanical studies seem to favour it, the clinical significance has not been clarified, nor has significant issues raised over the use of one method over another.

### 7.7. Weightbearing

The weightbearing status management with transsyndesmotic fixation is controversial. Some would recommend awaiting removal of screw fixation to allow weightbearing, although literature in general advocates weightbearing at 6 weeks postoperative [22]. Our results are consistent with that with 51% preferring 4-6 weeks post-operatively. Monga et al. [13] found that practice in the UK [13], 83.6% of surgeons will not allow full weightbearing until after the screw is removed.

### 7.8. Screw removal

Our results show an overwhelming preference to remove screw (80%), consistent with the Netherlands survey (86–88.4%). The England and Scotland is similar with 83.6% preferring removal of screw [24]. Monga et al. [13] survey of the United Kingdom also echoed these findings. The USA survey also showed a preference with routine removal in 65% of their survey [1].

Miller et al. [12] who undertook a case series of 25 patients and found that removal of locked syndesmosis screw and plate did improve range of movement and function. Manjoo et al. [10] undertook a study showing that removal of an intact screw produced functional benefit, but not in those whose screws were loose or broken. It should be noted that there was a lack of randomized controlled trials as noted by Schepers et al. [17] in 2011, in another paper.

Therefore in 2014, Boyle et al. [3] undertook a randomized study to compare removal of syndesmosis screw versus non-removal. They found that removal of the screw produces no significant functional, clinical or radiological benefit. This also concurs with a study by Tucker et al. [21] who retrospective study by Tucker et al. [21], which found that retained screws does not impair functional outcome, and therefore screws can be left in-situ.

Although the evidence does not have any preference, clinical practice still favours removing screws. This may be due to perceptions of expected limited range of movement, and risk of breakage. Education of recent trials may help change clinical practice. This can potentially save a patient from having two operations and has potential financial implications.

### 7.9. Time point to screw removal

Our study showed that the majority preferred removing earlier at 1-2 months (34%) and 2-3 months (29%). Bava et al. in his USA survey found that the majority remove their screws at 3 (49%) and 4 months (37%). (However this study was published in 2010 reflecting surgeon almost a decade ago)The AO recommendation for screw removal is usually at 2-3 months post-operatively [16], or maximum 4 months to avoid late syndesmotic widening [22].

### 8. Limitations of our survey

Our survey had 100 respondents, and gives a valuable insight into the current practice of the management of ankle syndesmotic injuries.

The survey was conducted at an international AO conference in Graz, Austria. This can lead to potential bias, as the majority practice has been influenced by AO principles, having done the AO basic fracture management course. There was disproportionate of mainland European representation. The majority of our respondents were in training. Their current practice likely represent their seniors practice. When they became independent this may significantly shift.

The questionnaire was in English, and although the majority spoke the language, their command was to different degrees. The surveyors throughout the process did clarify the meaning of the terms in the questionnaire to the participants. A multi-lingual questionnaire may have helped. Secondly, in the question on screw placement, many selected above 4 cm. We felt that if radiographs were shown with the different screw placements, many would have selected the recommended screw placement at 2-3 cm above the tibial plafond.

### 9. Conclusions

Our survey gives a valuable insight into the international management of syndesmotic ankle injuries. Our findings in our majority junior level tier doctors, is that most follow AO principles in the management of ankle fractures. The majority preferred to use one 3.5 mm screw, placed between 2 and 4 cm above ankle joint, with slight preference of three cortices. Despite evidence not favouring one method, the majority do remove their screws usually between 1 and 3 months.

### Sources of funding

Nil.

### Ethical approval

No ethical approval needed.

### Author contribution

Mr Hassan Shafiq, Lead Author and Idea.

Mr Zafar Iqbal, Data collection and Write up.

Mohammad Noah Hasan Khan: Data analysis.

Dr Muhammad Umer Rasool, Data collection.

Mr Ahmad Faraz, Data Analysis.

Muhammad Hamzah Jamshed, Data Collection.

Dr Basharat Ghaooor Khan, data collection.

### Registration of research studies

1. Name of the registry:
2. Unique Identifying number or registration ID:
3. Hyperlink to your specific registration (must be publicly accessible and will be checked):

### Guarantor

Mr Hassan Shafiq, Corresponding Author.

### Consent

All data anonymised.
Provenance and peer review

Not commissioned externally peer reviewed.

Declaration of competing interest

Nil.

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