PROSPECTIVE EVALUATION OF NANONEEDLE

(Nanoneedle Ankle Syndesmosis)

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1. INTRODUCTION

Arthroscopic techniques and equipment have advanced over many years. Traditional ankle arthroscopy is done with large diameter cannulas, which provide high flow irrigation. Despite the minimally invasive nature of the surgery, the overall complication rate from ankle arthroscopy is as high as 10.3%, most commonly due to damage to the nerves which cross the ankle and supply the foot [1,2]. Even with careful portal placement and no ankle traction, the reported rate of nerve injury is 1.9% [1].

Recent innovations have seen the introduction of nanoscopes (Arthrex Ltd. - www.arthrex.com), which uses chip-on-tip image sensor technology, allowing a small high-definition camera to be placed on the end of a small diameter probe. An even smaller instrument is the NanoNeedle, with a hand piece which is a similar size to a pen.

Due to the small diameter of the instruments, it is feasible that nanoneedle surgery could be performed under local anaesthetic in an outpatient setting. This would facilitate intra-articular visualisation of anatomical structures and also allow dynamic assessment under stress tests to assess for joint instability. Such technology would allow rapid diagnosis of joint instability, and could also reduce the need for MRI or CT assessment which does not allow dynamic assessment. Due to the ease of use, the NanoNeedle could also be applied by trauma surgeons who may not be traditionally trained in foot and ankle arthroscopy.

Ankle sprains are the most common injury seen in Emergency Departments worldwide. Up to 25% of ankle sprains include an injury to the syndesmosis [3]. Ankle syndesmosis injuries, also known as high ankle sprains, can be stable or unstable. Frequently syndesmosis injuries can be missed. Often initial x-rays are normal, even when there is instability. A delay to diagnosis or treatment is associated with pain and disability [3] and untreated syndesmosis instability inevitably leads to ankle arthritis [4]. When dynamic instability is suspected, the gold standard investigation is an arthroscopic evaluation [4]. Whilst ankle arthroscopy is considered the gold standard tool to assess for syndesmosis instability [5,7,8,6,4,] the NanoNeedle is novel, and no such studies have been conducted.

The current study aims to evaluate the NanoNeedle to assess unstable ankle syndesmosis injuries, compared with the current gold standard assessment which is arthroscopy, including ease of application, and diagnostic accuracy.

No previous studies have evaluated the NanoNeedle for syndesmosis injury. This technology potentially reduces the rate of nerve injury when compared with standard arthroscopy. In future, this technology could be performed in the outpatient setting under local anaesthetic, allowing dynamic intraarticular joint assessment, and may reduce the need for MRI.

This study will provide new useful information for patient clinical benefit, and the surgeons.

2. STUDY OBJECTIVE

The aim of the current study is to evaluate the ability of NanoNeedle scope to accurately assess acute ankle syndesmosis injuries compared with standard arthroscopy. Specifically, the aims are to determine the ease of use, arthroscopic field of view and diagnostic accuracy of the NanoNeedle in diagnosing ankle syndesmosis injury and instability.

This is a proof-of-concept study. The study will be conducted in a theatre setting in patients under general anaesthesia. The results could then be used to design a second study to evaluate whether the technology could be applied under local anaesthetic in the outpatient environment.

The primary aim is to assess the ability of NanoNeedle to detect syndesmosis instability.

The secondary aims are to assess ease-of-use, and field-of-view in comparison to ankle arthroscopy.

The Nanoneedle is novel technology which has not yet been evaluated in a clinical setting. With such new technology it is important that the NanoNeedle is rigorously analysed the results published, to better inform patients, surgeons, and the wider scientific community. Syndesmosis injuries are common and a delay to treatment can lead to prolonged disability and pain. Currently there are long delays to investigations such as MRI or CT scans and it is feasible that the Nanoneedle could be applied in an outpatient setting with the benefit of allowing dynamic assessment for instability, and therefore could reduce the burden for MRI on the NHS.

Participants will have a detailed assessment of their ankle by NanoNeedle, and by standard arthroscopy if the NanoNeedle assessment has been inadequate. They will receive the results of the full study findings earlier than non-participants. Participants will receive a more detailed information sheet regarding their injury and surgical procedure than might be routinely expected.

Potential adverse effects are minimal and will be limited to approximate five minutes of additional surgical time. The NanoNeedle will be placed via the exact same portals as would be done for ankle arthroscopy and therefore there should be no additional risk of academic injury compared with standard arthroscopy.

Study files and data will be stored in locked offices on the admitting hospital sites. Patient data will be stored electronically on a hospital server within a secure drive and a password protected folder.

All participants will be allocated a unique study ID number once consented. No Patient identifiable data will be shared between Trusts.

This study does not raise significant ethical legal or management issues. Patients will receive routine surgical care. Use of the NanoNeedle will add approximately five minutes of surgical time to the overall operation. Therefore, the risk of causing additional harm to the patient by participating in the study is extremely low.

As part of the recruitment process, potential participants will be thoroughly consented regarding the aim of the study and the short period of extra surgical time needed to use the NanoNeedle. As no post-operative surgical follow-up will be necessary, there will be no issues with loss to follow-up.

The end of the study will be after the final participant has received their treatment. HHFT will notify the REC that the trial has ended and a summary of the clinical trial report will be provided.

3. PARTICIPANT SELECTION / SAMPLE SIZE

Recruitment will be in patients listed for surgery with acute unstable ankle syndesmosis injuries requiring arthroscopic assessment. The sample size will be 20 patients.

Specific inclusion criteria are:

- Adults over 18 years of age

- Acute ankle syndesmosis injury with clinical evidence of instability and cross sectional imaging (CT or MRI)
- Time of injury to surgery < 6 weeks
- Injury patterns including posterior malleolus fractures and Maisonneuve (proximal fibula fracture) injuries)
- Pre-operative cross sectional imaging (MRI or CT)

Exclusion criteria
- Under 18 years of age
- No preoperative cross sectional imaging (CT or MRI)
- Injuries greater than 6 weeks old at the time of surgery

The sample size of 20 patients is deemed large enough to evaluate the ability of the NanoNeedle versus standard arthroscopy. Cadaveric studies which have simulated acute syndesmosis injuries have used similar sample sizes or smaller [9]. The sample size is also based upon the participating surgeon's caseload, the number estimated for a satisfactory case series, and as reasonable based on available industry funding.

The primary outcome is the ability of the NanoNeedle to detect ankle syndesmosis instability compared with standard ankle arthroscopy.

Secondary outcomes include ease-of-use and field of view with the narrow scope versus standard arthroscopy.

4. STUDY DESIGN

This is a prospective study and will evaluate 20 patients with acute syndesmosis injuries requiring arthroscopic assessment and syndesmosis fixation. Suitable patients will be identified by the Orthopaedic Foot & Ankle surgeons.

There is a separate agreed proforma which will be filled out for each study patient and will be sent to the Orthopaedic Research Team at Hampshire Hospitals NHS Foundation Trust.

The evaluation will be conducted in the theatre setting, in patients under general or spinal anaesthesia. The NanoNeedle will be used at the start of the procedure to determine:

a) If a standard review of anatomical structures can be undertaken (modified Ferkel 21-point examination – see proforma)

b) If the injury pattern and instability can be diagnosed (evidence of AITFL ligament rupture + widening or dynamic instability of the syndesmosis on an external rotation stress test)

The NanoNeedle findings would be correlated with preoperative findings from cross sectional imaging and findings on standard arthroscopy (4mm scope) at the time of surgery, if performed as detailed below.
If the operative surgeon has achieved adequate assessment of the joint and syndesmosis with the NanoNeedle scope, they may elect to not perform a standard scope, in the basis that this may prolong the procedure and potentially increase the risk for no additional benefit. The result in such a case would be that the NanoNeedle is comparable with the gold standard investigation (Standard Arthroscopy).

5. METHOD

After appropriate consent and anaesthesia the patient will be positioned supine with a thigh tourniquet.

Standard preparation and draping. No prefilling of joint by saline injection.

The NanoNeedle inserted along normal anteromedial port trajectory.

Saline lavage used if view not obtained.

The NanoNeedle inserted via anterolateral portal if needed.

Standard proforma filled out and emailed to the Orthopaedic Research team at Hampshire Hospitals NHS Foundation Trust after the procedure.

6. ETHICAL AND REGULATORY CONSIDERATIONS

Since this a prospective study comparing the Nanoneedle with standard arthroscopy, ethical approval will be sought.

Following Sponsor approval the protocol, informed consent form, participant information sheet will be submitted to an appropriate REC, and HRA (where required). Local R&D approval will also be required at each recruiting site.

The Investigator will ensure that this study is conducted in accordance with the principles of the Declaration of Helsinki, and relevant regulations with Good Clinical Practice.

Data will be collated at Hampshire Hospitals NHS Foundation Trust using the anonymised proformas.

7. ASSESSMENT AND MANAGEMENT OF RISK

Participation in the study is considered to be very low risk for causing additional complications beyond those associated with a standard arthroscopy, especially as the NanoNeedle is smaller than a standard arthroscope and it is inserted in the same anatomical areas. The main additional risk is that the operative time will increase by approximately 5 to 10 minutes.

A clear explanation of any risk/potential risks of the study will be discussed with the patient prior to consent.

Any incidents detected over the course of the study will be reported to the Hampshire Hospitals Orthopaedic Research Team with any Serious Adverse Events being reported to the local R&D Department as well as the Regional Ethics Committee.

Any device related issues will be reported to the manufacturer.

8. DATA PROTECTION AND PATIENT CONFIDENTIALITY

Each site will hold data according to the General Data Protection Regulation (Great Britain, 2018) and data will be collated in a proforma identified by a unique identification number (i.e. the participant identification number) only. A Trial Enrolment Log at the sites will list the participant identification numbers. HHFT will maintain a list of participant identification numbers for all trial patients at each site.

All study files will be stored in accordance with Good Clinical Practice guidelines. Study documents (paper and electronic) held at the Hampshire Hospitals NHS Foundation Trust will be retained in a secure (kept locked when not in use) location for the duration of the trial. All essential documents, including source documents, will be retained for a minimum period of 10 years after study completion.

9. PROTOCOL COMPLIANCE

The investigators will hold an initial meeting to discuss the study protocol. Regular meetings will be held to ensure study compliance.

Accidental protocol deviations can happen at any time. Any deviations will be adequately documented on the relevant forms and reported to the Chief Investigator and Sponsor immediately.

Deviations from the protocol which are found to frequently recur are not acceptable, will require immediate action and could potentially be classified as a serious breach.

10. COSTINGS

Research funding as agreed by Arthrex Ltd.

Arthrex Ltd will provide the requested products free of charge:

a) 20x NanoNeedle Handpieces (AR-3210-0043)
b) 20x Sheath Kit (AR-3210-0050)

11. PUBLICATION/STUDY DISEMMINATION

The results will be submitted for presentation at national and international peer attended conferences. The final manuscript will be submitted for publication in a peer-reviewed Orthopaedic journal.

12. STUDY MANAGEMENT

The day to day running of this multi-centre study will be managed by the Research & Audit Manager (Angie Dempster) based at Hampshire Hospitals NHS Foundation Trust. Mr Robin Elliot will remain in overall control and senior leadership of this project. Collaborator meetings will be held every six weeks. An initial meeting will be held to standardise protocols including surgical technique, and use of the proforma. The aim of subsequent meetings will be to monitor patient recruitment rates, discuss complications and ensure robust data collection. After completion of the study, results will be analysed, discussed and disseminated. The study is intended to run for one year.

There is no study steering group. No formal patient and public involvement process has been conducted.

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