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Case Reports and Series

Application of nano arthroscopy in the office setting for the removal of an intra-articular loose osseous body not identified by magnetic resonance imaging: A case report

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4

A 65-year-old female with 18 months of left ankle pain after a traumatic injury underwent nano arthroscopy of her left ankle with identification and removal of a loose osseous body annealed to her tibiotalar joint not seen on advanced imaging. The arrival of nano arthroscopy has provided foot and ankle surgeons with the necessary tools to now locate sources of pain and dysfunction not necessarily observed on advanced imaging and directly intervene on these disorders in the office setting. This case report describes one of the first patients treated with an innovative nano arthroscopy device.

In-office needle arthroscopy (IONA) became available in the 1990s as a method for foot and ankle surgeons to rapidly visualize and evaluate a joint under local anesthesia[1]. Undefined indications for the technique, inability to simultaneously treat identified pathologies, inadequate picture resolution, and lack of access all limited the widespread adoption of IONA[1-7]. Recent improvements on IONA have focused on developing a bedside arthroscopy kit capable of replacing many interventions offered by a full operating room arthroscopy suite.

The Arthrex® (Naples, Florida, US) Nanoscope™ nano arthroscopy system was released for clinical use in September 2019 in the United States.[8] This nano arthroscopy system is 2.2 mm in diameter with an inflow sheath covering a 1.9 mm camera. The camera offers a 400 × 400 resolution with 120° field of view and options for image and video capture. Video feed is sent through a 13″ high definition monitor. Instrumentation available for the system includes punches, graspers, scissors, a retractable probe, shavers, burrs, and resectors. This nano arthroscopy system aims to provide the foot and ankle surgeon with an innovative image guided alternative to primary or second-look arthroscopy that could be completed in the office.

In this case report, we describe a patient with chronic left ankle pain who failed conservative management and ultimately underwent in office wide-awake nano arthroscopy of her ankle with both discovery and removal of an osseous body that had not been visualized on her previous MRIs. The emphasis of this report is on the introduction of a relatively new and innovative office-based technology that is, by design, a less invasive intervention in the care of this and other disease processes.

Case Report

A 65-year-old woman presented to our office with anteromedial and lateral pain of her left ankle on dorsiflexion. Symptoms began after an access panel underneath a cash register closed on the dorsum of her ankle in November 2017. She had never had previous surgery on this ankle. Her past medical history, medications, and allergies were not pertinent to this report. A 3T MRI of her left ankle identified anterior sinus tarsi synovitis with ganglia extending from the anterior cervical ligament to the root of the extensor retinaculum and a fibrous extra-articular talocalcaneal coalition. The ganglion/synovial cyst was aspirated and injected with a mixture of lidocaine/bupivacaine/triamcinolone under ultrasound guidance with little relief. During subsequent follow-up visits, the patient's pain continued with an occasional associated locking sensation. Repeat MRIs demonstrated persistence of the ganglion/synovial cyst without other significant findings (Fig. 1A–C). At 18 months after her initial injury, the patient continued to report anterior ankle pain exacerbated with dorsiflexion. Having failed extensive conservative management, we felt that she was indicated for minimally invasive nano arthroscopy surgery to assess the degree of cicatrization in her ankle and seek additional sources for her pain. She underwent this procedure in August 2019.

A nano arthroscopy system was selected for this patient's procedure due to its capability to both diagnose and therapeutically intervene on identified pathology under local anesthesia (Fig. 2A). Prior to the procedure, the planned lateral and medial arthroscopy portal sites were injected with 1% lidocaine. The patient was placed supine on the procedure table. No tourniquet was applied. A needle was inserted into the anteromedial aspect of the joint and 10 mL of saline and 1% lidocaine were injected. The superficial peroneal nerve was marked. A standard anteromedial portal was developed, the nano arthroscope inserted, and the anterolateral portal developed under direct visualization. Synovial hyperplasia and cicatrized tissue were resected with the 2.0 mm shaver to allow for a diagnostic arthroscopy. At this stage, the medial aspect of

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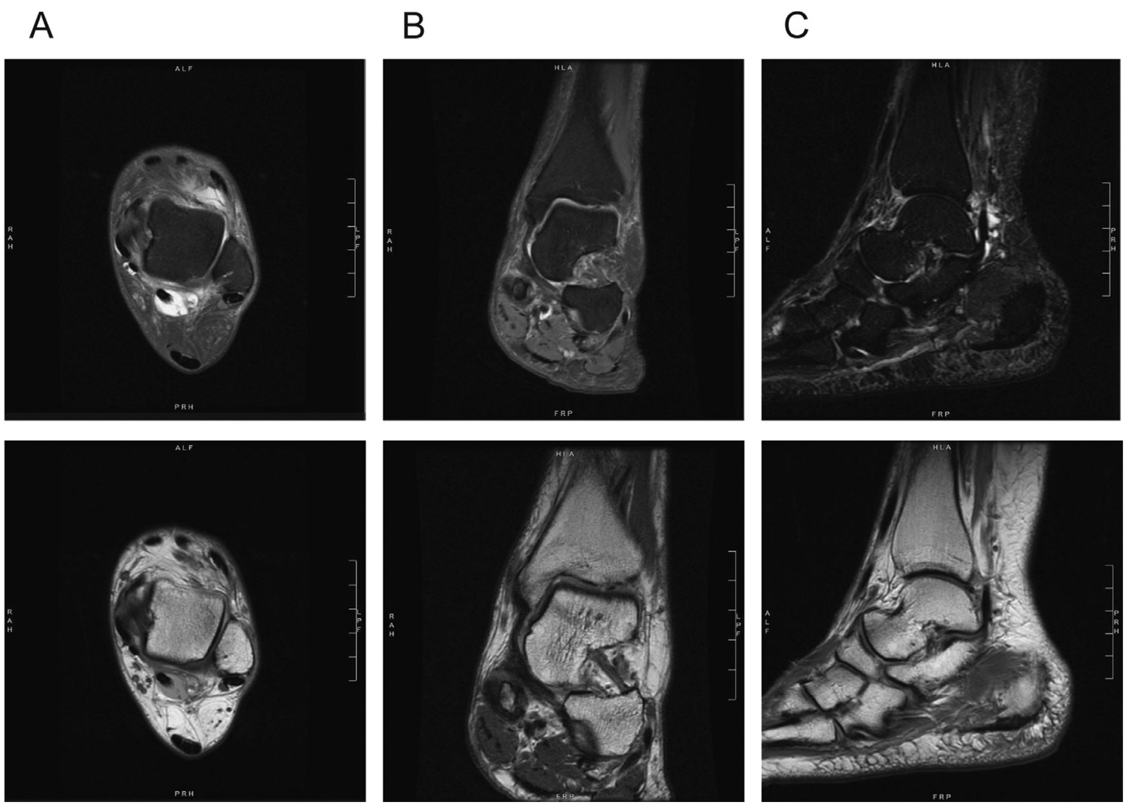

Fig. 1. An MRI of the patient's left ankle 4-months prior to the nano arthroscopy procedure. A $1.2 \times 0.7 \times 2.1$ cm ganglion is noted in the lateral aspect of the sinus tarsi. No loose osseous body is identified. (A) Representative axial view. (B) Representative coronal view. (C) Representative sagittal view. T2-weighted images are shown in the top row and T1-weighted images are shown in the bottom row.

the tibiotalar joint was visualized and a smooth 4 mm x 6 mm chronic-appearing osseous body was noted to be affixed with cicatrized tissue to the joint line (Fig. 2B,C). The osseous body was freed with a 2.0 mm shaver and removed with intra-articular graspers (Video). The diagnostic arthroscopy was subsequently completed and any remaining cicatrized tissue was debrided. Finally, the portal wounds were closed with steri-strips and a compressive bandage overwrap was applied without any sutures. The patient remained awake during the nano arthroscopy and observed each step of the procedure on the viewing monitor. She was instructed to remain non-weight bearing for one day and then allowed to self-transition to weight-bearing as tolerated.

The patient was seen for regularly scheduled follow-up visits. She was walking with less difficulty by two weeks after her procedure, and she actively participated in an outpatient physical therapy regimen. Although her anterior ankle pain had greatly improved since her nano arthroscopy, she continued to have lateral ankle discomfort at her six-month post-operative visit. She underwent resection of the ganglion cyst alongside an anterior talofibular ligament reconstruction and posterior ankle arthroscopy and debridement to treat the suspected source of this complaint. Post-operatively, she was unable to attend supervised physical therapy and self-limited travel outside her home due to concerns over COVID-19 exposure. At her one-year follow-up visit from the nano arthroscopy procedure, despite attempting home physical therapy exercises, she continued to have mild to moderate fluctuating pain over her medial, anterior, and lateral ankle suspected to now be secondary to functional deconditioning. Additional ongoing treatment modalities with an emphasis on an intense at-home physical therapy regimen were employed to assist the patient with alleviating the pain around her ankle.

Discussion

In-office needle arthroscopy has been available for over twenty years as a method to perform a diagnostic arthroscopy in the clinical office.[1,5,6] A recently released nano arthroscopy system expanded on IONA and permits foot and ankle surgeons to now conduct simple arthroscopic-based interventions with a higher resolution under local anesthesia. This case study presented a patient who benefitted from in-office nano arthroscopy via simultaneous identification and removal of a loose body not observed on multiple 3T MRI series.

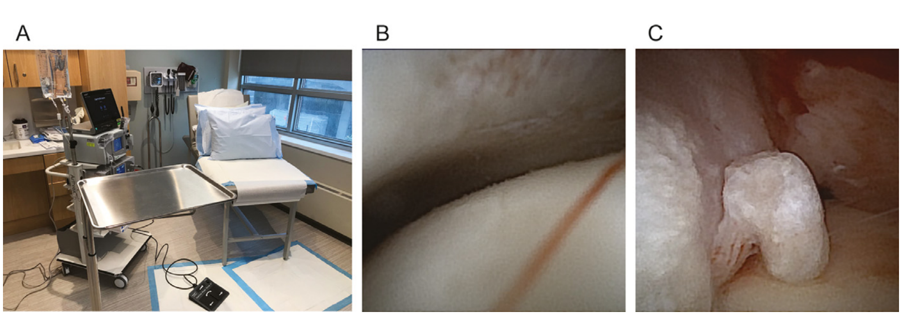

Fig. 2. Intraoperative snapshots of the patient's nano arthroscopy procedure. (A) The nano arthroscopy in-office set-up. (B) Representative view of the tibiotalar joint. (C) Loose body identified on the medial aspect of the tibiotalar joint.

Arthroscopy has previously been compared to MRI for diagnostic accuracy. Gill et al. in a prospective, blinded multicenter trial enroled 110 patients who each received an MRI, an IONA exam, and a surgical diagnostic arthroscopy of the knee joint[9]. The surgeon and a blinded expert then assessed 7 different anatomical regions. MRI was found to be less accurate than in-office arthroscopy and surgical diagnostic arthroscopy. In-office arthroscopy was equivalent to surgical diagnostic arthroscopy with regard to accuracy, sensitivity, and specificity. Deirmengian et al. performed a second prospective observational study that compared IONA to MRI for 106 patients with intra-articular knee pathologies.[5] The IONA demonstrated diagnostic accuracy for 91.5% of patients whereas MRI was accurate for 61.3% of patients for all pathologies. Sensitivity and specificity for the IONA was 92.6% and 100%, respectively, whereas MRI had statistically significant lower sensitivity and specificity at 77.8% and 87.5%, respectively, for identifying meniscal tears. Importantly, IONA had a sensitivity of 86.7% for identifying loose bodies compared to MRI with a sensitivity of 20%. Finally, the nano arthroscopy system used in our report has already been demonstrated to be safe and allow for adequate visualization of important structures around the ankle in cadaveric models.[10,11] These articles support our own case report in the use of nano arthroscopy for identification and management of suspected intra-articular loose bodies and lesions of the ankle not visualized on MRI.

Conclusion

Arthroscopic management of loose bodies of the ankle is an established treatment with identified expedient recovery providing no acute complications are appreciated. Our patient described in this case report was one of the first to undergo a diagnostic arthroscopy with intervention at the same time via a nano arthroscopy system. Unlike previous IONA systems which were only diagnostic tools, this innovative nano arthroscopy system allows for immediate correction of select lesions in an office setting. Feedback from patients about nano arthroscopy has been overall positive; many enjoy watching their procedure and interacting with the operative team. Future work will need to further explore how nano arthroscopy can augment diagnostic evaluation by MRI. Nevertheless, the nano arthroscopy system truly has the potential to change a paradigm in both diagnosis and treatment in clinical practice.

Roles of Investigational Team

John F. Dankert: Conceptualization, Methodology, Formal analysis, Resources, Writing- Original Draft, Writing - Review & Editing, Visualization; Yoshiharu Shimozono: Conceptualization, Methodology, Formal analysis, Resources, Writing - Original Draft, Writing - Review & Editing, Visualization; Emilie R. C. Williamson: Conceptualization, Methodology, Formal analysis, Resources, Writing - Original Draft, Writing - Review & Editing, Visualization; John G. Kennedy: Conceptualization, Methodology, Formal analysis, Resources, Writing - Original Draft, Writing-Review & Editing, Visualization, Supervision, Project administration.

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Patient Informed Consent Statement

We did not seek IRB approval for this investigation because NYU Langone Health does not require IRB review for case studies and we did not employ the use of protected health information in this investigation that would place the patient beyond minimal risk for identification. Furthermore, this single case study was designed to demonstrate innovative advancements in nano arthroscopy. Complete informed consent was obtained from the patient for the publication of this study and accompanying images.

Declaration of competing interest

Dr. Kennedy is a paid consultant for Arteriocyte, Inc. (Isto Biologics), and Arthrex, Inc. He is also a board member for the European Society of Sports Traumatology, Knee Surgery, and Arthroscopy (ESSKA), International Society for Cartilage Repair of the Ankle (ISCRA), American Orthopaedic Foot & Ankle Society (AOFAS) Awards and Scholarships Committee, and International Cartilage Repair Society (ICRS) finance board. The other authors have no disclosures to report.

CRediT authorship contribution statement

John F. Dankert: Writing – review & editing, Supervision. **Yoshiharu Shimozono:** Writing – review & editing, Supervision. **Emilie R.C. Williamson:** Writing – review & editing. **John G. Kennedy:** Writing – review & editing, Supervision.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.fastrc.2021.100012.

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