Anatomy & Physiology

Ramesh et al., Anat Physiol 2016, 6:2
http://dx.doi.org/10.4172/2161-0940.1000199

Research Article Open Access

Accuracy of Ankle Intra-articular Injections

Ashwanth Ramesh[1*], Farshid Maleki[2], Adrian Jesmond Cassar-Gheiti[2], Kathryne Hunter[3] and John Vincent McKenna[2]

[1]*Department of Anatomy, St. Stephens Green, Dublin 2, Ireland*

[2]*Department of Orthopaedics, St James's Hospital, James' street, Dublin 8, Ireland*

[3]*Department of Orthopaedics, Trinity College Dublin, Ireland*

[*]**Corresponding author:** Ashwanth Ramesh, Department of Anatomy, St. Stephens Green, Dublin 2, Ireland, Tel: 00447751523239; E-mail: ramo7isme@gmail.com

Rec date: Dec 23, 2015; **Acc date:** Feb 08, 2016; **Pub date:** Feb 11, 2016

Abstract

Purpose: Blind intra-articular injections (BIAI) of various joints are performed for diagnosis and treatments of different pathologies in sport medicine, rheumatology, general practice and orthopaedics. The gold standard for any joint injection is image guidance but studies have shown higher accuracy for BIAI. Objective of this study was to evaluate the intraoperative success and accuracy of ankle joint intra-articular injections.

Materials and Methods: A total of 100 patients were assessed. Mean age was 34.11 years (range 18 to 80). Three orthopaedic surgeons of a variable skill level carried out all ankle joints insufflation with a 14G sterile needle and physiological saline. The result was recorded as positive when a back flow of saline was seen during the insertion of the arthroscopic trocar, indicating that the joint capsule was breached. If no back-flow of saline was seen, this was recorded as a negative result. No further attempts to re-position or re-apply the needle were made if unsuccessful at the first attempt. Statistical analysis was performed using SPSS software version 21.0 (IBM Corp. 2012). Data was organised into contingency tables and analysed with Fishers' exact test (two-sided, 95% confidence interval).

Results: In total 78 male and 22 female patients were included in the study. Of the 100 injections performed 63 were intra-articular (translating to an accuracy rate of 63%). The pre-operative diagnosis affected the accuracy. This was found to be significant ($p<0.0001$). The side of surgery also affected the accuracy and this was also found to be significant ($p<0.02$).

Conclusion: The results of this study have demonstrated that blind intra-articular injection of the ankle joint is not incredibly accurate. Despite the high skill level of an experienced foot and ankle surgeon, only 63% of injections were placed successfully into the ankle joint. This study therefore stresses the importance of using image guidance when performing ankle joint injections for diagnostic and therapeutic reasons.

Levels of evidence: Level III

Keywords: Blind intra-articular injections; Sport medicine; Rheumatology general practice; Orthopaedics

Introduction

Most ankle intra-articular injections (IAI) are carried out by physical examination (PE) or palpation. These injections are carried out either diagnostically or therapeutically. Therapeutic injections are usually administered with corticosteroids mixed with local anaesthetic, or alternatively by viscos supplementation, either with hyaluronic acid or plasma rich platelet (PRP) [1-9]. In the past, many studies have been carried out to demonstrate a good accuracy rate with blind intra-articular injections (BIAI) of different joints and have also demonstrated its effectiveness measured through various clinical outcomes [1-4,9-14]. While other studies have shown poor accuracy rates [4,11-13,16] and advocate the use of image guidance to increase the accuracy of IAI [1-3,5-8,10,11,15,16]. The argument for using imaging is that it not only provides a valuable means of making a diagnosis for clinicians but also meets patient's therapeutic expectations of intervention. There are a number of imaging modalities currently in use, ranging from fluoroscopy, ultrasonography, computed tomography (CT) and magnetic resonance (MR- both direct and indirect) arthrography [17]. The reported accuracy rates in the literature for each modality varies ranging from 76-93.5% for fluoroscopy [5-8,11,15] 66-100% for ultrasonography [1,16,18], 96.7% for CT [19] and 67% for MRI [20]. Commonly all BIAI are carried out in an outpatient setting and there has been no attempt to evaluate the accuracy of IAI intra-operatively in an operating theatre setting. Therefore, the main objective of this study was to determine the accuracy rate of BIAI of the ankle joint in patients before they were underwent an elective ankle arthroscopic procedure. In particular, we wanted to determine the accuracy rate of BIAI in a controlled environment such as the operating theatre.

Material and Methods

Study design

The study was essentially a prospective multi-centre, multi-surgeon case series of 100 patients that presented to the elective foot and ankle

clinic. All patients had specific ankle pathologies that required surgical intervention. Prior to the respective elective surgical procedure patients were consented to participate in the study. In total, there were 78 male and 22 female patients. Patients with inflammatory and haemophiliac arthropathy were excluded. The procedures were carried out in three dedicated centres for foot and ankle surgery in Dublin, Ireland. A specialist foot and ankle surgeon (consultant), a senior orthopaedic registrar (on a foot and ankle fellowship) and one junior registrar (in orthopaedic clinical training) performed all ankle intra-articular injections, in the operating theatre. The ethics committee based in Sports Surgery Clinic, Dublin, Ireland approved the study.

Variable	Total	Intraarticular	Extraarticular	p value
Mean Age (years)		32.51	36.84	
Gender (%)				
Male	78	48	30	
Female	22	15	7	
Diagnosis (%)				
Chronic instability	34	20	14	< 0.0001
Chronic ankle pain	27	18	9	
High ankle sprain	18	14	4	
Ant. impingment	7	4	3	
End stage OA	11	4	7	
Others*	3	3	0	
SurgerySide (%)				
Right	60	34	26	0.02
Left	40	29	11	

Others*: 1. Ankle (pronation external rotation) fracture requiring ORIF & MCL repair.

2. Masonnaive fracture underwent ORIF with syndesmosis stabilization and MCL repair.

3. A Tillux fracture required arthroscopic fixation.

Table 1: Baseline characteristic of patients with various diagnosis, procedures and accuracy rate of IAI.

Injection technique

Following application of general anaesthesia and patient positioning, the ankle joint was cleaned with bethadine (10% Povidone Bethadine™ w/w alcoholic tincture) and sterile surgical drape were applied. All BIAI were carried out anteromedially at the tibiotalar joint line, just medial to Tibialis anterior tendon. A 22-gauge, 1.5-inch needle mounted on a 10 ml syringe was firstly used to inject blindly, 10 mls of 0.9% normal saline into the ankle joint. Subsequently, a 5 mm longitudinal incision (to house a 30º, 3.7 mm arthroscopic sleeve) was made over the injection site, and blind dissection with artery clips was carried out to create an access to the ankle joint. Then a standard arthroscopic trocar was introduced to pierce the joint capsule of the ankle joint. Positive result was noted when a sudden pressurised out flow of the previously injected normal saline was observed, indicating that the joint capsule was successfully breached. The failure to see this pressurised out flow of normal saline from the ankle joint was considered as a negative result. No further attempts to re-position or re-apply the needle were made if the first attempt was unsuccessful.

Statistical analysis

Statistical analysis was performed using SPSS software version 21.0 (IBM Corp. 2012). Data was organised into contingency tables and analysed with Fishers' exact test (two-sided, 95% confidence interval). The actual results were compared to an expected result (namely, a 100% accuracy rate). The alpha value was set at <0.05 and a p value less than this was considered to be significant.

Results

In total, 78 male and 22 female patients were included in this study. Patients' characteristics are summarised in Table 1. The mean age overall was 34.11 (range 18 to 80). Overall, 63% of BIAI were intra-articular and 37% were extra-articular. Specifically, 61.53% (48 out of 78) male patients had positive, and 38.47% (30 out of 78) had a negative result. In the female cohort, 68.18% (15 out of 22) had positive results and 31.82% (7 out of 22) had a negative result. With regards to the side of BIAI, 56.66% (34 out of 60) of right sided BIAI were accurate compared to 72.5% (29 out of 40) of left sided BIAI, this was found to be statically significant (p< 0.02). The primary reason of patients undergoing ankle arthroscopic intervention varied, from chronic ankle instability (34%), chronic ankle pain secondary to tibio-talar osteochondral defect changes (27%), high ankle pain (18%), end stage osteoarthritis (11%), anterior impingement due to osteophytes (7%) and others (3%).

Discussion

Blind intra-articular injections (BIAI) are usually carried out for diagnostic or therapeutic purposes for various ankle pathologies ranging from inflammatory arthropathy, degenerative arthropathy, post traumatic arthritis, soft tissue pathology and tendinopathy [1]. Numerous studies have highlighted the importance of BIAI not only for an accurate diagnosis but also for assessing patients response to therapy [1,2,4,7,10]. Overall, this study has demonstrated that 63% of BIAI were intra-articular and 37% were extra-articular, this was significant (p<0.0001). Additionally, BIAI of the left side was more accurate compared to the right (72.5% versus 56.66%, respectively), this was also significant (p<0.02).

Most intra-articular injections in an outpatient setting are carried out by clinical examination and palpation alone16. Many studies had shown a low accuracy rate for such injections of various articulating joints, reducing their clinical efficacy [4,11-13,16]. To date there have only been a few studies on the accuracy of BIAI of the ankle joint [1-4,9,14].

In a study by Jones et al. 33.3% out of ankle BIAI were 9 ankles IA injections (33.3%) recorded as inaccurate and 52% of BIAI injections of other peripheral joints were inaccurate, effectively reducing the clinical response [3]. The study recommended placing recommendations from the study is to place greater emphasis on training to improve the accuracy of injection techniques. Contrastingly, in another study, by Lopes et al. showed a very high accuracy (77%) for BIAI of the 54 ankle joints [2], showed a very high accuracy (77%) for BIAI of the 54 ankle joints. However, the study does

not describe the actual injection technique in detail making it difficult to validate the results. That was Again; Moreover, 4 out of the 12 injections were into the sub-talar joint and not the ankle. Heidari et al. in a cadaveric study showed a high accuracy for BIAI of the ankle joint. Overall, 76 ankles were injected through both anterolateral (86.1%) and anterometial (77.5%) approaches with resulting in a total accuracy rate of 81.6% [13]. Again However, the authors only considered one pathological entity (namely osteoarthritis), and no matter how well cadavers are preserved, it is difficult to extrapolate meaningful findings from a cadaveric specimen in comparison to a live patient in a clinical setting.

To improve accuracy rates imaging modalities such as ultrasound sound guidance might be a useful adjunct. Work carried out by Cunnington et al. [1] compared ultrasound guided intra-articular injection of the ankle joint to BIAI1. Compared ultrasound guided IA injection of the ankle joint with clinical examination. Guided IAI showed an accuracy of 85% compared to an accuracy rate of 58% accuracy rate by BIAI alone with clinic. The authors concluded IAI the accuracy of intra-articular injection improves significantly with musculoskeletal ultrasound, but it provides little or no benefit in terms of clinical outcome. Similarly, finally, a cadaveric study by Reach et al. demonstrated 100% accuracy, when performing various joint injections under ultrasound guidance [18] demonstrated 100% accuracy, when performing various joint injections under ultrasound guidance. These methods clearly emphasise the increasing accuracy of IAI as compared to injection by palpation. However, they both studies do recognise the limitations of that ultrasonography, in that, it is technically demanding, and therefore sufficient adequate training is required to achieve high accuracy rates as demonstrated. Further limitations with ultrasonography include the high set-up and running costs, therefore, this might not be suitable in an orthopaedics, rheumatology, general practise or sports medicine outpatient setting.

To our knowledge this is the first study to assess the accuracy of intraoperative intra-articular ankle injections confirmed using arthroscopy. All the patients were undergoing routine ankle arthroscopy by an experienced foot and ankle specialist surgeon for the various morbidities as listed in (Table 1). Taking into account the variation in In spite of the surgeons surgical experience we could only achieve could only achieve an accuracy of 63% overall, making. This translates to an inaccuracy of 37% of our intra-articular injections inaccurate (that is outside the ankle joint), which is quiet high. There are reports in the literature that pain reported by the patient can contribute to a higher inaccuracy rate [2]. This was not a factor in our study as all patients had a general anaesthetic. Extra-articular delivery of pharmacological agents can also cause adverse effects. We didn't not see any adverse events in our study as all injections consisted of sterile normal saline. One explanation for the degree of difficulty in the left ankle IAI could be due to the right hand dominance of the surgeon. It would be easier for a right handed surgeon to inject into the right ankle and vice versa.

Furthermore, we also looked at the rate of IAI accuracy in patients undergoing specific arthroscopic procedures for various ankle pathologies. The unstable ankle joint requiring lateral ligament stabilization showed the highest accuracy rate in this study. This followed by chronic ankle pain due to talar OCD pathology and syndesmosis ankle instability respectively. Our study has shown that this is an important factor when determine the success of IAI for the ankle joint. This did contribute to the 37% failure rate seen in our study and is in keeping with failure rates of 24%-33% reported in literature [4,6]. We have therefore given strong evidence suggesting the need for more accurate methods of needle placement inside the ankle joint. Some authors have demonstrated improved accuracy of various joint injections by using musculoskeletal image guidance such as, fluoroscopy, ultrasound, CT and MR arthrography [1,5-8,15-19]. Out of all these modalities fluoroscopy seems to be the best option, in terms of ease of use, being the most cost effective and least technical.

We recognise that this study has inherent limitations. Firstly this non-randomized, non-blinded controlled prospective study, which represents level IV evidence. It is a single surgeon experience as such is exposed to procedural and selection bias. The patient population was predominantly male and we did not have a control group for comparison. However, it is to our knowledge, that this is the first intraoperative surgical experience for BIAI and it further adds to the knowledge available in the literature.

Conclusion

This study demonstrated a high rate of inaccurate blind ankle joint injections, even by a highly qualified foot and ankle specialist. As such an even higher inaccuracy rate can be expected in trainee surgeons or physicians [21]. We therefore advocate and recommend ankle joint injections should be carried out by either trained physicians or radiologists under some form of image guidance.

References

1. Cunnington J, Marshall N, Hide G (2010) A randomized, double-blind, controlled study of ultrasound-guided corticosteroid injection into the joint of patients with inflammatory arthritis. Arthritis Rheum 62: 1862-1869.
2. Lopes RV, Furtado RN, Parmigiani L, Rosenfeld A, Fernandes ARC (2008) Accuracy of intra-articular injections in peripheral joints performed blindly in patients with rheumatoid arthritis. Rheumatology (Oxford) 47: 1792-1794.
3. Salk RS, Chang TJ, D'Costa WF, Soomekh DJ, Grogan KA (2006) Sodium hyaluronate in the treatment of osteoarthritis of the ankle: a controlled, randomized, double-blind pilot study. J Bone Joint Surg Am 88: 295-302.
4. Jones A, Regan M, Ledingham J, Pattrick M, Manhire A, et al. (1993) Importance of placement of intra-articular steroid injections. BMJ 307: 1329-1330.
5. Hay SM, Moore DJ, Cooper JR, Getty CJ (1999) Diagnostic injections of the hindfoot joints in patients with rheumatoid arthritis prior to surgical fusion. Foot 9: 40-43.
6. Witteveen AG, Sierevelt IN, Blankevoort L, Kerkhoffs GM, van Dijk CN (2010) Intra-articular sodium hyaluronate injections in the osteoarthritic ankle joint: effects, safety and dose dependency. Foot Ankle Surg 16: 159-163.
7. Witteveen AG, Kok A, Sierevelt IN, Kerkhoffs GM, van Dijk CN (2013) The optimal injection technique for the osteoarthritic ankle: a randomized, cross-over trial. Foot Ankle Surg 19: 283-288.
8. Fox MG, Wright PR, Alford B, Patrie JT, Anderson MW (2013) Lateral mortise approach for therapeutic ankle injection: an alternative to the anteromedial approach. AJR Am J Roentgenol 200: 1096-1100.
9. Mei-Dan O, Carmont MR, Laver L, Mann G, Maffulli N, et al. (2012) Platelet-rich plasma or hyaluronate in the management of osteochondral lesions of the talus. Am J Sports Med 40: 534-541.
10. Fuchs S, Mönikes R, Wohlmeiner A, Heyse T (2006) Intra-articular hyaluronic acid compared with corticoid injections for the treatment of rhizarthrosis. Osteoarthritis Cartilage 14: 82-88.

11. Helm AT, Higgins G, Rajkumar P, Redfern DR (2003) Accuracy of intra-articular injections for osteoarthritis of the trapeziometacarpal joint. Int J Clin Pract 57: 265-266.
12. Sethi PM, Kingston S, Elattrache N (2005) Accuracy of anterior intra-articular injection of the glenohumeral joint. Arthroscopy 21: 77-80.
13. Eustace JA, Brophy DP, Gibney RP, Bresnihan B, FitzGerald O (1997) Comparison of the accuracy of steroid placement with clinical outcome in patients with shoulder symptoms. Ann Rheum Dis 56: 59-63.
14. Heidari N, Pichler W, Grechenig S, Grechenig W, Weinberg AM (2010) Does the anteromedial or anterolateral approach alter the rate of joint puncture in injection of the ankle?: A cadaver study. J Bone Joint Surg Br 92: 176-178.
15. Jackson DW, Evans NA, Thomas BM (2002) Accuracy of needle placement into the intra-articular space of the knee. J Bone Joint Surg Am 84-A: 1522-1527.
16. Di Sante L, Cacchio A, Scettri P, Paoloni M, Ioppolo F, et al. (2011) Ultrasound-guided procedure for the treatment of trapeziometacarpal osteoarthritis. Clin Rheumatol 30: 1195-1200.
17. Cerezal L, Llopis E, Canga A, Rolón A (2008) MR arthrography of the ankle: indications and technique. Radiol Clin North Am 46: 973-994, v.
18. Reach JS, Easley ME, Chuckpaiwong B, Nunley JA 2nd (2009) Accuracy of ultrasound guided injections in the foot and ankle. Foot Ankle Int 30: 239-242.
19. Saifuddin A, Abdus-Samee M, Mann C, Singh D, Angel JC (2005) CT guided diagnostic foot injections. Clin Radiol 60: 191-195.
20. Fritz J, Thomas C, Tzaribachev N, Horger MS, Claussen CD, et al. (2009) MRI-guided injection procedures of the temporomandibular joints in children and adults: technique, accuracy, and safety. AJR Am J Roentgenol 193: 1148-1154.
21. Barilla-Labarca ML, Tsang JC, Goldsmith M, Furie R (2009) Design, implementation, and outcome of a hands-on arthrocentesis workshop. J Clin Rheumatol 15: 275-279.