Journal of Hip Preservation Surgery, 2023, **10**, 119–122
DOI: https://doi.org/10.1093/jhps/hnad011
Advance access publication date: 27 April 2023
Research article

The anterior superior iliac spine is a reliable novel landmark for preemptive periacetabular analgesia in hip arthroscopy

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ABSTRACT

Appropriate post-operative (post-op) pain control has been shown to reduce length of stay and facilitate day case surgery. Periacetabular injection of bupivacaine is effective in pain reduction after hip arthroscopy. This study aims to evaluate the anterior superior iliac spine (ASIS) as an anatomical landmark to facilitate needle insertion prior to fluoroscopy. The meeting point derived from a vertical line one fingerbreadth distal to the ASIS and a longitudinal line from the greater trochanter (GT) was used as a landmark in 30 consecutive hip arthroscopy patients for periacetabular analgesia. The distance between the tip of the needle and the acetabular roof was measured via fluoroscopy. Needle location was corrected if needed, followed by periacetabular bupivacaine injection (at anterior, lateral and posterior joint aspects). Post-op pain was measured using the Visual Analog Scale (VAS) 4–6 h post-op and at discharge. The ASIS and GT were identified and used for periacetabular analgesia landmarks in all cases. Results revealed that 93.3% of needle entries fell within 10 mm of the lateral acetabular rim and only one case had fallen distal to it. The post-op mean VAS score was 1.03 (range 0–6, standard error – 0.30, median = 0). At hospital discharge, 90% (27/30 of patients) reported VAS score $\leq$ 5. Twenty-six of the 30 patients were discharged on the same day as the operation (remaining four patients stayed due to accommodation/traveling issues). The ASIS and GT can be used as an anatomical landmark for periacetabular analgesia in hip arthroscopy with reproducible needle location, significant analgesic effect and minimal radiation.

INTRODUCTION

Hip arthroscopy is a well-established orthopedic intervention for numerous indications, and its use has grown exponentially in the past two decades [1, 2]. However, this procedure, like other orthopedic surgeries, may cause post-operative (post-op) pain to a moderate-to-severe degree, thus requiring effective pain management protocols [3, 4].

Periacetabular hip injection (PAI) has been proved in a randomized control trial to be effective and safe for post-op pain control [2]. These results were recently ratified by another study [5]. PAI is typically performed by a surgeon using fluoroscopic guidance. The PAI may require several attempts to correctly position the needle tip at the desired anatomical location, thus exposing both patient and surgeon to unnecessary/excessive radiation.

PAI prior to hip arthroscopy is routinely used in our institution for perioperative pain control. Constant relations between the needle entry point and anatomical landmarks have been observed. The needle entry point was observed to be about one fingerbreadth distal to the anterior superior iliac spine (ASIS) and in line with greater trochanter (GT).

Studies suggest that non-image-guided (i.e. using anatomical landmarks and palpation) injections into the hip are an effective and safe alternative to image-guided injections when evaluating the percentage and duration of pain relief after injection [6–8].

The purpose of this study was to evaluate reproducible needle placement at the desired periacetabular location using the ASIS and GT as anatomical landmarks. The secondary purpose was to evaluate the pain control compared with previous reported studies of PAI. We hypothesized that the use of superficial anatomical landmarks of the ASIS and GT for periacetabular needle placement can be accurate, can be reproducible in needle location, can control post-op pain and can minimize fluoroscopy exposure.

MATERIALS AND METHODS

The study protocol was reviewed and approved by the local institutional review board. This is a prospective, single-center study. Inclusion criteria were all patients undergoing hip arthroscopy

Submitted 30 January 2023; Revised 16 February 2023; revised version accepted 7 April 2023

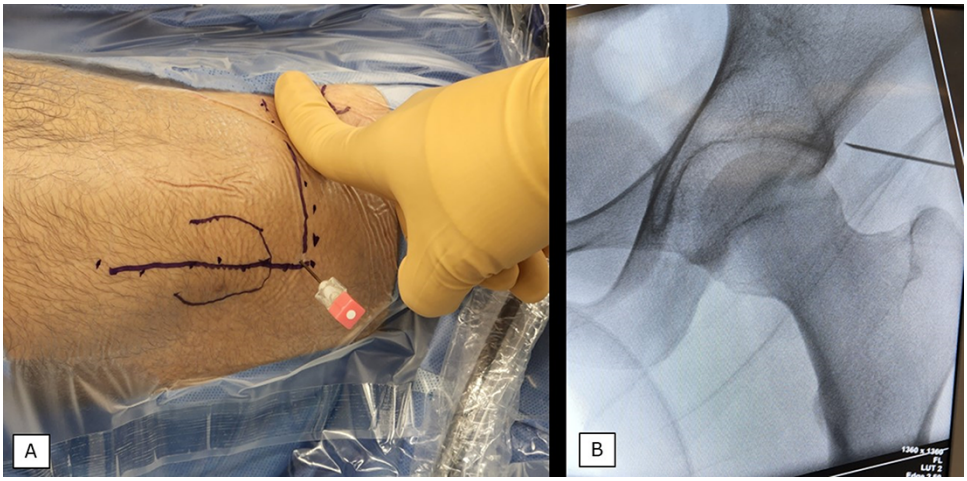

Fig. 1. (**A**) Placement of the needle in the intersecting point of a line drawn between one fingerbreadth distal to the ASIS and the distal-proximal line at mid-GT level. (**B**) Single AP fluoroscopy image confirms correct needle tip position.

for femoroacetabular impingement and/or labral repair, older than 18 years of age, with the ability to give informed consent. Exclusion criteria included patients younger than 18 and prior open hip surgeries.

All hip arthroscopies were performed by a single, fellowship-trained surgeon in a single institute from January 2022 through April 2022. Four pediatric cases were excluded. Thirty consecutive patients were included for needle placement site analysis and post-op pain score.

Needle placement and injection technique

Patients were positioned supine on a designated hip arthroscopy table (Smith & Nephew, Andover, MA, USA) with the hip in a neutral position, under general inhalation anesthesia. No other regional blocks (spinal, epidural, plexus or other regional) were performed. For induction prior to intubation, intravenous fentanyl 150 mic was administered.

All procedures were performed as central compartment first under traction. After prep and drape, PAI was performed. An 18G spinal needle was used to administer 20 mL of bupivacaine 0.5% with epinephrine (1:200 000) periacetabularly. The spinal needle insertion site was based entirely on anatomical landmarks without the aid of imaging tools. The bony landmarks used for needle insertion were the ASIS and the GT. The needle insertion point on the skin was located at the intersection between two lines: a mediolateral line one fingerbreadth distal to the ASIS and a distal-proximal line along the midline of the GT (Fig. 1). The needle was then advanced in a trajectory parallel to the floor and perpendicular to the trunk until a bony structure was met. At this point, a single anterior-posterior (AP) fluoroscopy image was taken (Fig. 1) to verify the needle tip position, and the needle tip position was adjusted if necessary.

Misplacement of the needle was defined as a deviation of >10 mm proximal to the lateral acetabular rim or any deviation distal to the lateral acetabular rim. In case of needle misplacement, an adjustment of needle tip position was performed. Prior to injection, gentle suction on the syringe was applied to avoid injection to a blood vessel. Bupivacaine was discharged into the periacetabular space in three boluses (∼7 mL each) at the anterior, lateral and posterior aspects of the joint as previously described Shlaifer et al. [2].

Traction was applied immediately after the PAI. No local anesthesia was used prior to skin incision for the arthroscopic portals. The anterolateral portal was created first once adequate joint space distention (1.5–2 cm) was achieved followed by the modified anterior portal. Interportal capsulotomy was performed in all cases. Saline lavage started once the first portal was created, within 5 min after the PAI. Appropriate surgery was performed according to the patient's diagnosis and intraoperative findings.

Pain management in the immediate post-op period

Post-op pain in the post-anesthetic care unit was assessed using the Visual Analogue Scale (VAS) pain score system which scores pain on a scale of 0–10. On this scale, 0 signifies no pain while 10 signifies the worst ever pain experienced. The VAS score was recorded by a non-related nurse practitioner experienced with VAS intake during the first 30 min and then hourly until discharge from the unit (4–6 h post-operatively) and at the discharge from the hospital. Patients were discharged from the hospital on the same day or 1 day after the procedure.

Management of pain in the post-anesthetic care unit was performed via a routine VAS-oriented pain protocol, taking patient, surgery and VAS information and contra-indications into account. Once a high VAS score was documented and/or a pain request was made by the patient, patients received analgesics based on the aforementioned VAS score protocol (1 to 4, paracetamol 100 mg; 5 to 7, tramadol 100 mg and 8 to 10 morphine 5 mg). Patients were later released from the post-anesthetic care unit based on the post-op and post-anesthetic care guidelines so long as they achieved adequate pain management (defined as VAS < 4).

Data collection

Needle placement site analysis was performed by an independent reviewer. The distance of the needle tip from the lateral acetabular rim was measured after calibrating the actual versus

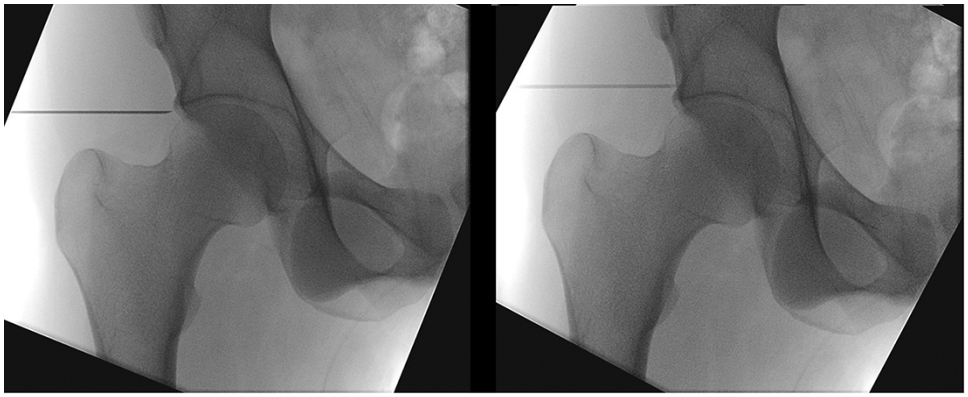

Fig. 2. A minor distal misplacement of the needle on the left with the correction to the desired injection location on the right .

measured needle diameter. This ratio was multiplied by the measured distance for the actual distance.

Medical, demographic and surgical data were collected from the patients' computerized files including body mass index (BMI). The VAS scores were than grouped into four correlating Numerical Rating Scale groups according to Karcioglu et al. [9]: 0 = no pain, 1–3 = mild pain, 4–6 = moderate pain and 7–10 = severe pain.

Statistical analysis

All statistical analyses were carried out using IBM SPSS 25 for Windows.

RESULTS

Thirty patients comprising 18 men and 12 women with a mean age of 41 years (range, 21–66 years) were enrolled in the study. The superficial landmarks of the ASIS and GT were successfully palpated in all patients. There were 27 correct placements of the needle and 3 misplacements, yielding a 90% success rate on the first attempt with a single fluoroscopy image. The average BMI of the correct needle placement group was 24.91 (range 19.4–32.9 with SD of 3.73). The average BMI of the incorrect needle placement group was 23.1 (range 19.5–25.4 with SD of 3.16). The three cases of misplacement were 13 and 14 mm proximal and 3 mm distal to the lateral acetabular rim; a minor single adjustment with no use of fluoroscopy was needed to achieve correct positioning (Fig. 2). Yet, for the purpose of the study, a second fluoroscopy was performed to confirm correct needle repositioning.

The post-op mean VAS score at discharge from the post-anesthetic care unit was 1.03 (range 0–6, Standard error (STE) – 0.30) with a median of 0. The post-op mean VAS score at discharge from the hospital was 1.52 (range 0–7, STE – 0.44) with a median of 0. At discharge from the hospital, 90% (27 patients) reported mild-to-moderate pain with VAS score $\leq$5 and 83.3% (25 patients) reported mild pain with VAS score $\leq$3.

Twenty-six out of the 30 patients were discharged on the same day as the operation (the remaining four patients stayed hospitalized due to accommodation and traveling issues and not health or pain concerns, and the mean VAS score for this group was 2.75).

No complications attributable to PAI were recorded.

DISCUSSION

The results of this study showed that the use of superficial anatomical landmarks (ASIS and GT) for periacetabular needle placement is accurate and reproducible in 90% of the cases on the first needle insertion without fluoroscopic guidance. A minor single adjustment was needed to achieve correct positioning in 10% of the patients. In addition, the results of pain control were comparable to previous reported studies of PAI [2, 5]. Pain scores demonstrated adequate pain relief in the immediate post-op period with 83.3% reported mild pain at hospital discharge.

In a randomized control study, Shlaifer et al. compared preemptive periacetabular to intra-articular administration of bupivacaine for post-op pain control after hip arthroscopy. PAI was superior to intra-articular administration in pain reduction during the first 18 h after hip arthroscopy. Kazum et al. did not demonstrate better pain control for patients who received post-op intra-articular blockade in addition to preoperative periacetabular blockade. Both the studies did not use superficial anatomical landmarks to facilitate correct needle placement nor they reported the number of fluoroscopy images performed to reach the desired periacetabular location of the needle. The post-op pain control in the current study was comparable to these studies with a mean VAS score of 1.52 at discharge from the hospital. Of note, the mentioned studies did not use pain-level categories as was used in the current study. Yet, the majority of the patients (83%) reported only mild pain at discharge [2].

Previous studies have investigated the success rate of non-image-guided hip injections, namely intra-articular; however, periacetabular injections were not discussed. The anatomical landmarks for injections around the hip included in these studies were the ASIS, GT, symphysis pubis and the palpated femoral artery pulse [6–8, 10–12]. Mei-Dan et al. found the intersection of the lines drawn from the ASIS and 1 cm distal to the tip of the GT to be a reproducible and successful method for non-image-guided intra-articular injection of the hip in 93% of the time [10]. Other studies have shown various success rates of non-image-guided hip injections (from 51% to 95%).

The injection method in the current study did utilize a single fluoroscopy after positioning of the needle confirming 90%

success on the first attempt. The three patients with incorrect needle placement had BMI within normal range.

This study has several limitations, primarily the relatively small population size and the absence of a control group. The sample size may have not taken into effect anatomical variations as can be expected in a large-scale dataset. The procedure was performed by a single, well-experienced hip arthroscopy surgeon. This anatomical landmark approach for periacetabular analgesia in residents or less-experienced surgeons is yet to be tested.

In summary, this study is the first to report the use of anatomical landmarks (ASIS and GT) for periacetabular needle placement for PAI. A single fluoroscopy image was needed to confirm needle location, thus diminishing radiation exposure both to the patient and the surgical team. Our results showed this method to be reliable, reproducible and effective, and minimized the use of fluoroscopy to a single image.

CONCLUSION

The use of anatomical landmarks (ASIS and GT) for periacetabular needle placement facilitates accurate introduction of the needle to the desired location. Only a single fluoroscopy image is needed to verify needle position and plan minor adjustments prior to injection. As showed in other studies, PAI provides adequate post-op pain control after hip arthroscopy.

DATA AVAILABILITY

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

FUNDING

No funding was received for this study.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have nothing to disclose in relationship with this manuscript.

ETHICAL APPROVAL

This study was conducted after approval by our hospital's ethics committee.

INFORMED CONSENT

Not applicable.

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