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Ultrasound-guided versus landmark in knee arthrocentesis: A systematic review

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ABSTRACT

Objectives: The objective was to assess the efficacy of ultrasound-guided (USG) versus landmark (LM) knee arthrocentesis in adults with knee pain or effusion.
Methods: A systematic review of the literature was performed until August 2015. All controlled trials reporting the accuracy or clinical efficacy between USG and LM knee joint arthrocentesis were selected. Pooled weighted mean difference (WMD) using the D–L fixed models for continuous outcomes and the risk ratio (RR) for dichotomous outcomes were assessed by meta-analysis. Heterogeneity between studies was estimated by I^2 statistic.
Results: Nine studies including 715 adult patients (725 knee joints) were eligible for this review versus LM group; there was a statistically significant difference in favor of USG for knee arthrocentesis accuracy rate (risk ratio = 1.21; 95% CI: 1.13–1.29; $P < 0.001$; $I^2 = 37\%$), lower procedural pain scores (WMD = −2.24; 95% CI: −2.92 to −1.56; $P < 0.001$; $I^2 = 4\%$), more aspiration volume (WMD = 17.06; 95% CI: 5.98–28.13; $P = 0.003$; $I^2 = 57\%$), and decreased pain score 2 weeks after injection (WMD = 0.84; 95% CI: 0.42–1.27; $P < 0.001$; $I^2 = 0$). There was no statistically significant difference in procedural duration between two groups (WMD = −0.8; 95% CI: −2.24 to 0.74; $P = 0.31$; $I^2 = 0$).
Conclusions: Ultrasound-guided knee joint arthrocentesis offer a significantly greater accuracy and clinical improvement over landmark technique in adults with knee pain or joint effusion.

The aspiration of joint effusion and injection are routine diagnostic and therapeutic procedure in clinical practices. Intra-articular knee injections are commonly performed by orthopedic surgeons, rheumatologists, physiatrists, and primary care physicians, and have become widely accepted as a therapy for pain accompanying knee osteoarthritis (OA) [1]. Intra-articular injections are traditionally performed "blind" which is guided by palpation, relying on common anatomic landmarks (LM). However, incorrect placement of an extra-articular arthrocentesis causes discomfort and a reduced effect of corticosteroids, hyaluronic acid, or other agents [2,3]. Intra-articular injections are often inaccurate and surprisingly, accuracy at knee and shoulder, the two most commonly injected joints was also poor [4]. A small volume (2–3 mL) of injectant may not be expelled as easily as a larger volume, which may dissipate into the joint through the soft tissues (fat pad) secondary to the injection pressure of the syringe [5].

In 1988, Christensen et al. [6] published the first overview of ultrasound-guided (USG) musculoskeletal intervention. In the last 2 decades, a number of radiologists have described the success of several techniques of USG joint and soft tissue injection. Several clinical studies suggested that sonography could be used as an adjuvant tool for intra-articular injections in the knee joint via the suprapatellar bursa [7–9]. Although several systematic review have been shown the improved accuracy of knee and shoulder joint injections by image-guided approach [10–12], there are no previous review evaluated the efficacy of the knee arthrocentesis between USG and LM. Also it is more controversial whether accuracy of needle placement has a significant impact on long fellow-up clinical outcome in knee injection. To assess the efficacy of this procedure, multiple clinical trials with heterogeneous design have reported conflicting outcomes.

Therefore, we conducted this systematic review to summarize the current evidence and evaluate the clinical efficacy of USG knee joint arthrocentesis. Our study aimed to assess the effectiveness of USG versus clinical landmark (LM)-guided knee arthrocentesis in adults with knee pain or effusion.

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Methods

This systematic review was performed according to the current recommendations of the Cochrane Collaboration [13] and reported using the criteria of the PRISMA statement [14].

Search strategy

The searches were performed on PubMed, Ovid MEDLINE, Ovid EMBASE, and Web of Science from database inception through on August 10th, 2015. Key search terms were image-guided, ultrasound, sonography, injection, aspiration, knee, and clinical trial. Each concept used a combination of controlled vocabulary (MeSH and EMTREE) combined with text words for each database which uses subject heading (PubMed, MEDLINE, and EMBASE). Web of Science depended primarily on text words alone.

Inclusion and exclusion criteria

We included randomized or non-randomized controlled trials (RCTs and N-RCTs) comparing the accuracy or clinical efficacy between USG and LM knee joint arthrocentesis. We did not restrict the clinical diagnosis of patients and the drug utilized. We also did not restrict language or study country. Outcomes of interest included accuracy rate, pain during treatment, aspirated fluid volume, decreased pain score after treatment, and mean procedure duration. Exclusion criteria were case reports, case serials, and technical reports without control group (LM), pilot studies with no data analysis and/or power analysis.

Study selection

Once all relevant full-text articles had been gathered, the reference lists of each eligible article were scrutinized by two reviewers (T.W. and Y.D.) for any omitted studies. Each search was imported into an EndNote (Thomson Reuters Research Soft), a bibliographic database manager, and duplicates removed. All conflicts were discussed and resolved with a third author (J.H.). The reference sections of all articles were used to identify additional relevant articles.

Data collection process and outcome measures

Following selection of all relevant articles, two authors (T.W. and Y.D.) extracted all data into a pre-constructed data table. The following data was extracted: author, year published, population, intervention, sample size, route of arthrocentesis, study design, and outcomes. The outcome measures collected were the accuracy rate, pain score during treatment (procedure pain), aspirated fluid volume, decreased pain score after treatment, and mean procedure duration.

Statistical analysis

All analyses were performed using the generic inverse variance method (Rev Man 5.3, The Cochrane Library). Statistical heterogeneity was quantified using the I^2 statistic and the chi-square-based test. For continuous outcomes using the same measurement (pain score during treatment, aspirated fluid volume, decreased pain score after treatment, and mean procedure duration), we pooled weighted mean difference (WMD) using the D–L fixed models. For summarizing the accuracy rate (successful frequency of total number), the risk ratio (RR) was used. We used the Cochrane Risk of bias tool to assess the methodological quality of the included trails in terms of sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other sources of bias [13]. The significance level was defined as $P < 0.05$.

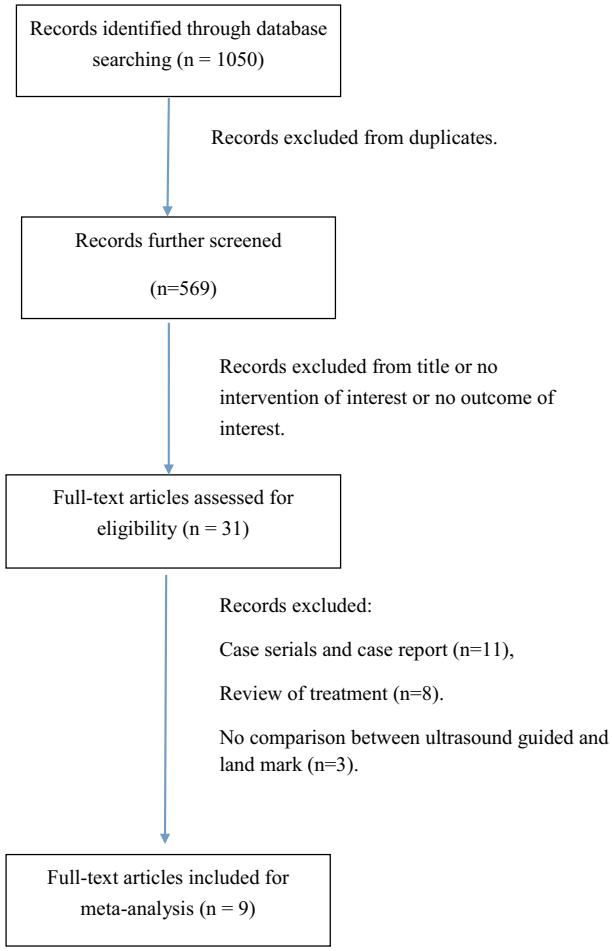

Fig. 1. Flow of participants through trial.

Results

We screened 1050 records, nine studies [15–23] were eligible for this article (Fig. 1), with a total of 715 adult patients (725 knee joints). Characteristics of the enrolled studies are described in the Table.

Clinical outcomes

Knee arthrocentesis accuracy of USG versus LM

Eight studies [15–19,21–23] assessed successful rate of knee arthrocentesis after injection. More successful rate was reported with USG group and the difference was statistically significant (risk ratio = 1.21; 95% CI: 1.13–1.29; $P < 0.001$; $I^2 = 37\%$; Fig. 2).

Procedural pain score (visual analog scale, VAS, 0–10) of USG versus LM

Three studies [17,20,22] assessed pain score during treatment (injection or aspiration). This analysis indicated a statistically significant difference between the groups, with greater lower pain scores in the USG group (WMD = −2.24; 95% CI: −2.92 to −1.56; $P < 0.001$; $I^2 = 4\%$; Fig. 3). The reduction of pain by 2.24 on the VAS pain scale (USG group reduced pain by an average of 2.24 more on the VAS scale than the LM group) as indicated by the