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SCIENTIFIC ARTICLE

Clinical and patient-reported outcomes after image-guided intra-articular therapeutic hip injections for osteoarthritis-related hip pain: a retrospective study

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Abstract

Objective To evaluate change in patient-reported outcomes following image-guided intra-articular therapeutic steroid hip injections for pain and assess correlations of outcomes with patient- and injection-specific factors.

Materials and methods We retrospectively reviewed consecutive patients treated for hip pain who completed outcomes assessments from October 2011 to September 2017 at an outpatient orthopedic surgery clinic. Only patients with radiographic hip osteoarthritis (Tönnis grade ≥ 1) who underwent steroid hip injections were included. Outcomes assessments included EuroQol-5 domain (EQ5D), EQ5D-visual analog scale (VAS), and hip disability and osteoarthritis outcome score (HOOS), obtained before and within 1–6 months post-injection. Among 113 patients who completed surveys, the mean age was 59 years (±13.7 years), including 77 women (68%) and 36 men (32%). Time to repeat injection or arthroplasty was recorded. Exact Wilcoxon signed rank test assessed score differences and Spearman correlation, Kruskal–Wallis, and Mann–Whitney tests assessed correlations.

Results Of 113 patients, 34 had outcomes measured at <8 weeks and 79 at ≥8 weeks. There was no significant change among any of the patients, short- or long-term follow-up subgroups in EQ5D ($p = 0.450$, 0.770, 0.493 respectively), EQ5D-VAS ($p = 0.581$, 0.915, 0.455), average-HOOS ($p = 0.478$, 0.696, 0.443) or total-HOOS ($p = 0.380$, 0.517, 0.423) scores. Forty-nine patients underwent hip arthroplasty within 1 year. Positive correlation was found between days from injection to surgery and change in EQ5D ($r = 0.29$, $p = 0.025$), average-HOOS ($r = 0.33$, $p = 0.019$), and total-HOOS ($r = 0.37$, $p = 0.008$).

Conclusion We demonstrated no significant change in patient-reported outcomes measured at short- and long-term intervals up to 6 months after therapeutic steroid hip injections.

Keywords Hip · Osteoarthritis · Steroid injection · Image-guided injection · Patient-reported outcomes

Introduction

Hip osteoarthritis is the second most common type of osteoarthritis worldwide [1] and a common condition in the USA, affecting 8% of the adult US population [2]. Global prevalence of hip osteoarthritis increases with age and age-standardized prevalence is higher among women (0.98%) than men (0.70%) [3]. At the individual level, symptoms related to hip osteoarthritis, including pain and progressive disability, lead to a decreased quality of life and patients seeking various forms of treatment. At the societal level, hip osteoarthritis results in a substantial economic burden, doubling the direct health care costs for afflicted patients and an important cause of years lost due to disability worldwide [3–6]. Knee and hip osteoarthritis were assessed by the World Health Organization

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to be the eleventh greatest contributor to years lived with disability globally, and the sixth greatest among East Asian countries specifically [1]. Given that the prevalence of hip osteoarthritis increases constantly with age, there is a growing need to improve current prevention and treatment strategies [3, 7, 8].

Therapeutic options for osteoarthritis range from conservative strategies such as physical therapy and various oral medications to more invasive interventions such as joint injection or replacement. Optimal pharmacological therapy for symptom management of hip osteoarthritis remains a vibrant area of investigation; one recent meta-analysis found oral celecoxib or a combination of glucosamine and chondroitin to be the most efficacious oral therapy [9]. Image-guided intra-articular therapeutic steroid injections have been a common treatment for hip osteoarthritis and are an important part of the interventional services that a radiology practice provides [10–13]. Despite their popularity, there are only a small number of studies evaluating the effectiveness of this treatment in terms of degree and duration of symptom relief. These studies are limited by short-term patient follow-up, small sample sizes, heterogeneous patient populations, and a lack of validated patient-reported outcomes (PROs) [12–19]. These deficiencies limit treating clinicians' ability to fully inform patients considering this treatment option.

The primary objective of our study was to evaluate the effectiveness of therapeutic steroid injections for patients being treated for hip pain with radiographic evidence of osteoarthritis using PROs. We also evaluated factors that might predict PRO improvement following hip injection for up to 6 months.

Materials and methods

Institutional review board approval and waiver of informed consent were obtained for this retrospective, Health Insurance Portability and Accountability Act-compliant study.

Patient selection

We performed a retrospective search for patients who presented to an outpatient orthopedic surgery clinic at a large academic institution for evaluation and treatment of osteoarthritis-related hip pain [7, 20], underwent image-guided hip steroid injection, had imaging performed at our institution within 6 months of the injection, and completed PRO assessments before and after the hip injection between October 2011 and September 2017. Patients being assessed or treated for osteoarthritis-related hip pain were included if they completed a survey within 3 months before an injection and a follow-up survey within 1–6 months after the injection. Patients were excluded if they had no radiographic evidence of osteoarthritis, determined by a review of hip radiographs, described in the retrospective review section below. Patients were also excluded if they had had prior ipsilateral hip surgery, a therapeutic injection before the first survey, bilateral hip injections for which multiple surveys were completed, or if surveys were not completed during the prescribed time intervals.

Patient-reported outcome assessments

As a standard of care, patients with hip pain who are seen within the orthopedic clinic are asked to complete serial assessments on electronic tablets during their clinic visits throughout the course of their care. These surveys include the EuroQol-5 domain (EQ5D), EQ5D visual analog scale (VAS), and hip disability and osteoarthritis outcome score (HOOS) [21–23]. The EQ5D assesses five general health-related quality of life domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The EQ5D-VAS is a scale from 1 to 100 assessing overall health from "worst" to "best" imaginable [21]. The HOOS instrument elicits information from patients about hip-related pain and functional limitations, and their impact on daily activities and overall quality of life [23].

Therapeutic hip injections

All intra-articular therapeutic hip steroid injections were performed using ultrasound or fluoroscopic guidance, depending primarily on the referring physician's preference, using standardized procedural techniques and steroid–anesthetic mixtures. Following a nurse-initiated pre-procedure assessment of each patient and physician-administered informed consent and "time out" process, each patient was prepared and draped in a sterile fashion. Superficial anesthesia was achieved using a subcutaneous injection of 1% lidocaine. Under direct visualization with ultrasound or fluoroscopy, a 3.5- or 5-inch 22-gauge needle was advanced into the hip joint using an anterior approach, with the patient in supine position. Intra-articular positioning of the needle tip was confirmed by injection of 1–2 mL of 1% lidocaine (ultrasound) or iohexol contrast medium (fluoroscopy; Fig. 1). A 5-mL mixture containing 80 mg (or 40 mg) of triamcinolone (40 mg/mL) and 3 mL (or 4 mL) of 0.5% ropivacaine was injected (the lower triamcinolone dose is used at the discretion of the interventionalist, most often if the patient has a history of diabetes). Patients were discharged from the department with nurse-administered standard post-injection precautions.

Retrospective review

Retrospective review of the patients' EQ5D, EQ5D-VAS, and HOOS scores, electronic medical records, and the available

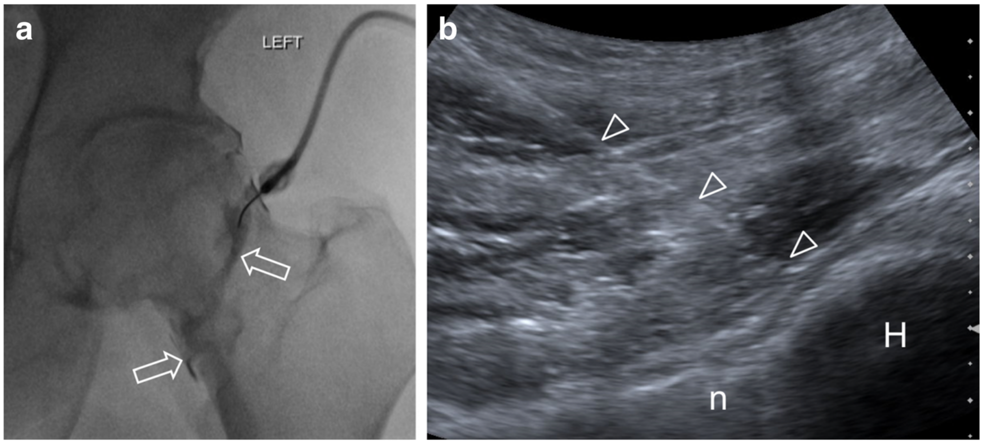

Fig. 1 **a** A 62-year-old man with progressive left hip pain referred for therapeutic hip joint injection under fluoroscopic guidance. Intra-articular injection is shown with flow of iohexol contrast (240 mg/mL) into the hip joint space (*arrow*). **b** A 47-year-old woman with right hip pain referred for therapeutic injection under ultrasound-guidance. A grayscale ultrasound image demonstrates the needle (*arrowheads*) entering the hip joint space. *H* femoral head, *n* femoral neck

radiographs of the symptomatic hip was performed. Each patient's immediate pre-injection survey score was compared with their first survey score within 1–6 months post-injection. Patient-specific data were also recorded, including age, sex, and body mass index. The therapeutic injections were reviewed for steroid dose and imaging modality. Radiographs were reviewed to determine the degree of osteoarthritis according to the Tönnis Classification: 0 (no radiographic evidence of osteoarthritis), 1 (subchondral sclerosis, slight joint space narrowing), 2 (small subchondral cysts, moderate narrowing), or 3 (large subchondral cysts, severe narrowing) [24, 25]. The time between initial injection and any repeat injection or hip surgery on the symptomatic hip was recorded for each patient.

Statistical analysis

The within-subject change in each PRO score from the pre- to the post-injection time was computed for each patient as the post-injection value minus the pre-injection value. A paired-sample Wilcoxon signed rank test was performed to assess whether each score changed following injection. For each outcome, the Wilcoxon test was applied to the sample as a whole (all patients) and to the patient subgroups defined as having short-term (<8 weeks) or long-term (≥8 weeks) follow-up. The Spearman rank correlation was used to assess the association of score change with age, body mass index, Tönnis score, and time interval from injection to second injection or performance of arthroplasty. The Mann–Whitney test was used to compare sex, patients with short- versus long-term follow-up, dose of triamcinolone injected (40 mg versus 80 mg) and patients imaged with fluoroscopy versus ultrasound in terms of the change in each outcome score following injection. Patients were classified as manifesting a clinically meaningful change in average HOOS score if the change was of a magnitude ≥17, the previously estimated minimal clinically important difference for this instrument [24]. Fisher's exact and Kruskal–Wallis tests were used to assess associations between various patient-specific and injection-specific variables and whether a patient showed a clinically meaningful decrease in average HOOS score following injection. All statistical tests were conducted at the two-sided 5% significance level using SAS 9.4 software (SAS Institute, Cary, NC, USA).

Results

A total of 394 patients received image-guided steroid hip injections and completed pre- and post-injection surveys during the study period. Forty-three patients were excluded because they received therapeutic hip injections before their initial survey. An additional 207 patients were excluded because they had prior ipsilateral hip surgery, bilateral hip injections with multiple surveys, or they completed surveys outside the prescribed time intervals relative to the injection. An additional 31 patients were excluded for Tönnis score < 1, allowing analysis of PRO scores among 113 patients. There were 77 women (68%) and 36 men (32%) with a mean age of 59 years (±13.7 years) who completed baseline surveys within a mean of 40 days (±14 days) before the injection and a mean of 89 days (±44 days) after the injection. Mean patient body mass index was 28.2 (±6.1) and the mean Tönnis score was 1.9 (±0.8; Table 1).

Each patient completed pre- and post-injection surveys for one or more of the EQ5D ($n = 111$), EQ5D-VAS ($n = 111$), and HOOS ($n = 84$) assessments. There was no significant change in the EQ5D (mean score change = 0.02, $p = 0.450$), EQ5D-VAS (mean score change = 0.48, $p = 0.581$), average HOOS (mean score change = 0.39, $p = 0.478$), or the total

Table 1 Tönnis classification of osteoarthritis among the study cohort

Tönnis grade	n	Percentage	Criteria
0	0	0	No radiographic evidence of osteoarthritis
1	37	33	Subchondral sclerosis, slight joint space narrowing
2	47	41	Small subchondral cysts, moderate narrowing
3	29	26	Large subchondral cysts, severe narrowing

HOOS (mean score change = 1.32, $p = 0.380$) when comparing pre- and post-injection survey scores among all patients (Table 2). Neither were there significant changes in mean scores for any of the outcomes instruments among the short- or long-term follow-up groups, also summarized in Table 2. The minimal clinically important difference for average HOOS score was not exceeded by the mean score among patients in our study. In terms of individual patient scores, the minimal clinically important difference was achieved in 8 out of 82 (9.8%) patients. A Fisher exact test showed no significant association among these patients with injection-specific or patient-specific factors, including triamcinolone dose ($p = 0.818$), sex ($p = 0.324$) or short- versus long-term follow-up ($p = 0.482$). The Kruskal–Wallis test found no significant difference in terms of age ($p = 0.106$), Tönnis score ($p = 0.$ 986) or body mass index ($p = 0.737$).

Thirty-three patients (29%) eventually underwent repeat injection at a mean time to second injection of 208 days (±443 days), and 49 patients (43.3%) had eventual ipsilateral hip arthroplasty at a mean time to surgery of 229 days (±135 days) following injection. A positive correlation was found between number of days to surgery and the within-subject change in EQ5D ($r = 0.29$, $p = 0.025$), average HOOS ($r = 0.33$, $p = 0.019$), and total HOOS ($r = 0.37$, $p = 0.008$) scores (Table 2). No significant correlations were detected between PRO score changes and patient age, body mass index, or Tönnis score (Table 3).

Injections were performed under either ultrasound ($n = 53$, 47%) or fluoroscopic ($n = 60$, 53%) guidance, which also showed no significant association with outcomes according to the Mann–Whitney test. The Mann–Whitney test revealed no significant association between injected steroid dose (40 mg or 80 mg of triamcinolone), patient sex, and short- versus long-term follow-up intervals (Table 4).

Discussion

Our study was primarily aimed at evaluating the effectiveness of intra-articular therapeutic hip steroid injections for patients being treated for hip pain related to osteoarthritis with the use of PROs. We found no significant difference in PRO scores measured at 1–6 months post-injection overall and among subgroups with short- and long-term follow-up. Secondarily, we found no significant association between change in PRO scores and patient-specific or injection-specific factors, such as body mass index or degree of osteoarthritis.

Several studies have evaluated outcomes in hip osteoarthritis patients after therapeutic steroid injections. Deshmukh and colleagues retrospectively evaluated pain relief up to 2 weeks after injection using a VAS, finding 71.4% of patients endorse delayed pain relief [26]. Pain relief was defined in a binary manner with >50% reduction in VAS score considered to be positive. A randomized, placebo-controlled trial in 52 patients with osteoarthritis found that mean Western Ontario and McMaster Universities OA Index (WOMAC) scores fell 49.2% a period of 8 weeks after steroid injections, with significantly higher rates of pain relief compared with placebo [15]. Many other studies have evaluated pain VAS scores, revealing short-term symptom improvement of varying magnitudes [12, 27, 28]. Our study evaluated patient outcomes beyond simple pain severity scales, attempting to determine the effects of injections on quality of life. Further, we analyzed PROs among patients with short- (<8 weeks) or long-term (≥8 weeks) follow-up, up to 6 months. The discordant results from the study by Lambert and colleagues [15] may relate to the outcomes instrument used; WOMAC is an outcomes instrument designed specifically to assess treatment of osteoarthritis, compared with the more general quality of life measurement tools used in our study.

The current literature on the effectiveness of steroid injections for hip osteoarthritis is limited for several reasons, including short follow-up times, varied outcome measures, narrow patient selection, and varying injection techniques. One systematic review evaluated studies of pain relief from corticosteroid injections for knee (13 studies) and hip (8 studies) osteoarthritis, with only 38% of studies analyzed having follow-up beyond 8 weeks post-injection [12]. Inconsistent use of validated, clinically relevant outcome assessments or use of non-standard outcome measures was cited as contributing to the poor quality of the existing literature [12]. Hirsch et al. also noted the problem of small patient cohorts (all studies included fewer than 101 patients), and most previous studies consisted of patients with advanced hip osteoarthritis who were good candidates for hip arthroplasty, limiting study generalizability for patients with mild osteoarthritis where the best treatment is unclear [13]. Lastly, heterogeneous injection techniques and lack of image guidance limit conclusions drawn from these studies [13].

Table 2 Change in patient-reported outcome (PRO) scores at short- and long-term follow-up intervals after therapeutic hip injections

Group	Outcome measure	Mean	SD	Median	IQR	*p*
All	EQ5D	0.02	0.20	0.00	0.17	0.450
n = 113	EQ5D-VAS	0.48	19.83	−1.00	21.00	0.581
	Average HOOS	0.39	17.07	−2.20	18.50	0.478
	Total HOOS	−1.32	89.56	−13.00	91.50	0.380
Short-term follow-up	EQ5D	0.01	0.22	0.00	0.21	0.770
n = 34	EQ5D-VAS	1.00	18.32	0.50	20.25	0.915
	Average HOOS	−0.32	18.05	−1.80	24.90	0.696
	Total HOOS	−11.46	103.33	−11.00	119.25	0.517
Long-term follow-up	EQ5D	0.02	0.20	0.00	0.14	0.493
n = 79	EQ5D-VAS	0.25	20.58	−1.00	21.00	0.455
	Average HOOS	0.70	16.77	−2.60	12.90	0.443
	Total HOOS	3.22	83.24	−13.50	65.25	0.423

The mean, standard deviation (SD), median and inter-quartile range (IQR) of within-patient change in each outcome measure following injection

The *p* value from the Wilcoxon test of the change in each outcome is considered significant if <0.05

Results are provided for all patients and among patient subgroups with short-term (<8 weeks) or long-term (≥8 weeks) follow-up intervals

EQ5D EuroQol-5 domain, *EQ5D-VAS* EuroQol-5 domain visual analog scale, *HOOS* hip disability and osteoarthritis outcome score

We attempted to address these deficiencies in our study. We measured PRO score differences over a clinically meaningful timeframe. Baseline PRO scores were assessed within a short period of time (3 months) before injection to minimize the likelihood of potentially confounding change in patient condition in the interval. Post-injection responses were analyzed specifically between 1 and 6 months after the injection to increase the likelihood of reflecting the greatest effect of the injected steroid [29]. Our study attempted more comprehensive PRO evaluation in the hope of determining the effects of therapeutic injections on patients' quality of life. Our cohort is large compared with many existing studies [12, 15] and includes patients with a range of osteoarthritis severity. As all injections were image-guided, intra-articular injection was confirmed in every case.

We found no significant change in PRO scores 1–6 months after hip injection, regardless of short- or long-term follow-up interval. Deshmukh and colleagues found in their retrospective study that patients with more severe osteoarthritis (according to the Kellgren and Lawrence Classification) were significantly more likely to experience immediate and delayed pain relief (2 weeks' follow-up) compared with mild osteoarthritis [26]. In accordance with our findings, several other studies refute this correlation, failing to demonstrate greater effects from injections in patients with more severe osteoarthritis [15, 27, 28, 30].

Diagnostic hip injections have been advocated as valuable, cost-effective procedures in other clinical contexts, such as for young patients with labral tears or femoroacetabular impingement syndromes [31, 32]. Our results call into question the potential value of therapeutic steroid hip injections specifically for treating patients with painful hip osteoarthritis. This is in concordance with the sentiments of some clinicians, as demonstrated by one survey study of 99 hip surgeons, revealing

Table 3 Correlations of key variables with change in PRO scores

	Age		BMI		Tönnis		Days to injection		Days to surgery	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
EQ5D	−0.01	0.902	−0.01	0.896	0.10	0.301	0.06	0.750	0.29	**0.025***
EQ5D-VAS	0.05	0.629	−0.08	0.413	0.02	0.803	−0.13	0.457	0.19	0.151
Average HOOS	−0.12	0.269	−0.10	0.385	0.01	0.901	0.12	0.574	0.33	**0.019***
Total HOOS	−0.09	0.410	−0.13	0.228	0.05	0.620	0.07	0.734	0.37	**0.008***

The Spearman correlation (r) and *p* value for the association of age, body mass index (BMI), Tönnis osteoarthritis score, and the number of days to either repeat injection or surgery with change in outcomes scores after injection

*Significant correlation (p<0.05)

Table 4 Bivariate associations between PRO score changes and patient-specific and injection-specific factors

Outcome measure	Steroid dose	Sex	Guidance modality	Follow-up interval
EQ5D	0.748	0.822	0.490	0.894
EQ5D-VAS	0.892	0.210	0.402	0.628
Average HOOS	0.416	0.222	0.313	0.886
Total HOOS	0.498	0.130	0.397	0.707

Numbers are provided as p values from the Mann–Whitney test used to compare patient sex, patients with short- (<8 weeks) versus long-term (≥8 weeks) follow-up, dose of triamcinolone injected (40 mg versus 80 mg), and patients imaged with fluoroscopy versus ultrasound in terms of the outcome score change after injection

that 56% believed the injections to be therapeutically useful and most estimated that ≤60% of their patients achieved any symptomatic benefit at all [33].

Therapeutic steroid injections are aimed at controlling symptoms rather than altering disease course; therefore, progressive decline in function and quality of life may be inevitable in some patients. This phenomenon may compromise the utility of PROs to demonstrate a significant improvement over time. One study comparing healthcare utilization among patients undergoing hip or knee arthroplasty and intra-articular injection found an initial decrease in costs associated with injection, but a long-term decrease in health care cost and utilization among patients who underwent joint replacement [34, 35]. Nevertheless, our results do not refute that injections could provide an alternative treatment for poor surgical candidates. Knee [36] and image-guided hip [35] intra-articular steroid injections have been shown to be cost-effective. In our study, outcome improvements after injection correlated with a longer time between hip injection and eventual hip arthroplasty, supporting a common clinical utility for these injections: symptom relief to delay hip arthroplasty for a clinically significant amount of time [14, 37]. Assessing the effectiveness of injections to delay arthroplasty for osteoarthritis would be a worthy objective for a future, large-scale prospective study.

Many radiologists commonly engage in patient-facing activities in their daily practices. As the competition among subspecialists to perform image-guided procedures such as epidural steroid injections [38] or joint injections [39] increases, radiology departments should be prepared to demonstrate the high quality and value of their services. Studies such as this have the potential to provide patients with meaningful data about symptom improvement and could provide the basis for more informed clinical decision-making in the future [40, 41].

We acknowledge limitations of our study, foremost among which is its retrospective design, precluding uniform follow-up intervals and correlation with standardized clinical parameters. The survey data are heterogeneous regarding the instruments used and the timing of surveys, dictated mainly by convenience to clinic visits rather than rational research questions or clinical utility. Therefore, PRO assessments may have occurred too frequently or not often enough to address relevant clinical questions, causing a large percentage of patients to be excluded from analysis. Moreover, surveys analyzed in our study were not administered in specific reference to the therapeutic hip injections, and unrelated factors such as surgery or osteoarthritis of other joints may confound patients' scores. As it remains possible that our study simply failed to detect a transient but real improvement in patient symptoms, either because of the study design or limitations of the PRO instruments, further prospective study is necessary to confirm our findings. Construction of a departmental database of patients receiving injections would be useful to assess a variety of image-guided interventions. Inclusion of outcomes instruments specifically designed for the assessment of patients treated for osteoarthritis, such as WOMAC or the Outcomes Measures in Rheumatology-Osteoarthritis Research Society International (OMERACT-OARSI) would also be a helpful addition to similar studies in the future.

Our study demonstrated no significant change in PRO scores after image-guided intra-articular steroid injections over a follow-up period of up to 6 months among a large cohort of patients with osteoarthritis-related hip pain. Further research should be aimed at identifying other patient subgroups or factors that might predict benefit from image-guided injections, using measurement tools that can best detect these benefits.

Compliance with ethical standards

Conflicts of interest None of the authors has any conflicts of interest or commercial interests to disclose.

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