

# Intraarticular cortisone injection for osteoarthritis of the hip. Is it effective? Is it safe?

David W. Kruse

Published online: 17 May 2008  
© The Author(s) 2008

**Abstract** Osteoarthritis of the hip is a significant source of morbidity in the elderly. Treatment guidelines are available for the management of hip osteoarthritis, but these do not address the application of intraarticular corticosteroid injection. The intraarticular injection of corticosteroid is used in the management of other large joint osteoarthritic diseases and is well studied in the knee, however, this data cannot be used to make sound clinical decisions regarding its use for hip osteoarthritis. There are also concerns regarding the safety of this modality. Review of the published literature reveals that there are eight trials examining the efficacy of intraarticular corticosteroid injection for hip osteoarthritis and of these only four are randomized controlled trials. In general, the available literature demonstrates a short-term reduction of pain with corticosteroid injection and is indicated for patients refractory to non-pharmacologic or analgesic and NSAID therapy. The use of radiologic-guidance is recommended and, with proper sterile technique, the risk of adverse outcomes is very low. Future randomized controlled trials are needed to further examine the efficacy and safety of intraarticular corticosteroid injection for hip osteoarthritis.

**Keywords** Intraarticular corticosteroid injection · Hip osteoarthritis · Musculoskeletal ultrasound · Septic arthritis · Osteonecrosis

## Introduction

Osteoarthritis is the most common form of arthritis in the United States and osteoarthritis of the hip is a significant

cause of morbidity in the elderly [1–6]. There are standard treatment guidelines for the management of hip osteoarthritis; however, these typically do not include intraarticular steroid injection as a possible therapeutic modality secondary to potential side effects of these injections and the paucity of studies looking at this intervention [7–14]. Intraarticular injection of steroid is mostly used for large joint inflammatory disease and its use is well studied in the knee. Some of this data can be extrapolated to its application for the hip; however, this is not adequate to make an evidence-based decision for clinical practice.

To date only eight trials examining the efficacy of intraarticular corticosteroid hip injection for osteoarthritis have been published [15–22]. Of these, only four are randomized controlled trials (RCTs) [15–18]. There remains many questions about the use of steroid injection for hip arthritis. These include: injection technique, including fluoroscopic-guidance, ultrasound-guidance, or the use of anatomic landmarks; measuring efficacy; and safety. Some of these safety issues are: difficult access to the joint, introduction of infection, rapid progression of arthritis following injection, and the potential adverse effect on the eventual outcome of a total hip replacement.

This review article examines the above-published trials of intraarticular corticosteroid injection of the hip as well as other literature as it relates to the management of osteoarthritis of the hip in an attempt to discuss the potential benefit and safety of this intervention.

## Methods

### Search strategy

A search of the following databases and journals was done: Medline Systematic Reviews, the Cochrane Library,

---

D. W. Kruse (✉)  
South Bend Sports Medicine Fellowship, Memorial Sports  
Medicine Institute, South Bend, IN, USA  
e-mail: krusedw@gmail.com

American Family Physician, Clinical Journal of Sports Medicine, British Journal of Sports Medicine, Pubmed, Clinics in Sports Medicine, ACP Journal Club, Agency for Healthcare Research Quality, Institute for Clinical Systems Improvement, Ortho Clinics, Journal of American Academy of Orthopedic Surgeons, Journal of Orthopedic Research, American Journal of Orthopedics, OVID. The following search keywords were used with “and” inclusion criteria: “Hip Injection” (narrowed using “Intraarticular Hip Injection” and “Hip Corticosteroid Injection”), “Intraarticular Hip,” “Intraarticular Injection Number,” and “Hip Osteoarthritis” (narrowed using “Hip Osteoarthritis Injection”).

#### Selection criteria

Inclusion: randomized controlled studies, blinded studies, longitudinal clinical outcome studies, retrospective analysis studies, review articles, and case reports. Articles relevant to hip injections and in particular the safety of such injections, indications for, procedure/technique used, treatment of osteoarthritis, and adverse outcomes of such injections. Exclusion: articles published before 1955, editorial letters, poster sessions, and book extracts.

#### Search results

After literature search, only eight published trials looking at the efficacy of intraarticular corticosteroid hip injection for osteoarthritis were found. Of these, four studies are RCTs. Three studies were found looking at infection risk after total hip replacement following pre-operative intraarticular corticosteroid injection. Seventeen published review articles and guideline statements were found discussing the use of intraarticular corticosteroids for hip osteoarthritis and three review articles and guideline statements discussing the use of musculoskeletal ultrasound for hip injection were discovered. In addition to the above, four case reports have been published discussing adverse outcomes after hip intraarticular corticosteroid injection, including septic arthritis and osteonecrosis.

## Discussion

#### Therapeutic standards

There are a variety of published recommendations for the management of hip osteoarthritis. More recently, a review article from the *Annals of the Rheumatic Diseases* was published in 2005 with evidence-based recommendations for the management of hip osteoarthritis [7]. This journal is the official publication of the European League Against Rheumatism (EULAR), which provides task force reports

on the EULAR Standing Committee for International Clinical Studies Including Therapeutics (ESCISIT). The review study produced 10 proposed interventions for the treatment of hip osteoarthritis. Five of the interventions are supported by controlled-trial evidence and include: education, non-steroidal anti-inflammatory drugs (NSAIDs), cyclooxygenase-2 (COX-2) selective inhibitors (listed with evidence separate from NSAIDs), opioids, and chondroitin. Intraarticular steroid injection was included in the 10 proposed interventions, but the review concluded that the results from available studies are inconclusive and controlled-trials are required.

Review articles published in 1995 and 2000 by the American College of Rheumatology, provide guidelines on the medical management of osteoarthritis of the hip [8, 9]. These guidelines are consistent with 2005 published EULAR interventions including: patient education, physical exercise, and NSAIDs including COX-2 inhibitors. Similar to the EULAR study, these guidelines provide no conclusive recommendations for intraarticular injection of corticosteroid. The authors state that steroid injection has not been studied and if performed should be done under radiologic guidance. Other published reviews and expert opinion guidelines on the management of hip osteoarthritis also provide little evidence for the use of intraarticular steroid injection [10, 11, 13, 14, 23–25].

#### Indications & contraindications

Indications for intraarticular injection should be considered in this article. A review paper published in *The American Journal of Orthopedics* in 2000 provided an updated overview on the use of intraarticular corticosteroids [11]. Among the clinical uses discussed, osteoarthritis of the knees, ankles, shoulders, acromioclavicular joints, and first metacarpophalangeal and metatarsophalangeal joints, as well as lumbar facet arthropathy are listed as common indications for injection. Notably, hip osteoarthritis was not listed. *Clinics in Sports Medicine* published a review on the use of injections for joint osteoarthritis in sports [26]. The authors state that, based on available literature, injection of small non-weight-bearing joints may have better results as compared to larger weight-bearing joints. More specific to the hip, a study looking at the safety and efficacy of intraarticular hip injection stated the following as additional indications: use diagnostically to determine the likelihood of achieving pain relief after hip arthroplasty; and as treatment of arthritic symptoms in patients who are not candidates for total hip arthroplasty [27]. In an expert opinion study of orthopedic surgeons looking specifically at indications for hip steroid injection, the majority of physicians studied listed diagnostic (hip vs. spine) and therapeutic pain relief [25]. Other possible indications or clinical situations when

injection may be useful could include: when surgery is contraindicated secondary to coexisting medical condition and in young patients with whom there is concern for longevity of hip prosthesis (Graphic 1).

A comprehensive list of contraindications for intra-articular hip steroid injection is more widely accepted. Absolute contraindications include: suspected or known joint infection, presence of joint fracture, coagulopathy, overlying cellulitis or infection, hypersensitivity to corticosteroids, and presence of prosthetic joint. Relative contraindications include: anticoagulation therapy, joint instability, poorly controlled diabetes, and adjacent skin abrasions [11, 12, 25, 26].

### Efficacy

As stated above, only eight published trials have been done looking at the efficacy of intraarticular corticosteroid hip injection for osteoarthritis and of these only four are RCTs (Graphic 2). The most promising and recent study was published in 2007 in *Arthritis & Rheumatism* [15]. Lambert et al. carried out a double-blinded, placebo-controlled trial of 52 patients with hip osteoarthritis. The patients were randomized to intraarticular hip injection of corticosteroid treatment (10 mg bupivacaine and 2 ml of triamcinolone) or placebo (10 mg bupivacaine and 2 ml of saline) via fluoroscopic guidance. The results revealed significant improvement in pain and function in the treatment group at three months of follow-up. No significant adverse events were observed and there was no difference in the frequency of adverse events noted between study groups. The results from this trial offer very convincing evidence that intra-articular corticosteroid injection can be an effective therapy for osteoarthritis-related hip pain. Lambert et al. propose that future research should explore the benefits of repeated injection and the effect of injection on disease modification.

In a prior randomized controlled trial, Qvistgaard et al. randomized 101 patients to: three intraarticular injections of saline, one intraarticular injection of corticosteroid followed by two sham injections, or three intraarticular injections of hyaluronic acid [16]. The injections were done

via ultrasound guidance at 14-day intervals and a primary outcome of “pain on walking” was used via the visual analogue scale (VAS). Evaluation was done at baseline and after 14, 28, and 90 days. The authors showed a significant improvement and clinical effect in the corticosteroid group as compared with the placebo; however, the effect was very short-lived with no effect observed at the 3-month follow-up. Of note, there was no statistically significant change in any primary outcome with the hyaluronic acid series. They concluded that there was a definite short-lived effect that would indicate a use for intraarticular steroid injection in the treatment of hip OA for acute pain relief. The study also showed an association between presence of hip joint effusion and good clinical response.

Kullenberg et al. published a prospective, double-blinded study of 80 patients randomized to intraarticular injection of either corticosteroid (without anesthetic) or local anesthetic [17]. Patients were followed for pain, functional ability, range of motion, and analgesics consumed at 3- and 12-week intervals. The authors found that pain for all modalities, the most being pain at rest, decreased after corticosteroid injection at both the 3- and 12-week follow-up, with no improvement found in patients treated with local anesthetic. The study suggests that intraarticular injection might improve pain and range of motion in hip osteoarthritis.

A prospective controlled study of 35 patients, done by Flanagan et al. in 1988, found an insignificant difference between saline, bupivacaine only, or bupivacaine with triamcinolone injection in patients awaiting hip replacement [18]. Patients in this study, however, were told that they would be given priority for surgery if their pain worsened after injection and therefore were biased toward a negative result.

Trials looking at steroid hip injection for osteoarthritis date back to 1956, when Leveau and Quin published a study investigating the effect of hydrocortisone and lidocaine compared to lidocaine alone [22]. Their initial study showed a greater symptomatic improvement in the patients treated with hydrocortisone. Other subsequent studies have shown similar short-term results, but these are not randomized controlled trials and have subsequent bias in the results. Smith et al. showed a 69% improvement in hip pain 3 months after intraarticular injection of hydrocortisone and lidocaine [20]. In another study, Plant et al. demonstrated improvement in pain and internal rotation up to 12 weeks following injection of methylprednisolone and lidocaine in 45 patients, 27 of whom had osteoarthritis as the indication for injection [19]. Of note, however, is the patients in the study experienced a return of their pain by the 26-week follow-up. The authors also were following the radiographic pattern of response to injection in these patients, and suggest that the radiographic severity of the

### Graphic 1 Indications for hip intraarticular corticosteroid injection

1. Diagnostic test to determine if hip pain is secondary to hip versus spine pathology.
2. Diagnostic test to determine if hip pain is secondary to intraarticular versus extraarticular pathology.
3. To help determine the likelihood of achieving pain relief with hip arthroplasty.
4. When surgical intervention is contraindicated.
5. In a young patient with whom there is a concern for the longevity of hip prosthesis.

**Graphic 2** List of randomized control trials: intraarticular corticosteroid hip injection for osteoarthritis

Citation	Authors	Number of patients	Study length	Technique	Outcomes	Adverse outcomes
[15]	Lambert et al.	52	6 months	Fluoroscopic-guidance	↓ Pain—3 months ↓ Stiffness—3 months ↑ Function—3 months	No serious adverse events (1 Pt—DVT)
[17]	Kullenberg et al.	80	12 weeks	Fluoroscopic-guidance	↓ Pain—12 weeks ↑ ROM—12 weeks	None reported
[16]	Qvistgaard et al.	101	90 days	Ultrasound-guidance	↓ Pain—14 & 28 days No relief—90 days	No serious adverse events (3 Pts—Steroid flare)
[18]	Flanagan et al.	35	12 months	Fluoroscopic-guidance	No effect	Increased symptoms with steroid

**Graphic 3** Key points

1. There is a lack of randomized controlled trial data.
2. Available studies support a possible short-term benefit for patients refractory to non-pharmacologic or NSAID therapy.
3. The use of radiological guidance is recommended.
4. Literature supports the use of musculoskeletal ultrasound to guide injection.
5. With proper sterile technique, injection can be performed with a low risk of serious adverse outcomes.
6. If total hip arthroplasty is planned, avoid injection within 2 months of the surgery.

arthritis does not have an influence on response to injection but that patients with atrophic changes on X-ray had no significant benefit when compared to hypertrophic or mixed bone response.

The most recent uncontrolled trial, submitted for publication in September of 2005, looked at the change in pain, stiffness, and disability after intraarticular injection of two different doses of methylprednisolone, 40 and 80 mg, in 120 patients with hip osteoarthritis [21]. In the 40 mg dose group, the authors demonstrated a significant improvement

in pain and stiffness but not disability at the 6-week follow-up with only an improvement in stiffness at 12 weeks. In the 80 mg dose group, however, the authors showed a beneficial effect in pain, stiffness, and disability at 6 weeks and 12 weeks. They conclude that both groups showed a beneficial effect and noted evidence of a dose response.

#### Technique

Intraarticular injection of the hip can be a challenging procedure. The hip joint cannot be palpated and is adjacent to important neurovascular structures. For this reason, there are many publications in the literature regarding the appropriate technique for locating the joint to facilitate injection [23, 27–35]. This also contributes to why intraarticular hip injections are not used or studied as much as other joints, i.e. the knee. In general, three techniques are utilized: anatomic landmarks, fluoroscopic guidance, and ultrasound guidance. Because of the significant potential for injury to the femoral nerve, femoral artery, and lateral femoral cutaneous nerve and the potential high rate of extraarticular injection, the use of anatomic landmarks is not considered a desirable technique given the increasingly easy access to radiologic guidance. Leopold et al. studied the safety and efficacy of using anatomic landmarks for intraarticular hip injection [27]. The authors injected 30 cadaver hips with methylene blue dye. With a lateral approach, intraarticular injection was successful 80% of the time, and an anterior approach was successful only 60% of the time. Also, the authors noted that with an anterior approach their needle contacted or pierced the femoral nerve 27% of the time and was within 5 mm of the nerve 60% of the time. The lateral approach was noted to be significantly safer showing that the needle never came within 25 mm of any neurovascular structure. The authors suggest based on the results of the study that a lateral approach in concert with fluoroscopy or ultrasound guidance may achieve the safest and most effective needle placement.

**Graphic 4** Future research

#### Randomized controlled trials

1. Efficacy of injection. Does intraarticular injection of corticosteroid for osteoarthritis achieve:
  - Decreased pain?
  - Increased function?
  - What is the duration of benefit?
2. Safety and accuracy of musculoskeletal ultrasound-guidance for hip intraarticular injection.
3. Incidence of joint sepsis after THA following pre-operative intraarticular corticosteroid injection.
4. What is the benefit of repeated injections?
5. What is the effect of injection on disease modification?

Further literature search supports the conclusions of the Leopold et al. study, and in general, more recent published articles have supported the use of ultrasound over fluoroscopic guidance for injection. A report from the *Archives of Physical Medicine & Rehabilitation*, published in 2006, describes an office-based technique for ultrasound-guided intraarticular hip injection [28]. The authors of the study, Drs. Smith and Hurdle, list many advantages of ultrasound as compared to fluoroscopy. These include: accessibility, compact size, lack of radiation exposure, and visualization of neurovascular and other soft-tissue structures. Other results and recommendations from the rheumatologic and radiology literature are also consistent with the Smith and Hurdle report [29, 34, 35].

### Safety

As for any intraarticular joint injection, various side effects may occur with intraarticular hip injection. These may include: pain with injection, post-injection flare, skin pigment changes, fat atrophy, and joint infection. Systemic effects can also occur and include: disruption of diabetes and hypertension control, facial flushing, inhibition of the hypothalamo–pituitary–adrenal axis, sepsis, and death [10–12, 36].

Specifically for the hip, literature review reveals three side effects of particular concern. These include: septic arthritis, osteonecrosis, and the risk of joint infection after total hip replacement following pre-operative intraarticular corticosteroid injection. Significant research has been done looking at joint sepsis following knee injection with incidences ranging from 1 in 3,000 to 1 in 5,000 [37]. The incidence of septic arthritis in the hip has not been as thoroughly studied. During literature search for this review article, 2 case reports of septic hip arthritis following corticosteroid injection were found. Nallamshetty et al. documented a case of hip septic arthritis in a 65-year-old woman after intraarticular injection of betamethasone and lidocaine mixture via fluoroscopic guidance for hip pain secondary to osteoarthritis [38]. The patient returned 3 weeks later with increasing pain and was shown to have extensive joint destruction on plain films and MRI. Hip aspirate at that time was positive for alpha-hemolytic *Streptococcus*. The patient required subsequent resection arthroplasty of the hip 2 months after presentation secondary to the joint destruction. The only other case report found in the literature was submitted by Chazerain et al. in 1999 [39]. Their case showed septic hip arthritis in a 51-year-old man following 10 intraarticular injections of sodium hyaluronate and one injection of triamcinolone between April 1995 and October 1998. The steroid injection was performed in April 1998. The patient presented with septic arthritis in October 1998 after the last sodium hyaluronate injection.

The infection was likely secondary to the increased exposure from performance of multiple repeat injections and not likely specific to the corticosteroid therapy.

Osteonecrosis of the femoral head after intraarticular corticosteroid injection has also been reported in the literature. Four case reports were found, but three of these four were following corticosteroid injection of other joints, including shoulder, knee, and ankle [40, 41]. The fourth case report discussed a 50-year-old female patient who received a single injection of methylprednisolone and sensorcaine into the hip joint, in which rapid collapse of the femoral head was noted within a 3-month period of time [42]. Osteonecrosis was found on subsequent histologic analysis. General consensus proposes that osteonecrosis after joint injection is more likely related to the severity of the underlying disease and represents a natural progression of that disease rather than a side effect of the injection itself.

The safety of intraarticular corticosteroid injection of the hip prior to ipsilateral total hip replacement has also been called into question because of concerns for an increased incidence of post-operative joint infection. A paper submitted by Kaspar and de V de Beer, in 2005, found in a retrospective cohort study of 80 patients a significant increase in arthroplasty revision secondary to infection in patients who had intraarticular steroid injection prior to hip replacement [43]. The mean time between injection and surgery was 11 months, with an incidence of 10% in those who received injection compared to 0% in those who did not. The authors proposed that intraarticular injection of corticosteroid should be considered as relatively contraindicated in patients who are candidates for hip replacement. Two subsequent retrospective studies exploring the relationship between injection and post-operative infection do not show results consistent with the findings of the Kaspar and de V de Beer study. McIntosh et al. found in a cohort study of 437 patients, with a mean time of 112 days between injection and surgery, no significant relationship between injection and post-operative rates of infection [44]. However, in the patients who had injection and subsequent infection, the mean time between interventions was 44 days. This was not statistically significant. The authors caution giving injections less than 2 months prior to hip replacement surgery. A recent study published in *The Journal of Bone and Joint Surgery* found in 36 patients, with a mean time between injection and surgery of 18 months, no cases of deep joint sepsis during a mean follow-up time of 25.8 months [45].

### Conclusions

In general, there is still a lack of RCTs studying the effectiveness and safety of intraarticular steroid injection



for the treatment of hip osteoarthritis. However, current data from available RCTs and other uncontrolled studies demonstrate strong evidence that steroid injection can provide a short-term reduction in pain. Published guidelines state a probable benefit for patients refractory to non-pharmacologic or analgesic and NSAID therapy. If intraarticular hip injection is performed, the current literature supports the use of radiological guidance and there is evidence supporting the use of musculoskeletal ultrasound. There are case reports in the literature describing septic arthritis following hip injection but these are rare and may be avoided with proper sterile technique. Also, the current literature does not support an increased incidence of infection after total hip replacement following pre-operative intraarticular corticosteroid injection. However, there are no RCTs studying this adverse outcome and the current data is conflicting (Graphic 3). Additional RCTs are needed to adequately assess the efficacy and safety of corticosteroid injection therapy in hip osteoarthritis (Graphic 4).

**Open Access** This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

## References

- Lawrence RC, Helmick CG, Arnett FC, Deyo RA, Felson DT, Giannini EH, et al. Estimates of the prevalence of arthritis and selected musculoskeletal disorders in the United States. *Arthritis Rheum.* 1998;41:778–99.
- Lawrence JS, Bremner JM, Bier F. Osteoarthritis: prevalence in the population and relationship between symptoms and X-ray changes. *Ann Rheum Dis.* 1966;25:1–24.
- Roberts WN, Williams RB. Hip pain. *Prim Care.* 1988;15:783–93.
- Felson DT. Epidemiology of hip and knee osteoarthritis. *Epidemiol Rev.* 1988;10:1–28.
- Ingvarsson T, Hagglund G, Lohmander LS. Prevalence of hip osteoarthritis in Iceland. *Ann Rheum Dis.* 1999;58(4):201–7.
- Tepper S, Hochberg MC. Factors associated with hip osteoarthritis: data from the First National Health and Nutrition Examination Survey (NHANES-I). *Am J Epidemiol.* 1993;137:1081–8.
- Zhang W, Doherty M, Arden N, Bannwarth B, Bijlsma J, Gunther KP, et al.; EULAR Standing Committee for International Clinical Studies Including Therapeutics (ESCISIT). EULAR evidence based recommendations for the management of hip osteoarthritis: report of a task force of the EULAR Standing Committee for International Clinical Studies Including Therapeutics (ESCISIT). *Ann Rheum Dis.* 2005;64(5):669–81.
- Hochberg MC, Altman RD, Brandt KD, Clark BM, Dieppe PA, Griffin MR, et al. Guidelines for the medical management of osteoarthritis. Part I: osteoarthritis of the hip. *Arthritis Rheum.* 1995;38(11):1535–40.
- American College of Rheumatology Subcommittee on Osteoarthritis Guidelines. Recommendations for the Medical Management of Osteoarthritis of the Hip and Knee. 2000 Update. *Arthritis Rheum.* 2000;43:1905–15.
- Ayral X. Injections in the treatment of osteoarthritis. *Best Pract Res Clin Rheumatol.* 2001;15:609–26.
- Rozental TD, Sculco TP. Intra-articular corticosteroids: an updated overview. *Am J Orthop.* 2000;29:18–23.
- Cole BJ, Schumacher HR. Injectable corticosteroids in modern practice. *J Am Acad Orthop Surg.* 2005;13:37–46.
- O’Kane JW. Anterior hip pain. *Am Fam Physician.* 1999;60:1687–96.
- Manek NJ, Lane NE. Osteoarthritis: current concepts in diagnosis and management. *Am Fam Physician.* 2000;61:1795–804.
- Lambert RGW, Hutchings EJ, Grace MGA, Jhangri GS, Conner-Spady B, Maksymowych WP. Steroid injection for osteoarthritis of the hip. A randomized, double-blind, placebo-controlled trial. *Arthritis Rheum.* 2007;56(7):2278–87.
- Qvistgaard E, Christensen R, Torp-Pedersen S, Bliddal H. Intra-articular treatment of hip osteoarthritis: a randomized trial of hyaluronic acid, corticosteroid, and isotonic saline. *Osteoarth Cartil.* 2006;14:163–70.
- Kullenberg B, Runesson R, Tuvhaq R, Olsson C, Resch S. Intraarticular corticosteroid injection: pain relief in osteoarthritis of the hip? *J Rheumatol.* 2004;31:2265–8.
- Flannagan J, Thomas TL, Casale FF, Desai KB. Intraarticular injection for pain relief in patients awaiting hip replacement. *Ann R Coll Surg Engl.* 1988;70:156–7.
- Plant MJ, Borg AA, Dziedzic K, Saklatvala J, Dawes PT. Radiographic patterns and response to corticosteroid hip injection. *Ann Rheum Dis.* 1997;56:476–80.
- Smith RW, Cook PL, Cawley MID. A survey of arthrography and intra-articular corticosteroid injection of the hip joint. *Br J Rheumatol.* 1994;33(suppl):76.
- Robinson P, Keenan A-M, Conaghan PG. Clinical effectiveness and dose response of image-guided intra-articular corticosteroid injection for hip osteoarthritis. *Rheumatology.* 2007;46:285–91.
- Leveaux VM, Quin CE. Local injections of hydrocortisone and procaine in osteoarthritis of the hip. *Ann Rheum Dis.* 1956;15:330–7.
- Tehranezhadeh J, Booya F, Root J. Cartilage metabolism in osteoarthritis and the influence of viscosupplementation and steroid: a review. *Acta Radiol.* 2005;46:288–96.
- Creamer P. Intra-articular corticosteroid treatment in osteoarthritis. *Curr Opin Rheumatol.* 1999;11:417–21.
- Kaspar J, Kaspar S, Orme C, de V de Beer J. Intra-articular steroid hip injection for osteoarthritis: a survey of orthopedic surgeons in Ontario. *Can J Surg.* 2005;48:461–9.
- Snibbe JC, Gambardella RA. Use of injections for osteoarthritis in joints and sports activity. *Clin Sports Med.* 2005;24:83–91.
- Leopold SS, Battista V, Oliverio JA. Safety and efficacy of intraarticular hip injection using anatomic landmarks. *Clin Orthop.* 2001;391:192–7.
- Smith J, Hurdle M-FB. Office-based ultrasound-guided intra-articular hip injection: technique for physiatric practice. *Arch Phys Med Rehabil.* 2006;87:296–8.
- Adler RS, Sofka CM. Percutaneous ultrasound-guided injections in the musculoskeletal system. *Ultrasound Q.* 2003;19:3–12.
- Qvistgaard E, Kristoffersen H, Terslev L, Danneskiold-Samsøe B, Torp-Pedersen S, Bliddal H. Guidance by ultrasound of intraarticular injections in the knee and hip joints. *Osteoarth Cartil.* 2001;9:512–7.
- Carson B, Wong A. Ultrasonographic guidance for injections of local steroids in the native hip. *J Ultrasound Med.* 1999;18:159–60.
- Koski J. Ultrasound-guided injections in rheumatology. *J Rheumatol.* 2000;27:2131–8.
- Mayekawa D, Ralls P, Kerr R, Lee KP, Boswell WD, Halls JM. Sonographically guided arthrocentesis of the hip. *J Ultrasound Med.* 1989;8:665–8.

34. Brown AK, O'Connor PJ, Roberts TE, Wakefield RJ, Karim Z, Emery P. Recommendations for musculoskeletal ultrasonography by rheumatologists: setting global standards for best practice by expert consensus. *Arthritis Rheum.* 2005;53(1):83–92.
35. Migliore A, Tormenta S, Martin Martin LS, Valente C, Massafra U, Latini A, et al. Safety profile of 185 ultrasound-guided intra-articular injections for treatment of rheumatic diseases of the hip. *Reumatismo.* 2004;56(2):104–9.
36. Duclos M, Guinot M, Colsy M, Merle F, Baudot C, Corcuff JB, et al. High risk of adrenal insufficiency after a single articular steroid injection in athletes. *Med Sci Sports Exerc.* 2007;39(7):1036–43.
37. Charalambous CP, Tryfonidis M, Sadiq S, Hirst P, Paul A. Septic arthritis following intra-articular steroid injection of the knee: a survey of current practice regarding antiseptic technique used during intra-articular steroid injection of the knee. *Clin Rheumatol.* 2003;22(6):386–90.
38. Nallamshetty L, Buchowski JM, Nazarian LA, Narula S, Musto M, Ahn NU, et al. Septic arthritis of the hip following cortisone injection: case report and review of the literature. *J Clin Imaging.* 2003;27:225–8.
39. Chazerain P, Rolland D, Cordonnier C, Ziza J-M. Septic hip arthritis after multiple injections into the joint of hyaluronate and glucocorticoid. *Rev Rhum Engl Ed.* 1999;66:436–37.
40. Laroche M, Arlet J, Mazieres B. Osteonecrosis of the femoral and humeral heads after intraarticular corticosteroid injections. *J Rheumatol.* 1990;17(4):549–51.
41. McCarty DJ, McCarthy G, Carrera G. Intraarticular corticosteroids possibly leading to local osteonecrosis and marrow fat induced synovitis. *J Rheumatol.* 1991;18(7):1091–4.
42. Yamamoto T, Schneider R, Iwamoto Y, Bullough PG. Rapid destruction of the femoral head after a single intraarticular injection of corticosteroid into the hip joint. *J Rheumatol.* 2006;33(8):1701–4.
43. Kaspar S, de V de Beer J. Infection in hip arthroplasty after previous injection of steroid. *J Bone Joint Surg Br.* 2005; 87-B:454–7.
44. McIntosh AL, Hanssen AD, Wenger DE, Osmon DR. Recent intraarticular steroid injection may increase infection rates in primary THA. *Clin Orthop.* 2006;451:50–4.
45. Chitre AR, Fehily MJ, Bamford DJ. Total hip replacement after intra-articular injection of local anaesthetic and steroid. *J Bone Joint Surg Br.* 2007;89-B(2):166–8.