Title
Outcomes of intra-articular corticosteroid injections for adolescents with hip pain

Journal
Journal of Hip Preservation Surgery, 5(1)

ISSN
2054-8397

Authors
Tangtiphaiboontana, Jennifer
Zhang, Alan L
Pandya, Nirav K

Publication Date
2018

DOI
10.1093/jhps/hnx027

Peer reviewed

Journal of Hip Preservation Surgery Vol. 5, No. 1, pp. 54–59
doi: 10.1093/jhps/hnx027
Advance Access Publication 24 July 2017
Research article

OXFORD

Outcomes of intra-articular corticosteroid injections for adolescents with hip pain

Jennifer Tangtiphaiboontana[1], Alan L. Zhang[2]* and Nirav K. Pandya[3]

[1]Department of Orthopaedic Surgery, University of California, San Francisco (UCSF), 500 Parnassus Avenue, MU-302 West, San Francisco, CA 94143, USA,
[2]Department of Orthopaedic Surgery, University of California, San Francisco (UCSF), 1500 Owens Street, San Francisco, CA 94158, USA and
[3]Department of Orthopaedic Surgery, UCSF Benioff Children's Hospital of Oakland, 744 52nd Street, Oakland, CA 94609, USA
*Correspondence to: A. L. Zhang.
Submitted 8 March 2017; Revised 1 May 2017; revised version accepted 19 June 2017

ABSTRACT

Intra-articular injection of corticosteroid and anesthetic (CSI) is a useful diagnostic tool for hip pain secondary to labral tears or femoroacetabular impingement (FAI). However, the effectiveness of CSI as a stand-alone treatment for hip pain in adolescents is unknown. The purpose of this study is to evaluate the use of CSI for the treatment of hip pain and determine factors that may affect outcomes after injection. Retrospective analysis of 18 patients and 19 hips that underwent fluoroscopic guided hip injection for the treatment of pain at a single institution from 2012 to 2015 was carried out in this study. Mean age at the time of injection was 15.1 years (range 13–17) with mean follow-up of 29.4 months. Fifty-two percent (10/19 hips) went on to surgery after the injection. Average time to surgical conversion was 12.8 months after CSI. Cam or pincer morphologies were present in 90% (9/10 hips) of the operative group. Patients with FAI were more likely to need surgery than patients without bony abnormalities (RR= 10, 95% CI 1.6–64.2, $P = 0.0001$). There was no difference in the presence of labral tears in the operative and non-operative groups (100% versus 89%, $P = 0.47$). For adolescents without bony abnormalities, 90% improved with CSI alone and did not require further treatment within 2.4 years. Fluoroscopic guided corticosteroid hip injection may have limited efficacy for the treatment of hip pain secondary to FAI in adolescents. However, for patients without osseous deformity, CSI may offer prolonged improvement of symptoms even in the presence of labral tears.

INTRODUCTION

There has been an increase in diagnosis and treatment of hip injuries among adolescents. Treatment for pediatric hip disorders such as dysplasia, perthes and slipped capital femoral epiphysis (SCFE) have been well established; however, the diagnosis and treatment of conditions such as femoroacetabular impingement (FAI) and labral tears has limited long-term evidence [1, 2]. Hip pain secondary to FAI and/or labral tear has been described as a common phenomenon among adolescent athletes [1, 2]. The workup and diagnosis typically includes a physical exam and radiographic evaluation with X-rays and/or magnetic resonance imaging (MRI). Initial treatment of acute hip pain includes activity modification and physical therapy to increase flexibility, strength and balance, which have been well established in the adult population [3, 4]. When these interventions fail, an intra-articular injection of corticosteroid and anesthetic (CSI) is considered.

Intra-articular injection of CSI under fluoroscopic guidance is a useful tool for the localization of pain secondary to an intra-articular process. A study by Byrd and Jones demonstrated that an improvement in pain after an injection is a reliable indicator of intra-articular pathology as 90% of patients had abnormalities on MRI, MRA or arthroscopy [5]. Studies evaluating the therapeutic role of CSI in adults have demonstrated varying results. Hunt *et al*. demonstrated pain relief in 6 out of the 18 patients with mild FAI at 12 months whereas Krych *et al*. found a mean duration of significant pain relief at 9.8 days with only 6% of patients who had relief up to 6 weeks [3, 6].

These studies support a trial of conservative treatment and CSI for therapeutic purposes; however, conservative treatment appears to be most effective in those who have lower baseline activity scores and those who can accommodate activity modification [3, 6, 7]. Although the use of CSI for localization for intra-articular pathology has been well documented, the effectiveness and duration of improvement of CSI as a stand-alone treatment for hip pain in adolescent patients is unknown. The purpose of this study is to evaluate the use of intra-articular CSI for the treatment of hip pain in adolescents and determine factors that may affect outcomes after injection. We hypothesize that there is limited prolonged therapeutic effects from CSI in the adolescent population.

MATERIALS AND METHODS

A retrospective chart review of 1600 patients who underwent surgical intervention at a single institution from 2012 to 2015 was performed. Twenty-seven patients who underwent fluoroscopic guided hip injection with corticosteroid for the treatment of hip pain were identified. Those with less than 12 months of follow-up and age >18 years were excluded from the study. Five patients had a history of prior hip surgery and were also excluded. A total of 19 hips in 18 patients (15 females, 4 males) were included in the analysis. All patients were referred to physical therapy and completed a 6-week course prior to the injection.

All hip injections were performed in the operating room by the senior author and anesthesia was used for patient comfort. Physical examination of the hip and range of motion (ROM) was assessed under anesthesia. Using an entry point over the superior border of the greater trochanter and 1 cm anterior to it, an 18-gauge spinal needle was placed into the hip joint under fluoroscopic guidance. Two milliliters of half-strength Conray dye were injected to confirm intra-articular placement of the needle. The dye was aspirated out of the joint and the hip was injected with a mixture of 40 mg of kenalog, 2 ml of 1% lidocaine and 2 ml of 0.125% bupivacaine. All patients were referred to physical therapy after receiving the injection.

The primary outcome of the study was conversion to surgical intervention. Other data collected from the medical records for secondary analysis included patient demographics, intraoperative hip ROM, and radiographic findings on X-ray and MRI. The lateral center edge angle (LCEA) and α angle were measured on all available X-rays. The presence of cam morphology was defined as an α angle $>55^\circ$ on X-ray [8, 9]. Pincer morphology was defined as a LCEA $> 40^\circ$ or the presence of a crossover or ischial spine sign [10–12]. MRIs were also reviewed for intra-articular pathologies such as labral tears or chondral labral separation.

IRB approval was obtained for this study. Statistical analysis was performed using STATA (Version 12, StataCorp, College Station, TX, USA). The presence of labral pathology and bony abnormalities, defined as the radiographic evidence of dysplasia or CAM/pincer morphology, were compared between patients who require surgical intervention and those whose hip pain was sufficiently treated with the injection alone using χ^2 test and Fisher's exact test, when appropriate. Continuous variables including means for age, α angle and LCEA angle were compared using Student's t test. Statistical significance was defined as a P values <0.05.

RESULTS

The mean age at time of injection was 15.1 years (range 13–17). Thirteen patients reported participation in sports. At a mean follow-up of 29.4 months (range 12–52 months), 52.6% (10/19 hips) of the cohort went on to surgical intervention after the injection. Of the 10 hips that underwent surgery, the average time between the injection and surgical treatment was 12.8 months (range 2–36 months) (Table I). Nine hips were treated arthroscopically while one was treated with open labral repair and acetabuloplasty of the anterior wall. There was no difference in gender, age, history of prior hip surgery or hip ROM between patients that underwent surgery and patients that improved with CSI alone (Table II).

Diagnostic imaging revealed osseous deformities in nine hips consistent with FAI (cam or pincer morphology). Pre-injection MR imaging demonstrated the presence of labral tears in 94.7% (18/19 hips) of the cohort. A majority (88.9%) of tears involved the anterior-superior aspect of the labrum. Mean α angle was 55.4° and 44° in the operative and non-operative groups, respectively ($P = 0.0001$). Mean LCEA between both groups was 37° and 31.2°, respectively ($P = 0.02$) (Table II). Cam or pincer morphology consistent with FAI were present in 90% (9/10 hips) of the operative group. There were no osseous deformities in the non-operative group. Patients with osseous deformities were more likely to need surgical intervention than patients without FAI (RR= 10, 95% CI 1.6–64.2, $P = 0.0001$). Of the remaining 10 patients without osseous deformities, 90% improved with CSI alone even in the presence of a labral tear and did not require further treatment. There was no statistically significant difference in the presence of a labral tear between those that required surgery compared with those who were treated with an injection alone (10 hips versus 8 hips, $P = 0.47$).

DISCUSSION

The results of our study suggest that fluoroscopic guided corticosteroid hip injection may have limited efficacy for

Table I. Demographics and imaging findings of individual patients in the surgical group

Patient number	*Gender*	*Age at injection (years)*	*Sport*	*Affected hip*	*Bony deformity*	*α angle (degrees)*	*LCEA (degrees)*	*Other X-ray findings*	*Labral tear*	*Time to surgery (months)*
1	F	13	Soccer, basketball, volleyball, baseball	Left	Yes	49	50	Protrusio	Anterior	8
2	F	13	Softball, basketball	Left	Yes	58	38		Anterior	13
3	F	17	Soccer	Right	Yes	47	38	Acetabular Retroversion	Anterior	10
4	F	16		Right	Yes	56	39	Acetabular Retroversion	Anterior-Superior	5
5	F	17	Crew	Right	Yes	60	40		Anterior-Superior	2
6	M	15	Soccer	Right	Yes	57	29		Anterior	
7	M	17		Right	No	45	33		Posterior	4
8	M	13	Football	Left	Yes	64	31		Anterior-Superior	3
9	F	14	Dance	Right	Yes	56	36		Anterior-Superior	36
10	F	13		Right	Yes	62	36		Posterior	34

LCEA, lateral center edge angle.

Table II. Summary of demographic and radiographic findings in the surgical and non-surgical groups

	Surgery (n=*10*)	*No surgery* (n=*9*)	P-*value*
Age, mean (SD) years	14.8 (1.8)	15.4 (1.1)	0.37
Gender			0.58
Female	7	8	
Male	3	1	
Hip range of motion, mean (SD) degrees			
Flexion	117.8 (3.6)	119.4 (1.7)	0.23
Internal rotation	41.1 (4.9)	49.4 (10.7)	0.05
External rotation	58.3 (10)	63.9 (3.3)	0.13
Bony abnormality	9	0	0.0001
Mixed cam/pincher	2	0	
Cam only	5	0	
Pincher only	2	0	
No bony abnormality	1	9	
α angle, mean (SD) degrees	55.4 (6.4)	44.0 (4.8)	0.0009
LCEA, mean (SD) degrees	37 (5.8)	31.2 (2.9)	0.02
Labral tear	10	8	0.47

LCEA, lateral center edge angle; SD, standard deviation.

therapeutic treatment of adolescent hip pain secondary to osseous deformities such as FAI. Of the 9 hips with bony abnormalities, all required surgical intervention within 12.8 months of injection. However, for adolescents without bony abnormalities, 90% (9/10 hips) improved with CSI alone and did not require further treatment within 2.4 years even if a labral tear was present on MRI/MRA. While the diagnostic role of intra-articular hip injection is well understood, in a pediatric/adolescent population, this is often performed under anesthesia or sedation for patient comfort. To our knowledge, this study is the first to evaluate the efficacy of CSI for the treatment of adolescent hip pain.

There has been an increase in pediatric and adolescent hip pain in the population, which may be attributed to an increased participation in athletic activities. In this specific group of patients, bony morphology such cam and pincer morphologies and labral tears are one of the most common causes of pain. Several studies have demonstrated an association of cam morphology and sports activities in childhood [13, 14]. A study by Siebenrock *et al*. reported a 10-fold increase of cam-type impingement in athletes compared to age match controls who did not participate in sports [14]. One of the proposed mechanisms for the increase of cam impingement in adolescent athletes includes repetitive stress demands during period of growth that may alter the development of the proximal femur and lead to cam formation [15–17]. Further investigation of treatment options such as physical therapy, corticosteroid injection, or surgery for these patients is warranted.

The patients in our study with FAI had a significant rate of treatment failure with the injection and eventually required surgery. Surgical indications and treatment of hip pain in young patients has continued to evolve with the advancement and improvement in hip arthroscopy techniques. Clohisy *et al*. proposed surgical treatment guidelines of hip pain in young adults based on the etiology of pain [18]. Those with intra-articular disorders without structural abnormalities such as labral tears, chondral defect, or synovitis could be treated with hip arthroscopy. Patients with structural abnormalities such as dysplasia, SCFE, and FAI are treated with osteotomies or osteoplasty via arthroscopic or open techniques depending on the severity of the deformity. Chen *et al*. demonstrated good results with osteoplasty in treatment of cam morphologies in patients with a history of SCFE [19]. There have been several studies demonstrating the safety of hip arthroscopy in the pediatric population with encouraging results of surgical treatment of FAI [20–23].

Despite the high rate of treatment failure with injections in our cohort, there was a group of patients with labral tears in the absence of FAI who did well with injections. This finding suggests that this specific population may be adequately treated with conservative management and may prevent or delay the need for surgery. While there is a high rate of labral tears associated with FAI [24], there have been a number of studies evaluating the rate of asymptomatic labral tears in the population. Prior studies have reported an 85.7 and 56% prevalence rate of labral tears in asymptomatic military personnel and professional/collegiate level ice hockey players, respectively [25, 26]. Among young, recreationally active adults, the prevalence rate was lower at 38.6% [27]. There has been one study reporting a prevalence of 1.4% of asymptomatic labral tears in children; however, the patients in this population were those with chronic medical conditions and low physical demands [28]. None of the patients with isolated labral tears in our study reported a traumatic episode or injury event; however, a majority of patients participated in sports activities and may have experienced microtrauma that resulted in labral tears detected on MRI/MRA.

Finally, repeated use of CSI under anesthesia may accrue local and systemic reactions. Systemic effects of intra-articular steroid injections include a transient suppression of the hypothalamic–pituitary–adrenal axis and cortisol levels, increase in blood glucose levels, decrease in markers of bone turnover and formation, potential growth suppression, subcutaneous lipoatrophy, and dermatologic changes such as flushing, acne, and pigmentary changes at the injection site [29, 30]. Several studies have also demonstrated the injury to chondrocytes with local anesthetic. Piper *et al.* summarized the chondrotoxic effects of bupivacaine, lidocaine, and ropivacaine on human articular cartilage [31]. Another study by Farkas *et al.* demonstrated a synergistic effect of local anesthetic and steroids on chondrocyte apoptosis with the combination of betamethasone and ropivacaine being the most cytotoxic [32]. Exposure to general anesthesia may also have neurocognitive consequences such as development and behavioral disorders; however, these findings have been limited to patients with early anesthetic exposure (age <36 months) and animal studies [33–35]. The results of our study indicate that there is limited therapeutic benefit from CSI in the adolescent population with osseous hip deformity; therefore, repeated CSI in this population may incur greater risks than benefits.

Our study has several limitations. The first limitation is the small sample size of our cohort which limits our statistical power and is likely underpowered. While our study may have been able to detect differences in some outcomes, we were unable to perform a power analysis as there are no prior studies evaluating the efficacy of intra-articular injections as a standalone treatment for hip pain in the adolescent population. The data collection and analyses were also limited to the information available in the medical records as this was a retrospective study. The study also lacked important clinical results such as patient reported outcomes scores. While we were able to report and analyze objective data such as hip ROM and conversion to surgery, we were unable to determine the extent of pain relief or quality improvement with the injections. Finally, there may be an inherent bias towards surgical treatment in patients with bony morphology as they may feel that injections would not be able to treat this. However, these adolescent patients and families were very conservative with respect to their treatments and therefore all underwent CSI while under anesthesia with the hopes of avoiding further surgery. Despite these limitations, this study offers initial pilot data with over 2-year follow-up in adolescent patients. The results provided here can be used to launch larger analyses for more in-depth investigations.

Our data suggest that CSI may not be as effective for patients with hip pain in the presence of osseous deformities but may provide prolonged symptom improvement in those without osseous deformities, even in the presence of a labral tear seen on MRI. Additional studies are required to further investigate the role of injections, especially among patients with labral tears alone, to determine the therapeutic effects of intra-articular injections.

ACKNOWLEDGEMENT

We would like to acknowledge the continued support of the authors' facilities in making this research study possible.

FUNDING

No funding was received for this work.

CONFLICT OF INTEREST STATEMENT

None declared.

REFERENCES

1. Frank JS, Gambacorta PL, Eisner E. a. Hip pathology in the adolescent athlete. *J Am Acad Orthop Surg* 2013; **21**:665–74.
2. Jacoby L, Yi-Meng Y, Kocher MS. Hip problems and arthroscopy: adolescent hip as it relates to sports. *Clin Sports Med* 2011; **30**:435–51.
3. Hunt D, Prather H, Harris Hayes M *et al.* Clinical outcomes analysis of conservative and surgical treatment of patients with clinical indications of prearthritic, intra-articular hip disorders. *Pm R* 2012; **4**:479–87.
4. Wall PDH, Fernandez M, Griffin DR *et al.* Nonoperative treatment for femoroacetabular impingement: a systematic review of the literature. *Pm R* 2013; **5**:418–26.
5. Byrd JWT, Jones KS. Diagnostic accuracy of clinical assessment, magnetic resonance imaging, magnetic resonance arthrography, and intra-articular injection in hip arthroscopy patients. *Am J Sports Med* 2004; **32**:1668–74.
6. Krych AJ, Griffith TB, Hudgens JL *et al.* Limited therapeutic benefits of intra-articular cortisone injection for patients with femoro-acetabular impingement and labral tear. *Knee Surg Sport Traumatol Arthrosc* 2014; **22**:750–5.
7. Khaled E, W.ail S, Hausain M *et al.* Conservative treatment for mild femoroacetabular impingement. *J Orthop Surg (Hong Kong)* 2011; **19**:41–5.
8. Hack K, Di Primio G, Rakhra K *et al.* Prevalence of cam-type femoroacetabular impingement morphology in asymptomatic volunteers. *J Bone Joint Surg Am* 2010; **92**:2436–44.
9. Nötzli HP, Wyss TF, Stoecklin CH *et al.* The contour of the femoral head-neck junction as a predictor for the risk of anterior impingement. *J Bone Joint Surg Br* 2002; **84**:556–60.
10. Tannast M, Hanke MS, Zheng G *et al.* What are the radiographic reference values for acetabular under- and overcoverage? *Clin Orthop Relat Res* 2015; **473**:1234–46.
11. Wiberg G. Studies on dysplastic acetabula and congenital subluxation of the hip joint. *Acta Chir Scand* 1939; 5–135.
12. Tönnis D. Normal values of the hip joint for the evaluation of X-rays in children and adults. *Clin Orthop Relat Res* 1976; **119**:39.
13. Nepple JJ, Vigdorchik JM, Clohisy JC. What is the association between sports participation and the development of proximal femoral cam deformity? A systematic review and meta-analysis. *Am J Sports Med* 2015; **43**:2833–40.
14. Siebenrock KA, Ferner F, Noble PC *et al.* The cam-type deformity of the proximal femur arises in childhood in response to vigorous sporting activity. *Clin Orthop Relat Res* 2011; **469**:3229–40.
15. Murray R.O, Duncan C. Athletic activity in adolescence as an etiological factor in degenerative hip disease. *J Bone Jt Surgery* 1971; Aug. **53**:406–19.
16. Philippon M, Schenker M, Briggs K *et al.* Femoroacetabular impingement in 45 professional athletes: associated pathologies and return to sport following arthroscopic decompression. *Knee Surg Sport Traumatol Arthrosc* 2007; **15**:908–14.
17. Keogh MJ, Batt ME. A review of femoroacetabular impingement in athletes. *Sport Med* 2008; **38**:863–78.
18. Clohisy JC, Keeney JA, Schoenecker PL. Preliminary assessment and treatment guidelines for hip disorders in young adults. *Clin Orthop Relat Res* 2005; **441**:168–79.
19. Chen A, Youderian A, Watkins S *et al.* Arthroscopic femoral neck osteoplasty in slipped capital femoral epiphysis. *Arthrosc J Arthrosc Relat Surg* 2014; **30**:1–6.
20. Kocher MS, Kim Y, Millis MB *et al.* Hip arthroscopy in children and adolescents. *System* 2005; **25**:680–6.
21. Sa DD, Cargnelli S, Catapano M *et al.* Femoroacetabular impingement in skeletally immature patients: a systemic review examining indications, outcomes, and complication of open and arthroscopic treatment. *Arthrosc J Arthrosc Relat Surg* 2015; **31**:373–84.
22. Roy DR. Arthroscopy of the hip in children and adolescents. *J Child Orthop* 2009; **3**:89–100.

23. Philippon MJ, Patterson DC, Briggs KK. Hip arthroscopy and femoroacetabular impingement in the pediatric patient. *J Pediatr Orthop* 2013; **33(Suppl 1)**:S126–30.
24. Clohisy JC, Baca G, Beaule PE *et al*. Descriptive epidemiology of femoroacetabular impingement. A North American Cohort of patients undergoing surgery. *Am J Sport Med* 2013; **41**:1348–56.
25. Silvis ML, Mosher TJ, Smetana BS *et al*. High prevalence of pelvic and hip magnetic resonance imaging findings in asymptomatic collegiate and professional hockey players. *Am J Sport Med* 2011; **39**:715–21.
26. Schmitz MR, Campbell SE, Fajardo RS *et al*. Identification of acetabular labral pathological changes in asymptomatic volunteers using optimized, noncontrast 1.5-T magnetic resonance imaging. *Am J Sports Med* 2012; **40**:1337–41.
27. Lee AJJ, Armour P, Thind D *et al*. The prevalence of acetabular labral tears and associated pathology in a young asymptomatic population. *Bone Jt J* 2015; **97–B**:623–7.
28. Georgiadis AG, Seeley MA, Chauvin NA *et al*. Prevalence of acetabular labral tears in asymptomatic children. *J Child Orthop* 2016; **10**:149–54.
29. Habib GS. Systemic effects of intra-articular corticosteroids. *Clin Rheumatol* 2009; **28**:749–56.
30. Goldzweig O, Carrasco R, Hashkes PJ. Systemic adverse events following intraarticular corticosteroid injections for the treatment of juvenile idiopathic arthritis: two patients with dermatologic adverse events and review of the literature. *Semin Arthritis Rheum* 2013; **43**:71–6.
31. Piper SL, Kramer JD, Kim HT *et al*. Effects of local anesthetics on articular cartilage. *Am J Sports Med* 2011; **39**:2245–53.
32. Farkas B, Kvell K, Czompoly T *et al*. Increased chondrocyte death after steroid and local anesthetic combination. *Clin Orthop Relat Res* 2010; **468**:3112–20.
33. Psaty BM, Platt R, Altman RB. Neurotoxicity of generic anesthesia agents in infants and children. *JAMA* 2015; **313**:1515.
34. Dimaggio C, Sun LS, Li G. Early childhood exposure to anesthesia and risk of developmental and behavioral disorders in a sibling birth cohort. *Anesth Analg* 2011; **113**:1143–51.
35. Ing CH, DiMaggio CJ, Malacova E *et al*. Comparative analysis of outcome measures used in examining neurodevelopmental effects of early childhood anesthesia exposure. *Anesthesiology* 2014; **120**:1319–32.