Original Article

Endoscopic Excision of Hip Heterotopic Ossification, Plus Indomethacin and Radiation, Is Effective in Treating and Preventing Recurrence

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Purpose: To describe the clinical and patient-reported outcomes of heterotopic ossification (HO) excision as well as the results of a standardized HO prophylaxis protocol among a group of patients who previously underwent open or arthroscopic hip surgery. **Methods:** Patients who developed HO after index hip surgery and were subsequently treated with arthroscopic excision of HO and postoperative HO prophylaxis using 2 weeks of indomethacin and radiation were retrospectively identified. All patients were seen by a single surgeon and were treated with the same arthroscopic technique. Patients were also placed on a regimen of 2 weeks of indomethacin 50 mg and radiation therapy with 700 cGy in one fraction on the first postoperative day. Outcomes assessed included recurrence of HO and conversion to total hip arthroplasty by latest follow-up. Other outcomes included Modified Harris Hip Scores and Non-Arthritic Hip Scores, which were collected preoperatively and at 1-year and 2-year follow-up. **Results:** There were 5 female and 9 male subjects, with an average age of 39 years (range 22-66) and average body mass index of 27.1 (19.1-37.5). Average follow-up time was 46 months (range 4-136). No patients had experienced HO recurrence by latest follow-up. Only 2 patients converted to total hip arthroplasty, one at 6 months and the other at 11 months postexcision. Average outcome scores improved by 2-year follow-up (average Modified Harris Hip Scores 52.8 improved to 86.5, average Non-Arthritic Hip Scores 49.4 improved to 83.8). **Conclusions:** Minimally invasive arthroscopic excision of HO and postoperative prophylaxis with combined indomethacin and radiation therapy effectively treats and prevents the recurrence of HO. **Level of Evidence:** Level IV, case series, therapeutic.

Historically, treatment of most orthopaedic hip pathologies has involved open surgical technique. However, advancements in the field of hip arthroscopy have enabled minimally invasive interventions for a variety of hip disorders including femoroacetabular impingement syndrome (FAI) and labral injuries.[1,2] Complication rates following hip arthroscopic procedures are low, but approximately 1% to 12% of cases are associated with the postoperative development of heterotopic ossification (HO).[3,4] HO can lead to compromised functional outcomes following hip arthroscopy, including recurrent pain, limited range of motion (ROM), and the need for further surgeries.[5] Therefore, early identification and treatment of HO is essential for preserving hip function among patients undergoing arthroscopic procedures.

Early-stage hip HO may be treated conservatively with physical therapy and ROM exercises, but late-stage HO usually necessitates surgical intervention via open or arthroscopic excision. Little is known about standardized treatment of symptomatic HO following hip arthroscopy. A previous case series described a surgical technique for the arthroscopic excision of HO after previous hip arthroscopy and discussed postoperative outcomes of HO excision among 3 patients treated at single urban academic medical center.[3] The present case series is a follow-up on those patients plus additional patients who underwent arthroscopic HO excision at our center. The purpose of this study was to

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describe the clinical and patient-reported outcomes of HO excision as well as the results of a standardized HO prophylaxis protocol among a group of patients who previously underwent open or arthroscopic hip surgery. We hypothesized that patients treated with HO excision and prophylaxis would remain recurrence-free for up to 1 year postoperatively.

Methods

This study was approved by the New York University Langone Health Institutional Review Board (#20-01686).

Patient Selection

Patients were identified via retrospective review of the senior author's (T.Y.) surgical case log at a single urban academic medical center from August 2008 to November 2021. All patients included in the case series developed HO after index hip surgery and were subsequently treated with arthroscopic excision of HO and postoperative HO prophylaxis using 2 weeks of nonsteroidal anti-inflammatory drugs (NSAIDs) and radiation. Patients whose HO was treated via an open approach were excluded from this series. All patients were assessed by the senior author, a sports medicine fellowship-trained orthopaedic surgeon.

Radiographic Analysis

HO severity was assessed on plain anteroposterior view hip radiographs obtained before HO excision. HO severity was graded using a 4-stage classification system previously described by Brooker et al.[6] Grade 1 describes islands of bone within soft tissues, grade 2 describes bone spurs leaving >1 cm between opposing bone surfaces, grade 3 describes bone spurts leaving <1 cm between opposing bone surfaces, and grade 4 describes radiographic ankylosis of the hip.[7]

Surgical Technique

A surgical technique for arthroscopic excision of HO was described previously.[3] To summarize in brief, surgery was indicated for symptomatic patients with limitations in ROM, radiographic evidence of HO, and concomitant intra-articular hip disorder (FAI or labral pathology). Arthroscopic HO excision was not performed on patients with Booker grade 4 HO. Additionally, immature HO and severe hip osteoarthritis that would impede arthroscopic access to the joint were contraindications. Arthroscopic HO excisions were performed in the supine position with general anesthesia. Diagnostic and therapeutic arthroscopy of the central and peripheral compartments was performed. Intraoperative fluoroscopy with spinal needle localization was used to locate HO deposits. Once a deposit was identified, a cannula was inserted over the spinal needle, an arthroscope was inserted to visualize the deposit, and a burr and grasper were used to excise the HO and remove any loose fragments.

Table 1. Demographic Characteristics

Patient No.	Age, y	Sex	Weight, kg	BMI	HO Grade	Follow-Up Time, mo
1	66	M	91	30.4	3	44
2	28	M	104	31.2	2	25
3	41	F	70	25.6	2	19
4	27	M	91	28.7	2	42
5	29	F	45	19.1	1	37
6	53	F	70	28.2	1	33
7	25	M	77	24.3	2	27
8	57	M	83	27.0	1	17
9	63	M	107	37.5	2	11
10	25	M	74	23.9	2	5
11	31	M	88	28.0	2	4
12	48	F	68	25.8	1	107
13	29	M	74	23.2	1	136
14	22	F	75	26.7	3	134
Mean ± SD	39 ± 15	–	80 ± 16	27.1 ± 4.3	–	46 ± 45

BMI, body mass index; F, female; HO, heterotopic ossification; M, male; SD, standard deviation.

Postoperative Protocol

Patients were placed in a hinged hip brace for the first postoperative week and instructed to remain foot-flat partial-weight-bearing on crutches for 14 weeks depending on concomitant procedures such as labral repair and FAI resection. Formal physical therapy commenced once full weight-bearing was allowed. Physical therapy was scheduled for 2 to 3 times per week for a minimum of 4 weeks up to 3 months until full ROM and strength were achieved. At 3- to 6-month follow-up, patients could be cleared for return to all activities without restriction. Patients were also placed on a standardized HO prophylaxis regimen consisting of 2 weeks of indomethacin 50 mg and radiation therapy with 700 cGy in one fraction on the first postoperative day.

Outcome Scores

The 3 patients from the previous study completed the modified Harris Hip Score (mHHS)[8] before HO excision surgery. The remaining 11 patients completed the mHHS as well as the Non-Arthritic Hip Score (NAHS)[9] before surgery. mHHS and/or NAHS were collected again at 1-year and 2-year follow-up. In addition to functional scores, primary outcomes of interest included recurrence of HO. Secondary outcomes included conversion to total hip arthroplasty (THA) by the most recent follow-up. We used the minimum clinically important difference (MCID) cutoffs of 8 points on the mHHS and 8.5 points on the NAHS that was were previously published by Bloom et al.[10]

Table 2. Previous Hip Surgeries, Preoperative Courses, and HO Excision Procedure Times

Patient No.	Previous Hip Surgery	Time from Previous Surgery to HO Diagnosis, mo	Time From HO Diagnosis to Excision, mo	HO Excision Operative Time, min
1	Total hip arthroplasty	11	5	96
2	Cam and pincer resection	10	76	144
3	Cam and pincer resection	14	<1	135
4	Excision of os acromiale	156	3	96
5	Derotational osteotomy	10	2	101
6	Cam and pincer resection	36	<1	116
7	Cam and pincer resection	18	8	118
8	Pincer resection	100	20	80
9	Cam and pincer resection	14	1	90
10	Cam and pincer resection	42	<1	69
11	Femur lengthening with intramedullary rod	120	<1	71
12	Pincer resection	5	3	45
13	Cam and pincer resection	3	4	–
14	Cam and pincer resection	3	4	–
Mean ± SD	–	39 ± 50	9 ± 20	97 ± 29

HO, heterotopic ossification; SD, standard deviation.

Results

Patient Demographics

Fourteen patients were included in this case series, and their demographic characteristics are summarized in Table 1. There were 5 female and 9 male patients, with an average age of 39 years (range 22-66) and average body mass index of 27.1 (19.1-37.5). Average follow-up time was 46 months (range 4-136). All 3 patients included from the previous study[3] had at least 8 years of follow-up, whereas only 2 of the new cases had less than 6 months of follow-up. On pre-excision radiographs, 5 patients had Brooker grade 1 HO, 7 patients had grade 2 HO, and 2 patients had grade 3 HO.

Previous hip surgeries, preoperative courses, and HO excision procedure times are displayed in Table 2. Ten patients developed HO following a previous arthroscopic cam and/or pincer resection. Three patients developed HO following open procedures including THA (patient #1), derotational femoral osteotomy (patient #5), and femoral lengthening over an intramedullary rod (patient #11). Average time from index hip surgery to HO diagnosis was 39 ± 50 months (range 3-156), average time from HO diagnosis to excision was 9 ± 20 months (range 0-76), and average excision procedure time was 97 ± 29 minutes (range 45-144). No patients underwent concomitant procedures in addition to arthroscopic HO excision. No patients reported complications besides HO following their index hip surgery, and no patients reported complications following HO excision.

Clinical and Patient-Reported Outcomes

Postexcision outcomes are summarized for each patient in Table 3. No patients experienced recurrent episodes of HO by latest follow-up. Of the 13 patients who did not previously undergo THA, 2 (15%) underwent THA by latest follow-up. Patient #3 underwent THA at 6 months postexcision and patient #6 underwent THA at 11 months postexcision. Neither of the patients who underwent THA had developed postoperative HO after arthroscopic excision.

Mean baseline mHHS among all 15 patients was 52.8 (range 31.9-78.0). Mean baseline NAHS among the 13 new patients was 49.4 (range 23.8-87.5). On average, patients experienced improvement by 2-year follow-up in both mHHS (mean 52.8 improved to 86.5) and NAHS (mean 49.4 improved to 83.8), although it should be noted that only 8 patients had 2-year follow-up mHHS and only 5 patients had 2-year follow-up NAHS. In total,7 of 8 patients achieved the MCID for mHHS by 2-year follow-up, whereas 4 of 5 patients achieved the MCID for NAHS by 2-year follow-up.

Discussion

In this study, we found that endoscopic excision of HO followed by appropriate prophylaxis is effective in treating and preventing HO recurrence. Furthermore, patients exhibited pre- to postoperative improvement in outcome scores, suggesting that treatment of symptomatic HO has a tangible impact on hip function and quality of life. Our study supports the clinical efficacy of our arthroscopic technique as well as the efficacy of our prophylaxis regimen, which combines indomethacin with radiation therapy.

Prophylaxis for HO may consist of a course of NSAIDs in the form of nonselective cyclooxygenase inhibitors, selective cyclooxygenase-2 inhibitors, or aspirin in addition to or in lieu of radiation therapy.[5] Although others have proposed the use of bone morphogenetic protein type 1 receptor inhibitors, bone morphogenetic protein antagonists, nuclear retinoic acid receptor γ agonists, free radical scavengers, or bisphosphonates,

Table 3. Clinical and Patient-Reported Outcomes

Previous No.	HO Recurrence	THA	mHHS Preoperative/ 1-year/2-year	2-Year MCID for mHHS	NAHS Preoperative/ 1-year/2-year	2-Year MCID for NAHS
1	No	—	40.5 / — / 90.2	Yes	42.5 / — / 87.5	Yes
2	No	No	57.2 / 62.7 / 62.7	No	87.5 / 67.5 / 67.5	No
3	No	Yes	36.3 / — / —	—	23.8 / — / —	—
4	No	No	53.9 / — / 95.7	Yes	56.3 / — / 92.5	Yes
5	No	No	44 / — / 70.4	Yes	38.8 / — / 78.8	Yes
6	No	Yes	31.9 / — / —	—	25.0 / — / —	—
7	No	No	62.7 / — / 95.7	Yes	62.5 / — / 92.5	Yes
8	No	No	48.4 / 70.4 / —	—	42.5 / 67.5 / —	—
9	No	No	40.5 / — / —	—	42.5 / — / —	—
10	No	No	48.4 / — / —	—	71.25 / — / —	—
11	No	No	57.1 / — / —	—	51.25 / — / —	—
12	No	No	70.0 / — / 85.0	Yes	— / — / —	—
13	No	No	78.0 / — / 96.0	Yes	— / — / —	—
14	No	No	70.0 / — / 96.0	Yes	— / — / —	—
Mean ± SD	—	—	52.8 ± 13.8 / 66.6 ± 5.4 / 86.5 ± 13.0	—	49.4 ± 19.1 / 67.5 ± 0.0 / 83.8 ± 10.7	—

HO, heterotopic ossification, MCID, minimum clinically important difference, mHHS, modified Harris Hip Score; NAHS, Non-Arthritic Hip Score; SD, standard deviation; THA, total hip arthroplasty.

such pharmacologic agents are rarely used in common clinical practice. Regarding radiation, most protocols include external beam radiation of 600 to 800 Gy preoperatively or postoperatively, typically within 3 days after surgery.[11-14] To date, no studies have shown that one radiation protocol is superior to another.

Amar et al.[5] published a literature review examining the pharmacologic agents for HO prophylaxis posthip arthroscopy and found that only a few small studies have compared the efficacy of certain drugs, without a clear consensus on the best agent. After reviewing the available literature comparing NSAID prophylaxis to no prophylaxis, the authors concluded that NSAIDs are generally effective at preventing HO after hip arthroscopy. Randelli et al.[15] retrospectively assessed a cohort of patients (hips) that received arthroscopic treatment for FAI, of which 285 hips received NSAID prophylaxis and 15 did not. The authors' analysis identified 5 patients who experienced postoperative HO, all of whom had not received NSAID prophylaxis. As such, they concluded that NSAIDs appeared to be an effective option for HO prophylaxis. Bedi et al.[16] reviewed a cohort of 616 hip arthroscopies, compared HO rates between patients with versus without indomethacin prophylaxis, and found a statistically significant difference in that patients who received indomethacin had a lower prevalence of HO after surgery (1.8% vs 6.3%; $P < .05$). Beckmann et al.[17] demonstrated in a prospective study of 357 consecutive hip arthroscopy cases that patients not on NSAID prophylaxis were 13.6 times more likely to develop postoperative HO ($P = .003$). The authors concluded that routine NSAID prophylaxis reduces but does not eliminate the incidence of HO in patients undergoing hip arthroscopy.

Although radiation is often used as an adjunct treatment for HO along with NSAIDs, it is associated with some potential side effects. Radiation therapy may increase the risk of malignant transformation, though small single doses of <3,000 cGy likely carry little risk.[18] Furthermore, NSAID therapy also carries some risk; drugs of this class have been shown to negatively affect the gastrointestinal, cardiovascular, hepatic, renal, cerebral, and pulmonary systems.[19] Indomethacin can cause platelet aggregation, interaction with other medications, and gastrointestinal upset, although a short, 2-week course administered with meals may mitigate these effects.[20] We recommend minimizing the duration and dosage of both radiation therapy and NSAID use for HO prophylaxis to reduce potential side effects and improve patient compliance.

Limitations

We note several important limitations of this study. First, our study constitutes a small case series without a comparison group of patients treated with either no HO prophylaxis or an alternative form of prophylaxis. Second, we did not have follow-up outcome scores for all patients due to a combination of factors including patients having recent surgery (<6 months) or failing to complete 1-year or 2-year follow-up surveys. Third, although patients' symptoms correlated with the development of HO and were improved with its excision, there may be confounding variables that influenced the presentation and resolution of their symptoms before and after HO excision that we did not identify.

Conclusions

The development of HO after hip procedures can be debilitating for some patients. Minimally invasive arthroscopic excision of HO and postoperative prophylaxis with combined indomethacin and radiation therapy effectively treats and prevents the recurrence of HO.

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