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Case Report

Hip arthroscopy for excision of osteoid osteoma and for the application of a collagen cartilage implant: Case report in a professional athlete, and literature review

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Abstract.
BACKGROUND: Osteoid osteoma is an osteoblastic benign bone tumor usually affecting young adolescents. Intra-articular lesions are not common; usually the diagnosis is delayed. A lot of studies report difficulties and complications in the management of osteoid osteoma of the hip joint using imaging guided techniques or open surgical procedures. Only few published cases have described that it can be treated precisely using hip arthroscopy. Additionally, the use of hip arthroscopy to apply the Chondrofiller®, an acellular collagen matrix for the management of articular cartilage defects of the hip joint, has not yet been described.
CASE PRESENTATION: This report presents an osteoid osteoma of the femoral neck. A 20-year-old female professional basketball player presented with pain in the left groin since more than 12 months. On magnetic resonance and computed tomography imaging, an osteoid osteoma was suggested. The lesion was successfully removed using arthroscopy. During surgery, a concomitant grade 4 cartilage lesion on the femoral head was detected. For the treatment of this severe defect we used the Chondrofiller®, which is a new acellular collagen implant for auto-regeneration of articular cartilage. This matrix was filled into the prepared and dried defect using CO2 arthroscopy. After the hardening of the matrix the surgery was finished. The patient was pain free shortly after the operation and returned to sports within 16 weeks. Return to high-performance sports 8 months after surgery was without of any sign of complaints.
CONCLUSIONS: This article demonstrates that hip arthroscopy is a valuable tool for biopsy and excision of intra-articular osteoid osteoma affecting the hip joint, as well as for addressing other concomitant pathologies such as a severe synovitis

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or cartilage defects. CO2 arthroscopy provided good conditions for the drying and filling of the cartilage defect with the Chondrofiller®.

Keywords: Hip arthroscopy, osteoid osteoma, cartilage defect, cartilage matrix, hip joint, CO2 arthroscopy

List of abbreviations

NaCl	sodium chloride
CO2	carbon dioxide
NSAIDs	nonsteroidal anti-inflammatory drugs
MRI	magnetic resonance imaging
CT	computed tomography

1. Background

In 1935, Jaffé described five cases with a benign osteoblastic tumor composed of osteoid and atypical bone. He defined the term Osteoid osteoma [1]. It usually affects individuals in the second and third decade of life with a male to female ratio of 2:1 [2,3]. It is the most common benign osteoblastic lesion with an incidence of 10% to 12% of all benign bone tumors and approximately 3% of all primary bone tumors [4,5]. Osteoid osteoma mainly affects the metaphysis or diaphysis of the long bones, but it can affect almost every bone. 25% to 27% of osteoid osteomas occur in the proximal femur [6,7]. Osteoid osteomas are usually found extra-articularly; with approximately 12% of all osteoid osteomas, intra-articular lesions are less common. The most common site for these intra-articular lesions is the hip joint [8]. Osteoid osteoma is composed of a nidus of vascular osteoid tissue that rarely exceeds 1.5 cm, surrounded by woven bone with osteoblasts. It is usually surrounded by a considerable inflammation. The exact site of the nidus must be located because its removal is essential for successful treatment [9].

The typical symptoms are nocturnal pain that is not related to activity, increased by rest, and relieved by nonsteroidal anti-inflammatory drugs (NSAIDs) [10]. The diagnosis of osteoid osteoma is usually easy because of its characteristic symptoms and radiological findings. The diagnosis of intra-articular lesions is often delayed because of their close similarity to many lesions like septic arthritis, synovitis, etc. Additionally, patients usually receive a variety of symptomatic therapies before the correct diagnosis [11]. Many non-invasive techniques are useful in the diagnosis of osteoid osteoma, such as scintigraphy, magnetic resonance imaging (MRI), and computed tomography (CT), which is the most accurate [12]. The adequate method to remove an osteoid osteoma, such as percutaneous radiofrequency or ultrasound ablation [13–15] and open surgical procedures is discussed controversially, whereas only a few reports describe an arthroscopic excision of osteoid osteomas [8,16,17].

Similarly, treatment of cartilage defects is discussed controversially [18]. Management options for articular cartilage defects all have varying degrees of success. These include microfracturing, autologous chondrocyte implantation, osteochondral allograft transplantation and mosaicplasty [19]. The use of acellular collagen implants for articular cartilage defects has been described in single cases and small case series with relatively good clinical outcomes. In animal tests with different cartilage repair techniques, Schneider et al. demonstrated a high quality regenerate tissue by using acellular collagen type I scaffolds. The quality of these tissues was equal to that of cellular scaffolds [20]. Schüttler et al. used acellular collagen type I in 15 patients with cartilage defects with good and sustained improvement in all clinical and radiological scores after a follow-up of four years [21]. In another case series with a

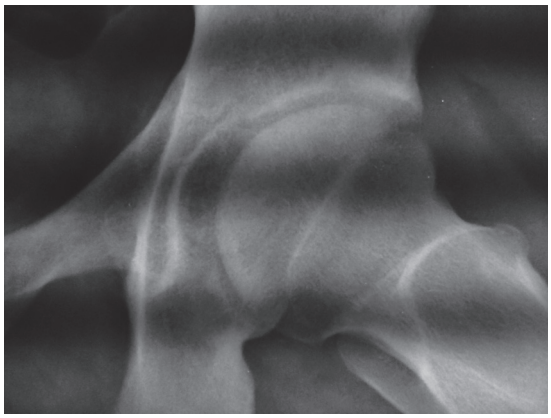

Fig. 1. Standard hip radiograph showing no pathological features.

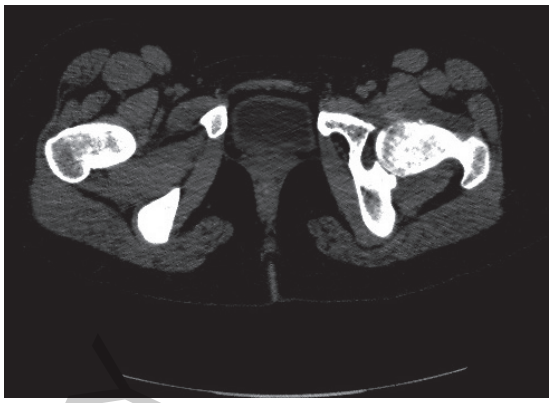

Fig. 2. Pre-operative CT scan showing an osteolytic lesion with a central subperiostal nidus (arrow).

follow-up of two years, Efe et al. demonstrated a good clinical and MRI outcome by using a cell free type I collagen matrix [22]. Chondrofiller® (Trimedicales) is an acellular type I collagen implant for auto-regeneration of articular cartilage defects. This matrix acts as a scaffold and provides good conditions for the ingrowth of cartilage and stem cells. Healing occurs with a hyaline-like cartilage [20]. Two forms of the Chondrofiller® are available, the liquid and gel form. We used the liquid form which hardens within the cartilage defect and which can be applied by arthroscopic procedure.

This article describes the use of hip arthroscopy as a useful surgical method for the detection and excision of an osteoid osteoma of the femoral neck. Because a severe grade IV cartilage defect was detected as a concomitant pathology, the implantation of the Chondrofiller® matrix was performed in the same session. After preparation of the defect, arthroscopy with sodium chloride (NaCl) was switched to carbon dioxide (CO2) insufflation to achieve good conditions to dry and fill the defect with the acellular matrix, This unique procedure is an exceptionally tissue-conserving method for a secured resection of the osteoid osteoma as well as for the treatment of cartilage disorders without worsening or enlarging the defect.

2. Case presentation

A 20-year-old female professional basketball player was referred to our hospital with ongoing pain in the left groin since more than 12 months. This pain increases especially in the night and during physical activity. Pain persisted even after longer periods of rest. Pain was relieved with oral NSAIDs. The history of trauma was negative. Clinical examination revealed antalgic gait with pain increasing especially with internal and external rotation of the hip joint. Neurological and vascular examination of the limb was inconspicuous, laboratory parameters for infection were normal. Standard hip radiographs were also normal (Fig. 1). CT showed the osteolytic lesion with a subperiostal nidus (Figs 2, 3B). MRI showed a hyperintense signal in the femoral neck extending to the femoral head, a joint effusion and erosions of anterior cortex of the neck (Figs 3A and B). Patient history, clinical evaluation and radiological findings suggested an osteoid osteoma of the femoral neck.

Hip arthroscopy was performed under general anesthesia in supine position on a traction table under fluoroscopic guidance. We used 2 portals: an anterolateral portal for the camera and an anterior portal for instrumentation. First, the peripheral compartment of the joint was explored without traction. A

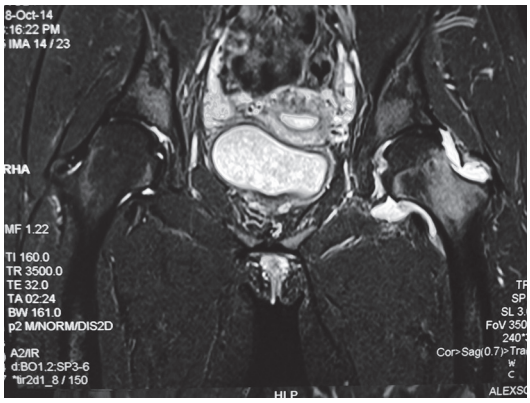

Fig. 3a. T2-weighted MRI showing a hyperintense signal in the left femoral neck extending to the femoral head, joint effusion. The extensive cartilage defect at the femoral head was not visible.

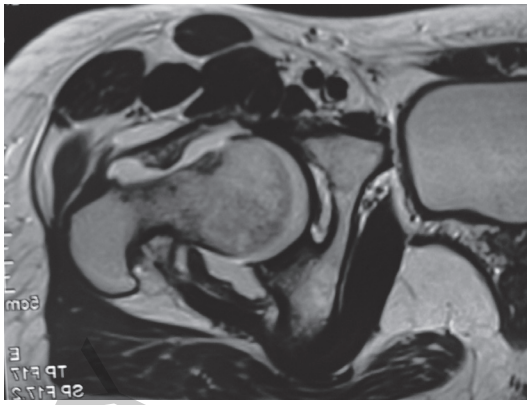

Fig. 3b. T1-weighted MRI shows erosions and a central subperiostal nidus of the anterior cortex of the neck.

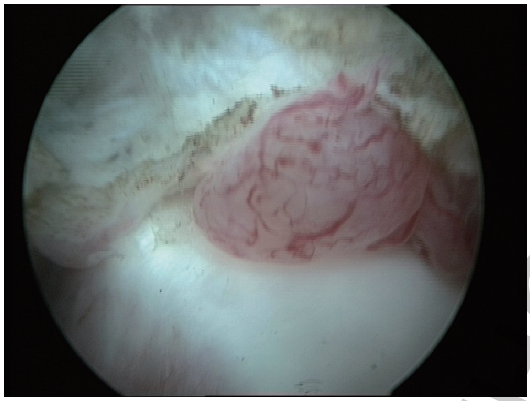

Fig. 4. Arthroscopic picture showing synovial inflammation between the capsule and the femoral head.

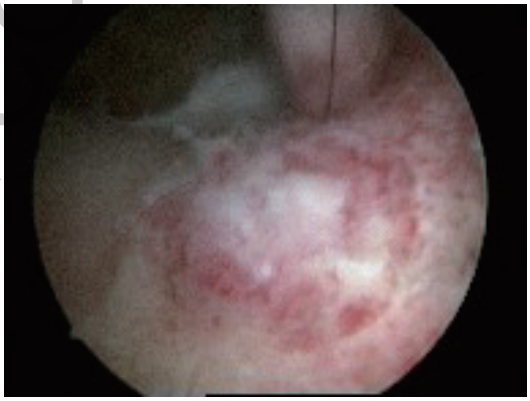

Fig. 5. Arthroscopic picture showing cherry-red color of the nidus in contrast to the normal background of cancellous bone. A grasper was used for initial resection.

capsulotomy was performed with a hook blade (VAPR® Radiofrequency Electrode System by Mitek Sports Medicine) and a shaver. Synovial inflammation and hyperemia were noted in the joint (Fig. 4), so thorough synovectomy was completed. The striking cherry-red color of the nidus in contrast to the normal background of cancellous bone was visualized on the anterolateral part of the femoral neck (Fig. 5). The nidus, which was soft in consistency, was removed using a curette and a grasper. The removed parts were sent for histopathological examination. To be sure of complete resection of the tumor, we smoothed the surrounding bone of the femoral neck with a burr until the cancellous bone was visible (Figs 6 and 7). The histopathological examination confirmed the diagnosis of osteoid osteoma. It revealed reactive synovium, corticocancellous bone tissue with the characteristic variable trabeculae and osteoid tissue with variable mineralization. There was no cellular atypia (Fig. 8).

Under arthroscopic visualization, adequate traction was applied to assess the central compartment of the joint. We detected an extended, crescent shaped grade IV cartilage defect on the upper quadrant of the femoral head measuring approximately 1.0 × 2.0 cm (Fig. 9). The defect was debrided down to the subchondral bone using a curette and a shaver. During this gentle preparation, the cartilage defect

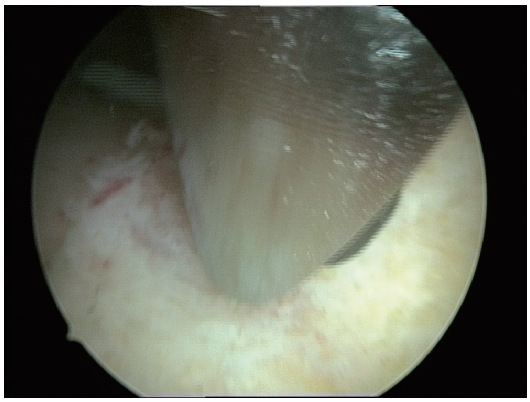

Fig. 6. Arthroscopic picture showing curettage of the lesion bed with the burr.

Fig. 7. Arthroscopic picture showing complete removal of the nidus and a smoothed surface of the femoral neck.

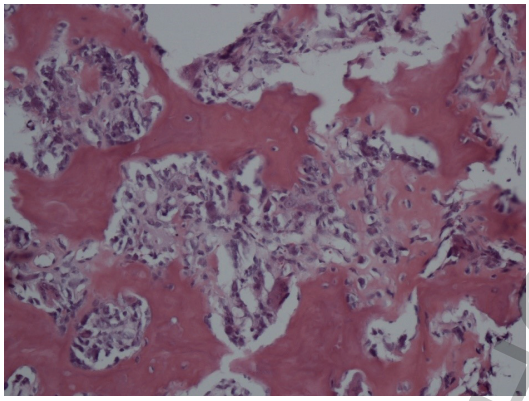

Fig. 8. Histopathological section showing the characteristic nidus with variable trabeculae and osteoid tissue and a variable mineralization. There were no cellular atypia.

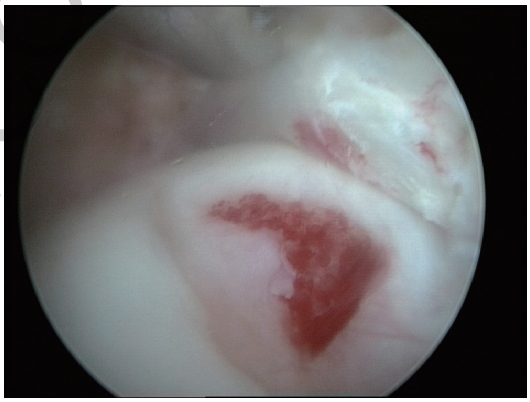

Fig. 9. Arthroscopic picture showing a full-thickness (grade IV) cartilage defect within the articular surface of the femoral head.

was not enlarged. Then, NaCl installation was stopped and CO2 insufflation was started for arthroscopic visualization under dry conditions. After carefully drying the defect using several small surgical swabs, the liquid Chondrofiller® was injected stepwise to fill the defect (Fig. 10). Five to ten minutes after the complete filling of the defect, the initially clear matrix hardened into a whitish, cloudy matrix. Hardening of the matrix was tested using a probe. The traction was completely released, total distraction time was 25 minutes.

There were no complications. The patient was completely pain-free three days after surgery. Mobilization was started the second day after surgery. The patient was instructed to perform partial weight bearing of 15 KG with crutches for two weeks after surgery followed by successive weight bearing as tolerated. After 16 weeks she started non-contact sports. The patient returned to full sports activity including basketball after six months. The last follow-up was ten months after surgery. The patient was still completely satisfied with the outcome of surgery. Up until now, return to sports was uncomplicated and pain-free.

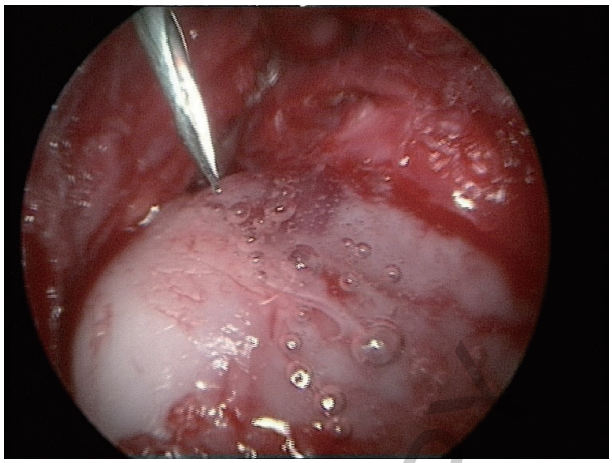

Fig. 10. Arthroscopic picture showing injection of the liquid Chondrofiller into the cartilage defect. Some fluid gel has run down over the femoral head.

3. Discussion and literature review

One key message of this case report is that intra-articular osteoid osteoma of the femoral neck can easily be approached and managed with hip arthroscopy. There are many case reports about treatment options including radiofrequency ablation [13], percutaneous CT-guided resection [14], fluoroscopy-guided percutaneous technique [23], MR-guided focused ultrasound ablation [15], open surgical procedure with femoral head dislocation, arthroscopic excision [8,16,17] and arthroscopy-assisted radiofrequency ablation technique [24]. Open surgical approaches especially with opened hip dislocation require a large incision with a wide dissection. This prolongs the rehabilitation time [25]. Radiofrequency ablation for intra-articular lesions carries a high risk of articular cartilage injury around the lesion. It also carries the risk of post procedure fracture needing internal fixation. Local skin and muscle burns can also occur after radiofrequency ablation [13]. All these complications should be communicated with the patient. Furthermore, it is not always feasible to get a reliable biopsy from the lesion for histopathological examination [25].

Regarding to the literature, several cases about arthroscopic osteoid osteoma resection have been described. Khapchik et al. described two cases of osteoid osteoma of the hip joint. In one of them the lesion was on the calcar area and in the other on the acetabular fossa; both were removed arthroscopically [17]. In these cases, concomitant lesions of the joint were reported in either case. Chang et al. described a case of osteoid osteoma in the posteroinferior part of the acetabulum which was excised arthroscopically [16]. The total distraction time in this case was 170 minutes. A postoperative neuropathy was not described. Despite using a third portal behind the greater trochanter, they reported difficulties in viewing and treating the posteroinferior part of the acetabulum. They discussed the need of special curettes with curved, thin and long shafts for a secured tumor removal. Nehme et al. also described two cases of osteoid osteoma in the hip joint which were removed arthroscopically [8]. In one of these cases the lesion was located at the base of the femoral neck with a concomitant small tear of the anterior part of the labrum with fraying. The labral tear and fraying was resected using a shaver.

However, the advantages of arthroscopic treatment are obvious: minimally invasive procedure, complete removal of the nidus, obtaining adequate specimens for histopathological examination, secure

avoidance of damage to the healthy articular cartilage and labrum, diagnosis and treatment of concomitant pathologies such as synovitis, articular cartilage lesions, labral tears, etc. In this case, a severe full-thickness cartilage defect measuring 1.0 × 2.0 cm was detected (Fig. 9). According to clinical follow-up studies [26] as well as experimental studies [27], chondral lesions measuring more than 5 mm in diameter increase the risk of extensive cartilage damage and osteoarthritis development. Therefore, a correct diagnosis, which was not provided by MRI in this case, was a special advantage of the arthroscopic procedure of our patient.

The adequate treatment method of cartilage defects is still discussed controversially [18]. In this case, we decided to use the Chondrofiller® as an arthroscopic treatment option. This matrix acts as a scaffold for the ingrowth of cartilage cells and stem cells [20]. During the preparation of the cartilage defect with a gentle cleaning and freshening of the subchondral bone, the defect area does not normally need to be enlarged. Regarding the surrounding articular surface, this cartilage treatment is a very tissue-conserving method with a low risk of worsening the defect. In our case, CO2 arthroscopy gave an excellent visualization with good conditions for the thorough drying of the defect zone before filling it with the Chondrofiller®. These dry conditions are essential for secure hardening of the matrix, to allow the injected liquid Chondrofiller® to stick to the subchondral bone, and to prevent flowing away from the defect area [28].

4. Conclusions

In summary, this report demonstrates that osteoid osteoma of the periphery of the femoral neck can easily be excised using hip arthroscopy. Beside an excellent visualization and treatment of the lesion, a secure diagnosis of concomitant lesions such as cartilage defects is provided by arthroscopy. In this case, the application of the Chondrofiller® was a very tissue-conserving cartilage treatment method with a low risk of worsening or enlarging the defect. CO2 arthroscopy provided an excellent visualization with good conditions for drying the defect zone before the injection of the Chondrofiller®. These arthroscopic treatment options for cartilage defects as well as peripheral osteoid osteomas might be of interest for future cases.

Acknowledgements

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Conflict of interest

The authors declare that they have no competing interests. There is a research project planned at our clinic on the Chondrofiller® produced by Trimedicales. This project will be supported in parts by Trimedicales.

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