Case Report

DOI: doi.org/10.47363/POS/2016(3)123

Large Synovial chondroma of the infrapatellar fat pad: A case report and review of the literature

Thomas I Sherman[1], Joseph Letzelter[1], James M Ryan[2], Joanna Shechtel[3], William Postma[1]

[1]MedStar Georgetown University Hospital Orthopaedic Surgery Department, Washington, D.C., USA.
[2]Georgetown University School of Medicine, Washington, D.C., USA.
[3]University of Tennessee Department of Radiology, Knoxville, TN, USA.

Address for correspondence:
Thomas I Sherman,
MedStar Georgetown University Hospital Orthopaedic Surgery Department, Washington, D.C., USA.
Thomas.i.Sherman@gmail.com

Received: June 07, 2016
Accepted: August 12, 2016
Published: September 04, 2016

ABSTRACT

Neoplasms of the infrapatellar fat pad (IFP) although rare are a potential source of anterior knee pain and swelling. Masses comprised of cartilage and/or osseous tissues within the IFP have been reported with marked inconsistency. Diagnosis is based upon radiographic, surgical, and histologic characteristics. As a result, multiple terms and variable nomenclature have been used to describe these masses. We present a case of a benign cartilage neoplasm of the IFP that was successfully treated with surgical excision and a review of case reports and series of similar masses to aid in the diagnosis and treatment of intrinsic osseous and chondral neoplasms of the IFP.

KEY WORDS: Orthopaedics; Oncology; Infrapatellar fat pad; Chondroma; Surgical excision

INTRODUCTION

Anterior knee pain is a common and often nonspecific complaint in the orthopedic setting [1]. Although the majority of anterior knee pain is thought to be secondary to abnormal pathomechanics in the patellofemoral joint, the orthopedist should be aware of rarer causes [2]. Neoplasms arising from the infrapatellar fat pad (IFP), while uncommon, are a potential alternative source of anterior knee pain [3]. The broad differential of masses involving the IFP includes intrinsic lesions arising from within the fat pad itself, and extrinsic lesions arising from pathologies originating in adjacent structures [4].

Intrinsic masses of the IFP are infrequently encountered but generally provide a diagnostic and therapeutic challenge as the natural history and etiology of these lesions are still largely unknown [5]. Osseous and cartilage lesions of the IFP have been previously reported in cases and small series but with inconsistent terminology and descriptions. Jaffe first characterized these lesions in 1958 as intracapsular paraarticular osteochondromas [6]. Since his initial description, alternative nomenclature describing similar lesions has emerged [7-47]. The inconsistency in terminology has led to confusion regarding osseous and cartilage masses of the IFP.

We present a case of a cartilage neoplasm of the IFP diagnosed as a large synovial chondroma successfully treated with marginal en-bloc resection. A review of the literature regarding chondral and osteochondral masses of the IFP is also reported. The purpose of this comprehensive review of all previous reports of cartilage and osseous masses of the IFP is to provide a basis for future diagnostic and therapeutic management of these lesions.

CASE REPORT

A healthy 36-year-old female presented with 3 months of right knee pain and swelling localized to the subpatellar region. She denied a history of trauma or participation in strenuous activities. The patient had previously undergone a 6-week course of physical therapy per her primary care physician with no relief of her symptoms.

Physical examination revealed normal gait and squat with full range of motion bilaterally. There was no joint line tenderness and ligamentous examination was normal. There was significant fullness overlying the fat pad but no general effusion. Examination of the contralateral knee was unremarkable.

Review of the MRI obtained by her primary care physician revealed a large mass confined to the IFP measuring 4.5 cm in height, 5.5 cm in width, and 2.9 cm in depth (Fig. 1a-c). Two musculoskeletal radiologists independently confirmed a diagnosis of pigmented villonodular synovitis (PVNS). There was appreciable anterior bowing of the patellar tendon due to the mass effect of the lesion. No loose bodies were seen and all other bony, ligament, tendon, and chondral structures were otherwise normal. Radiographs demonstrated a soft tissue mass but no effusion, osseous abnormality, or calcifications in the mass.

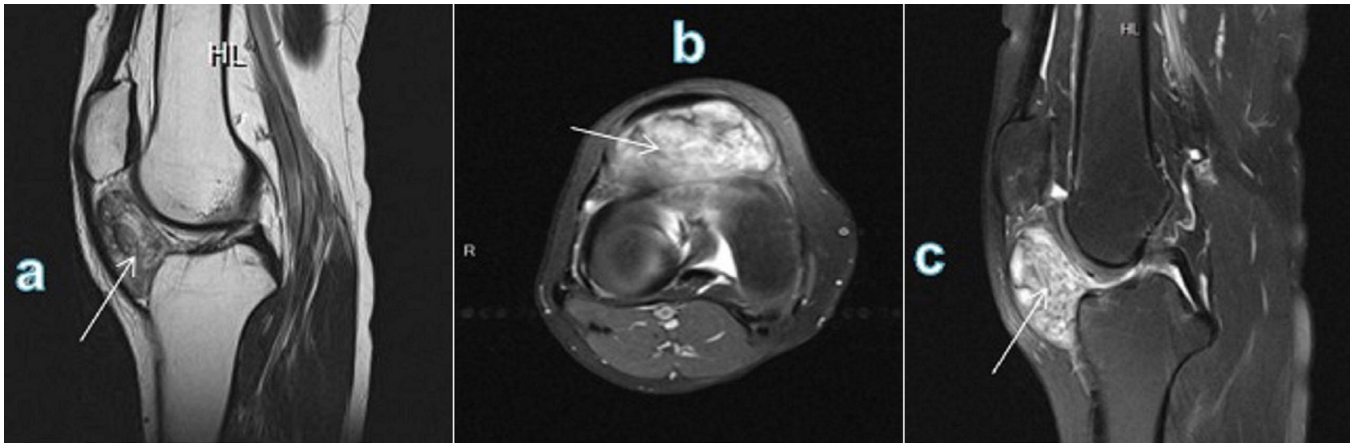

Figure 1. (a) Sagittal (b) and axial T2 fat-saturated MRI of the affected knee demonstrated a heterogeneous intermediate signal mass in the infrapatellar fat pad with (C) heterogeneous high and intermediate signal on T1.

Although open synovectomy was likely necessary, the mass and surrounding cartilage were approached arthroscopically and examined to assess the possibility of complete arthroscopic removal. This served as an attempt at a more conservative approach, potentially limiting arthrotomy induced arthrofibrosis and resultant stiffness that would prolong recovery time. The inferior surface of the patella demonstrated significant chondral wear. Several small loose bodies attached to the synovium of the fat pad were removed (Fig. 2). The medial and lateral compartments, as well as all ligamentous structures, were within normal limits. Upon arthroscopic debridement of the subpatellar synovium, a large, solid mass within the IFP was palpated. Arthroscopic removal of this mass was felt to be impossible due to its size and solid, inflexible texture. A medial arthrotomy was made for marginal en-bloc resection. There was no osseous attachment to the mass, but it was immediately adjacent to the extraarticular synovial surface posteriorly. A synovectomy overlying the IFP was performed with the intent of preventing recurrence. A tourniquet was used briefly and all intraoperative bleeding was controlled. The surgery was uncomplicated and of appropriate length as the arthroscopy was abandoned early in favor of arthrotomy.

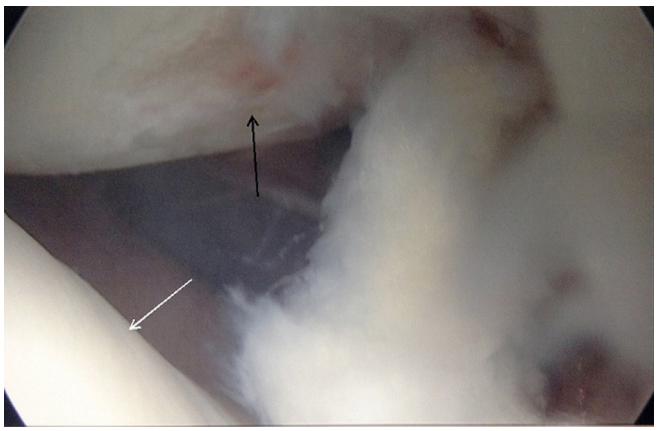

Figure 2. Arthroscopic image of a loose body attached to synovial tissue in the infrapatellar region. The patella (black arrow) demonstrated chondral injury. The femoral trochlea (white arrow) did not demonstrate any chondral injury or damage.

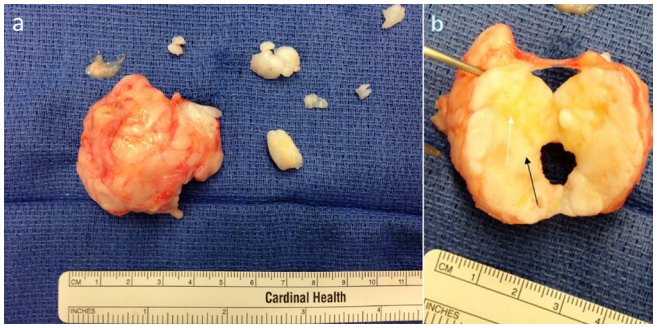

Figure 3. (a) Gross appearance of the large primary mass partially surrounded by fibrous and synovial tissue and smaller cartilage lesions removed from the intraarticular joint space. (b) The inner core of the mass demonstrated cartilage nodules (black arrow) with interposed adipose tissue (white arrow).

The largest specimen was 5.3 x 4.5 x 3 cm in size, irregularly shaped, tan-white in color with a cartilaginous appearance and intermixed, yellow, lobulated adipose tissue (Fig. 3a-b). Histologic examination was consistent with a chondroma (Fig. 4a-b). The microscopic appearance of the smaller lesions was identical.

Postoperatively, the patient had complete pain resolution; however, she required a 6-week course of physical therapy for stiffness, likely secondary to arthrofibrosis resulting from the arthrotomy. At final follow-up of 18 months she had full range of motion equal to the contralateral side, her pain had resolved, and she was without signs of recurrence.

The patient agreed to written report of this case.

LITERATURE REVIEW

A literature search for cartilage and/or osseous masses of the IFP was performed. Combinations of the following search terms were used: paraarticular, intraarticular, intracapsular, osteochondroma, chondroma, osteoma, Hoffa's Fat Pad, and infrapatellar fat pad. This produced a total of 42 publications reporting 58 cases in addition to ours with neoplasms 1) located in the infrapatellar region, 2) > 1 cm in the largest diameter, 3) comprised of cartilage and/or osseous tissue, and 4) that underwent surgical excision. All cases were manually reviewed and are summarized in Table 1.

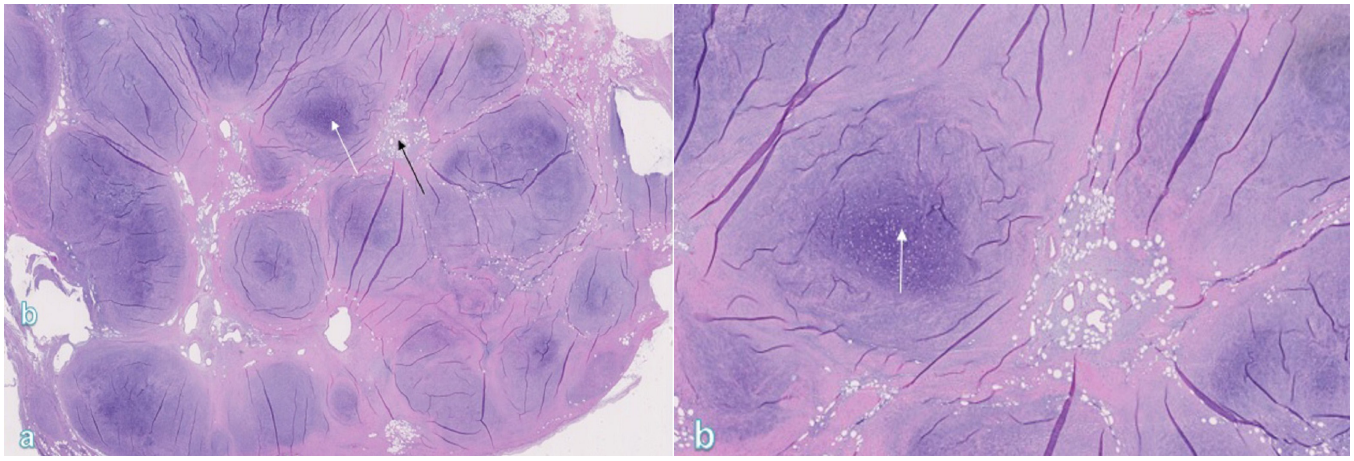

Figure 4. (a) Low power histologic appearance of primary lesion with hematoxylin and eosin staining demonstrating multiple nodules of cartilage tissue (white arrow) with interposed fat and vasculature (black arrow). The entire specimen was intermittently surrounded by soft tissue that could be consistent with synovial tissue. (b) High power view demonstrates highly concentrated chondroid cells (white arrow) within the nodules.

The median age of those affected was 52 years (range: 10 – 71); two cases did not report patients' ages. Twenty-six males and 32 females were affected; one case did not report the sex. Forty-four cases reported a median duration of pain prior to presentation of 24 months (range: 0.07 – 360), while 8 cases reported a painless process. Fifty-four cases reported the presence of a mass or swelling with a median duration of 24 months (range: 0.07 – 360) prior to presentation. Fourteen cases (29%) reported antecedent trauma, and 34 (71%) cases specifically reported a history negative for significant injury. Of the 55 cases with radiographic findings, 19 (35%) exhibited intralesional calcifications, 28 (51%) bone formation, 5 (9%) both calcifications and bone, and 3 (5%) soft-tissue swelling only. Twenty-five cases reported findings of MRI and are summarized in Table 1. All patients underwent excision of the mass. Forty-three (84%) of the masses were intraarticular or intracapsular, of which eight (19%) reported the mass located within or originating from the synovium. Nine (17%) cases specifically reported the mass as extraarticular. Of the 53 cases that provided histologic descriptions, 42 (79%) reported a peripheral rim of cartilage, 29 (55%) nodules of cartilage, 45 (85%) evidence of enchondral ossification, and 42 (79%) mature bone. The median volume of each mass was calculated when able, which was 60 cm3 (range: 6 – 471). The aggregate volume in the presence of multiple lesions was reported. Median follow-up was 18 months (range: 0.75-96) and there was one case reporting a local recurrence following excision. There were no complications.

DISCUSSION

The IFP is an intraarticular but extrasynovial adipose structure that contains multipotent mesenchymal cells, thus possessing an intrinsic capability to form ectopic osseous and/or chondral lesions [33].

Intracapsular paraarticular osteochondromas were described by Jaffe in 1958 as a distinct entity characterized by formation of large (>1 cm in diameter) solitary lesions comprised of bone and cartilage inferior to the patella [6,19]. The origin of these lesions is debated but theories include metaplasia of the adjacent synovium, extra-synovial tissue of the IFP, or the capsule itself [11,13,33]. Others have hypothesized that it may represent the end-result of Hoffa's Disease, in which impingement of the IFP induces a promoter-like effect on IFP mesenchymal cells to directly form osteochondral lesions [18, 23]. A solitary traumatic event has also been suggested by some as a prelude to formation of these masses [40].

Others have suggested that these lesions represent the same disease process at different stages on a temporal spectrum with enchondral ossification of synovial-derived cartilage masses representing the final stage [48]. Along these lines, 8 of the cases reviewed were reported to have originated from the overlying synovium of the IFP, and synovial stalks extending to the mass were also reported [11]. We believe that the mass in this report was derived from the overlying synovium given the presence of several typical synovial chondromas visualized within the synovium during arthroscopy, and their similar histologic appearance. The unique anatomy of the IFP, which has redundant folds of synovium projecting into the adipose lobulations, may make full inspection of the lesions and their relationship to the synovium difficult, leading some to believe similar lesions are falsely extrasynovial. There are also several reports of similar masses in the suprapatellar and posterior regions of the knee, which indicates that some of these lesions may not originate from the IFP itself but the adjacent synovium or capsule [27,49,50]. We limited our review to lesions isolated to the infrapatellar region to elucidate etiologic factors that may be unique to this location.

Some have suggested that ossification of these masses, regardless of their origin, is related to the duration of its presence as indicated by patients' symptoms [10,48]. We found that the average duration of pain and mass presence/swelling in patients with ossification was 52 and 66 months, respectively, as opposed to 20 and 25 months, respectively, in the 5 cases without ossification. Our patient had 3 months of symptoms and did not exhibit histologic evidence of bone formation.

Table 1. Literature Review

Author	Case	Age	Sex	Pain (mos)	Mass / Swelling (mos)	Trauma	Xray	MRI	Size	Volume (cm^3)	CC	CN	EO	TB	Diagnosis	Location
Robillard[7]	1	35	F	24	24	Y	C	NA	5.5 x 4 x 2	44	NA	NA	NA	NA	Ossification of the IFP	IA
Roth[8]	2	69	M	240	48	N	O	NA	5.5 x4 x 2.4	53	Y	N	Y	Y	Ossifying Synovial Chondroma	IA
Kautz[9]	3	MA*	F	Y	Y	Y	O	NA	NA	NA	Y	N	Y	Y	Capsular Osteoma	EA
Kautz[9]	4	51	F	Y	Y	NA	O	NA	5 x 4 x 2.5	50	Y	N	Y	Y	Capsular Osteoma	EA
Kautz[9]	5	47	M	10	10	Y	O	NA	4 x 4 x 2	32	Y	N	Y	Y	Capsular Osteoma	EA
Jaffe[6]	6	NA	NA	NA	NA	NA	NA	NA	6	NA	NA	NA	NA	NA	Intracapsular/Paraarticular osteochondroma	NA
Jaffe[6]	7	37	F	NA	NA	NA	NA	NA	7	NA	NA	NA	NA	NA	Intracapsular/Paraarticular osteochondroma	NA
Mosher[10]	8	23	F	12	12	N	C/O	NA	NA	NA	Y	Y	Y	Y	Intracapsular/Paraarticular osteochondroma	IA; ES
Mosher[10]	9	66	M	N	2	N	C	NA	3 x 2 x 1	6	Y	Y	Y	Y	Intracapsular/Paraarticular osteochondroma	IA; ES
Mosher[10]	10	65	M	24	60	Y	O	NA	6.5 x 4.8 x 3.9	122	Y	N	Y	Y	Intracapsular/Paraarticular osteochondroma	IA; IS
Sarmiento[11]	11	67	M	84	Y	Y	O	NA	8 x 5 x 3	120	Y	Y	Y	Y	Giant Intraarticular Osteochondroma	IA; IS
Milgram and Dunn[12]	12	66	F	NA	"Several"	N	O	NA	NA	NA	Y	Y	Y	N	Intraarticular Osteochondroma	IA; IS
Karlin[13]	13	10	M	Y	2	N	O	NA	4.5 x 4 x 2.2	40	N	Y	Y	Y	Synovial Chondromatosis	IA; IS
Karlin[13]	14	16	F	72	72	N	C/O	NA	NA	NA	N	Y	Y	Y	Synovial Chondromatosis*	IA; IS
Milgram and Jasty[14]	15	59	M	N	120	N	O	NA	9 x 9 x 1.5	122	Y	Y	Y	Y	Paraarticular Osteochondroma	IA
Böstman[15]	16	29	M	N	24	N	C	NA	5 x 4	NA	Y	N	Y	Y	Extraskeletal Ossifying Chondroma	IA; ES
Nuovo[16]	17	63	F	N	2.5	N	C	T1 – hypointensity T2 - hyperintensity	4 x 2 x 2	16	N	Y	Y	N	Intracapsular Paraarticular Chondroma	IA; ES
Pettrone[17]	18	12	M	12	12	N	ST	NA	3 x 3 x 2	18	Y	Y	N	N	Extraarticular Chondroma	EA IA;
Krebs[18]	19	52	M	Y	120	Y	C	NA	5 x 2 x 2	20	N	Y	Y	N	Extrasynovial Ossifying Chondroma	ES IC;
Steiner[19]	20	66	F	48	48	Y	C	NA	10 x 7 x 6	420	Y	Y	Y	Y	Intracapsular Chondroma	ES EA
Steiner[19]	21	49	F	240	Y	NA	C	NA	4.5 x 4 x 3.5	63	Y	Y	Y	Y	Soft Tissue Extracapsular Chondroma	IC; ES
Steiner[19]	22	66	F	24	24	NA	NA	NA	6 x 5 x 2	60	Y	N	Y	Y	Intracapsular Chondroma	EA IA;
Hagan[20]	23	14	F	3	5	N	O	"Normal"	4.2 x 3.1 x 3.1	40	Y	N	Y	Y	Paraarticular Osteochondroma	IS
Allahabadia[21]	24	32	F	48	48	Y	C	NA	4 x 3 x 6	72	NA	NA	NA	NA	Solitary Synovial Osteochondroma	
Bendall[22]	25	15	M	Y	3	NA	C	T1 – intermediate signal	5 x 3.5 x 2.3	40	N	Y	N	N	Intracapsular Chondroma	IC; ES
Rodriguez-Peralta[23]	26	52	F	N	120	N	O	NA	7.5 x 5 x 5	188	N	Y	Y	Y	Intracapsular Chondroma	IC; ES
Dhillon[24]	27	60	M	2	24	NA	O	NA	8 x 6	NA	Y	N	Y	Y	Paraarticular Extraosseous Osteochondroma	IC; ES
Sakai[25]	28	64	F	12	12	N	C	T1/T2 – heterogeneity; majority hypointense	6 x 4.5 x 3	81	N	Y	Y	N	Paraarticular Osteochondroma	IC; ES
Sakai[25]	29	47	M	24	24	N	C/O	T1 – heterogeneity; majority hypointense T2 - heterogeneity	7 x 5 x 3	105	N	Y	Y	N	Paraarticular Osteochondroma	IC; ES
Sakai[25]	30	56	M	N	N	Y	O	NA	NA	NA	Y	N	N	Y	Osteochondroma	IC
Cohen[26]	31	67	M	12	48	Y	C	NA	7.5 x 5 x 4	150	NA	NA	NA	NA	Giant Intraarticular Synovial Osteochondroma	IA; IS
González-Lois[27]	32	43	M	NA	"years"	NA	O	PD – hypointense, very hypointense center; T2 - hyperintensity T1 - isointense to muscle	4 x 3.5 x 2	28	Y	Y	Y	Y	Intracapsular Paraarticular Osteochondroma	IC; ES
González-Lois[27]	33	37	M	NA	NA	NA	NA	T2 - hyperintense with linear foci of hypointensity	3.5 x 2 x 2.7	19	Y	N	N	N	Intracapsular Paraarticular Chondroma	IC; ES
Hung[28]	34	46	M	NA	24	N	O	T1 - low/intermediate intensity T2 - heterogeneous hyperintensity	3 x 3 x 3; 4 x 2 x 3	51	Y	N	Y	Y	Osteochondroma	NA
Maheshwari[29]	35	30	M	N	240	N	O	NA	6.5 x 4 x 2.5	65	Y	N	Y	Y	Extraskeletal Paraarticular Osteochondroma	EA

Table 1. Resume

Author	Case	Age	Sex	Pain (mos)	Mass / Swelling (mos)	Trauma	Xray	MRI	Size	Volume (cm^3)	CC	CN	EO	TB	Diagnosis	Location
Oliva[30]	36	53	M	36	Y	N	O	T1- isointense to bone T2 - Heterogeneity	7	NA	Y	N	Y	Y	Extraskeletal Osteochondroma	IC; ES
Samardziski[31]	37	41	F	24	24	N	O	NA	3 x 3.5 x 2.5	26	Y	Y	Y	Y	Intracapsular Chondroma with Ossification	IC; ES
Samardziski[31]	38	56	F	360	360	N	O	NA	NA	NA	NA	Y	NA	NA	Paraarticular Chondroma	IC
Rizzello[32]	39	42	F	36	24	NA	C	T1 - intermediate; T2- heterogeneous	5 x 2.5 x 1.5; 2 x 2 x 1; 1.5 x 2 x 1 cm	26	N	Y	Y	Y	Paraarticular Osteochondroma	IA; ES
Turhan[33]	40	25	M	84	24	Y	O	T1 - hypointense core isointense to bone marrow surrounded by low/ intermediate intensity T2 heterogeneity	7 x 4 x 3.5	98	Y	N	N	Y	Extrasynovial Osteochondroma; End-Stage Hoffa's Disease	IC; ES
Carmont[34]	41	61	M	0.07	0.07	Y	C	T1 - low intensity; T2 hyperintensity (cartilage); hypointensity (bone)	4.5	NA	N	Y	Y	Y	Paraarticular Osteochondroma	IC; ES
Demir[35]	42	60	F	N	36	N	C	T1 – isointense to bone; T2 heterogeneity w/ peripheral enhancement w/ fat suppression	5 x 5	NA	Y	N	Y	Y	Extraskeletal Paraarticular Osteochondroma	IC; EA
Singh and Shah[36]	43	55	M	12	Y	Y	C	T2 - Heterogeneity	6 x 4.5 x 5	135	Y	Y	Y	Y	Extraskeletal Ossifying Chondroma	IC; ES
Ozturan[37]	44	60	F	24	240	N	O	T2 - heterogeneity T1 - isointense to muscle peripherally and central isointense to bone;	5 x 4.2 x 3.5	74	Y	N	Y	Y	Paraarticular Osteochondroma	EA
Mulcahy[38]	45	25	F	24	24	N	O	T2 - heterogeneity, diffuse hyperintensity w/ central hypointensity	5.5 x 4.5 x 3	74	Y	N	Y	Y	Extraskeletal Paraarticular Osteochondroma	EA
Nouri[39]	46	42	F	36	N	N	C	T1 - intermediate signal T2 - heterogeneity	3 x 2.5 x 2.5	19	Y	Y	Y	Y	Intracapsular Osteochondroma	IC
Veras[40]	47	54	F	84	36	Y	C/O	NA	9.5 x 9 x 5.5	470	Y	N	Y	Y	Atypical Solitary Synovial Osteochondroma	IC
Veras[40]	48	46	F	"long-standing"	"long standing"	N	C/O	NA	6.5 x 5 x 3.8	124	Y	Y	Y	Y	Soft Tissue Chondroma	IC; ES
Ogura[41]	49	56	F	24	24	N	C	T1 - hypointensity; T2 - heterogeneity and hyperintensity	5.5 x 4.8 x 2.3	61	Y	Y	Y	Y	Para-articular Osteochondroma Giant Intraarticular	IC; ES
De Maio[42]	50	58	F	12	120	N	C	NA	NA	NA	Y	N	Y	Y	Extrasynovial Osteochondroma	IC; ES
De Maio[42]	51	71	F	12	300	N	C	NA	NA	NA	Y	N	Y	Y	Giant Intraarticular Extrasynovial Osteochondroma	IC; ES
Sayum Filho[43]	52	40	M	6	Y	N	O	NA	5 x 4	NA	NA	NA	NA	NA	Synovial Chondromatosis	IC
Ingabire[44]	53	64	F	"chronic"	Y	N	O	T1 - intermediate w/ contrast enhancement;	4 x 2.7 x 4.6	50	N	Y	Y	Y	Soft Tissue Chondroma	NA
Singh and Jain[45]	54	52	M	NA	180	no	O	T2 - hyperintensity T1 - inhomogeneous hypointensity; T2 - heterogeneity	15.5 x 8 x 3.8	471	Y	Y	Y	Y	Extraskeletal Osteochondroma	IC; ES
Sen[46]	55	43	M	6	6	N	O	T1 - hyperintense core with hypointense rim; T2 - hyperintense core with hyperintense rim	2.6 x 4.3 x 3.7	41	Y	N	Y	Y	Extraskeletal Paraarticular Osteochondroma	IA; ES
Evaniew[47]	56	70	F	60	60	N	O	T1 - Heterogeneous Hyperintensity;	6.5 x 4.5 x 3.8	111	Y	N	Y	Y	Paraarticular Extraskeletal Osteochondroma	NA
Evaniew[47]	57	47	F	12	12	N	O	T2 - heterogeneity T2- hyperintense rim w/ gadolinium enhancement	6.5 x 3.7 x 1.7	41	Y	N	Y	Y	Paraarticular Extraskeletal Osteochondroma	NA
Evaniew[47]	58	54	F	60	60	N	ST	T1 - irregular hypointensity; T2 - irregular hyperintensity	6.4 x 3.6 x 2.2; 2.5 x 1.4 x 0.4	52	Y	Y	N	N	Paraarticular Extraskeletal Chondroma	NA
Postma	59	36	F	3	3	N	ST	T1	5.3 x 4.5 x 3	72	N	Y	N	N	Large Synovial Chondroma	IA; IS

Demographic, Patient History, Radiographic, Histologic, and Diagnostic Data of all Cases. Abbreviations: F, female; M, male; Y, yes; N, no; NA, not applicable; C, calcifications; O, ossifications; CC, cartilage cap; CN, cartilage nodules; EO, enchondral ossification; TB, trabecular bone; IA, intraarticular; IC, Intracapsular; EA, extraarticular; ES, extrasynovial. * Denotes recurrence. [7-47].

Radiographs are valuable in identifying the matrix of the mass with regard to ossification and calcifications. Of the 24 cases that reported MRI findings, the most common was low to intermediate signal on T1 images and high signal on T2 images likely corresponding to cartilage foci (Table 1). Similarly, synovial chondromatosis manifests as lobulated foci of intraarticular low-intermediate intensity on T1 images and high signal intensity on T2 images with concomitant low-intensity areas corresponding to calcified bodies [51]. Osteochondromas have the typical appearance of its components: bone and cartilage. A peripheral cartilage cap greater than 2 cm thick is concerning for malignancy [52].

Our case was initially misdiagnosed as PVNS by MRI. The appearance of PVNS is generally low-to-intermediate intensity on T1-weighted MR images with well-defined nodular or lobular margins. The appearance on T2-weighted images is often hypointense to the adjacent effusion and may display focal circular areas of low-intensity from hemosiderin deposition [53,54].

In all cases, patients underwent a marginal excision either via an open approach or arthroscopic-based procedure. There was one (1.6%) recurrence (Case 14) and no instances of malignant transformation suggesting that marginal excision is an appropriate treatment for benign osseous and cartilage lesions of the IFP. We also performed a synovectomy with the intent of decreasing recurrence. Because the origin of cartilage and/or osseous masses of the IFP is unknown and could be the synovium, we believe performing a synovectomy is prudent.

The histologic appearance of these lesions varied. However, we found that two general patterns existed: 1) multiple chondral nodules with variable foci of enchondral ossification and 2) primarily bony lesions with a peripheral cartilage cap. The former is similar to the histologic findings of synovial chondromatosis and the latter to extraskeletal osteochondromas [55]. Thus, these cases may represent different disease processes of distinct etiologies and may not be best represented by a singular diagnosis of intracapsular paraarticular osteochondroma.

This study is limited by its retrospective nature and the potential for selection bias by the case reports it is based. Furthermore, there was marked inconsistency and often ambiguity in the details of each case; however, multiple reviewers analyzed manuscripts in an effort to mitigate interpretational bias. Although this is the largest review of large cartilage and osseous masses of the IFP to our knowledge, it is also possible that some reports were not included due to our exclusion of non-English studies.

In summary, patients with large masses of the IFP composed of osseous and/or chondral tissue typically presents with pain and swelling for several months to years and these neoplasms should be included in the differential of anterior knee pain and swelling. Definitive diagnosis should be based upon radiographic and advanced imaging findings, the surgical appearance, precise localization, and histologic inspection. The variable descriptions of each of these categories in the cases reviewed have likely resulted in the inconsistent terminology and nomenclature used with these lesions. It is also possible that these neooplasms may represent multiple processes of distinct etiologies, i.e. synovial chondromas and extraskeletal osteochondromas, rather than a single, distinct entity of intracapsular paraarticular osteochondroma. Given the concomitant presence of small chondromas within the synovium and the histological appearance in the case we present, we believe that this large mass was derived from the adjacent synovium. Regardless of the tissue of origin or etiology, however, in the absence of suspicion for malignancy, marginal resection is curative and synovectomy should be considered at the time of surgery to decrease recurrence risk.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Metin Ozdemirli, MD, PhD, and Rong Shen MD for their pathology analysis and diagnostic assistance.

REFERENCES

1. Relwani J, Factor D, Khan F, Dutta A. Giant cell tumour of the patellar tendon sheath – an unusual cause of anterior knee pain: a case report. Knee. 2003; 10(2):145-148.
2. Powers CM, Bolgla LA, Callaghan MJ, Collins N, Sheehan FT. Patellofemoral pain: proximal, distal, and local factors, 2nd International Research Retreat. J Orthop Sports Phys Ther. 2012;42(6):A1–54.
3. Dragoo JL, Johnson C, Mconnell J. Evaluation and treatment of diosrders of the infrapatellar fat pad. Sports Med. 2012; 42(1):51-67.
4. Jacobson JA, Lenchik L, Ruhoy MK, Schweitzer ME, Resnick D. MR imaging of the infrapatellar fat pad of Hoffa. Radiographics. 1997;17(3):675-691.
5. Jaffe HL. Tumors and Tumorous Conditions of the Bones and Joints. Philadelphia: Lea & Febiger; 1958:567.
6. Bombaci H, Bilgin E. Infrapatellar fat pad para-articular osteochondroma: a ten-year follow-up and review. Arch Trauma Res. 2015; 4(3): e28381.
7. Robillard G. Ossification of Infrapatellar Bursae and Fat Pad. Amer J of Surg. 1941;51:442.
8. Roth P. Ossifying Chondroma Replacing the Infrapatellar Pad of Fat. Proc R Soc Med. 1944 Apr;37(6):279-280.
9. Kautz F. Capsular Osteoma of the Knee Joint. Report of Four Cases. Radiology. 1945;45(2):162 - 167.
10. Mosher JF, Kettelkamp DB, Campbell CJ. Intracapsular or para-articular chondroma. A report of three cases. J Bone Joint Surg Am. 1966;48(8):1561-1569.
11. Sarmiento A, Elkins RW. Giant intra-articular osteochondroma of the knee. J Bone Joint Surg Am. 1975;57(4):560-561.
12. Milgram JW, Dunn EJ. Para-articular chondromas and osteochondromas: a report of three cases. Clin Orthop Relat Res. 1980(148):147-151.
13. Karlin CA, De Smet AA, Neff J, Lin F, Horton W, Wertzberger JJ. The variable manifestations of extraarticular synovial chondromatosis. AJR Am J Roentgenol. 1981;137(4):731-735.
14. Milgram JW, Jasty M. Case report 238: para-articular osteochondroma of the knee. Skeletal Radiol. 1983;10(2):121-125.
15. Böstman O, Karaharju E, Heikkonen L, Holmström T. Extraskeletal ossifying chondroma in the knee. A case report. Acta Orthop Scand. 1985;56(1):87-89.
16. Nuovo MA, Desai P, Shankman S, Present D. Intracapsular paraarticular chondroma of the knee. Bull Hosp Jt Dis Orthop Inst. 1990;50(2):189-195.
17. Pettrone FA, Stay EJ. Chondroma. An unusual presentation of an extraarticular soft tissue mass about the knee. Am J Sports Med. 1990;18(5):536-538.
18. Krebs VE, Parker RD. Arthroscopic resection of an extrasynovial ossifying chondroma of the infrapatellar fat pad: end-stage Hoffa's disease? Arthroscopy. 1994;10(3):301-304.

19. Steiner GC, Meushar N, Norman A, Present D. Intracapsular and paraarticular chondromas. Clin Orthop Relat Res. 1994(303):231-236.
20. Hagan PF, Schoenecker PL. Para-articular osteochondroma. Am J Orthop (Belle Mead NJ). 1995;24(1):65-67.
21. Allahabadia VN, Kulkarni SS, Dogra AS, Bhosale PB. Solitary synovial osteochondroma of the knee. J Postgrad Med. 1995;41(4):113-114.
22. Bendall SP, Manners BT. Intracapsular chondroma of the knee. J South Orthop Assoc. 1997;6(1):69-72.
23. Rodriguez-Peralto J, Lopez-Barea F, Gonzalez-Lopez J. Intracapsular chondroma of the knee: an unusual neoplasm. Int J Surg Pathol. 1997;5(1-2):49-53.
24. Dhillon MS, Sharma R, Vaiphei K, Nagi ON. Para-articular / extra-osseous osteochondroma of the knee. The Knee. 1999;6:155-158.
25. Sakai H, Tamai K, Iwamoto A, Saotome K. Para-articular chondroma and osteochondroma of the infrapatellar fat pad: a report of three cases. Int Orthop. 1999;23(2):114-117.
26. Cohen AP, Giannoudis PV, Hinsche A, Smith RM, Matthews SJ. Post-traumatic giant intraarticular synovial osteochondroma of the knee. Injury. 2001;32(1):87-89.
27. González-Lois C, García-de-la-Torre P, SantosBriz-Terrón A, Vilá J, Manrique-Chico J, Martínez-Tello J. Intracapsular and para-articular chondroma adjacent to large joints: report of three cases and review of the literature. Skeletal Radiol. 2001;30(12):672-676.
28. Hung JY, Huang GS, H, Peng YJ, Wu SS, Chao KH, 2005. Fat pad osteochondroma of the knee. J Med Sci. 2005;25(6):315-318.
29. Maheshwari AV, Jain AK, Dhammi IK. Extraskeletal paraarticular osteochondroma of the knee--a case report and tumor overview. Knee. 2006;13(5):411-414.
30. Oliva F, Marconi A, Fratoni S, Maffulli N. Extra-osseous osteochondroma-like soft tissue mass of the patello-femoral space. BMC Musculoskelet Disord. 2006;7:57.
31. Samardziski M, Foteva M, Adamov A, Zafiroski G. Intracapsular and para- articular chondroma of knee: a report of four cases and review of the literature. Radiol Oncol. 2006;40(4):205-209.
32. Rizzello G, Franceschi F, Meloni MC, et al. Para-articular osteochondroma of the knee. Arthroscopy. 2007;23(8):910.e911-914.
33. Turhan E, Doral MN, Atay AO, Demirel M. A giant extrasynovial osteochondroma in the infrapatellar fat pad: end stage Hoffa's disease. Arch Orthop Trauma Surg. 2008;128(5):515-519.
34. Carmont MR, Davies S, Gey van Pittius D, Rees R. Accelerated para-articular osteochondroma formation within the knee: a case report. Cases J. 2008;1(1):6.
35. Demir MK, Unlu E, Usta U. A curious mass of the anterior compartment in the knee. Br J Radiol. 2009;82(977):435-437.
36. Singh VK, Shah G, Singh PK, Saran D. Extraskeletal ossifying chondroma in Hoffa's fat pad: an unusual cause of anterior knee pain. Singapore Med J. 2009;50(5):e189-192.
37. Ozturan KE, Yucel I, Cakici H, Guven M, Gurel K, Dervisoglu S. Patellar tendinopathy caused by a para-articular/extraskeletal osteochondroma in the lateral infrapatellar region of the knee: a case report. Cases J. 2009;2:9341.
38. Mulcahy H, Hoch B. An extraskeletal paraarticular osteochondroma of Hoffa's fat pad. Radiology Case Reports. 2010;5(4).
39. Nouri H, Ben Hmida F, Ouertatani M, et al. Tumour-like lesions of the infrapatellar fat pad. Knee Surg Sports Traumatol Arthrosc. 2010;18(10):1391-1394.
40. Veras E, Abadeer R, Khurana H, Tan D, Ayala A. Solitary synovial osteochondroma. Ann Diagn Pathol. 2010;14(2):94-99.
41. Ogura K, Goto T, Nemoto T, Imanishi J. Para-articular osteochondroma of the infrapatellar fat pad. J Knee Surg. 2011;24(3):209-213.
42. De Maio F, Bisicchia S, Potenza V, Caterini R, Farsetti P. Giant intra-articular extrasynovial osteochondroma of the knee: a report of two cases. Open Orthop J. 2011;5:368-371.
43. Sayum Filho J, Garms E, Teixeira de Carvalho R, Sayum J, Mitsuro Matsuda M, Cohen M. Synovial chondromatosis of the knee: case report. Revista Brasileira de Ortopedia. 2011;46(5):605-606.
44. Ingabire MI, Deprez FC, Bodart A, Puttemans T. Soft tissue chondroma of Hoffa's fat pad. JBR-BTR. 2012;95(1):15-17.
45. Singh R, Jain M, Siwach R, Rohilla S, Sen R, Kaur K. Large para-articular osteochondroma of the knee joint: a case report. Acta Orthop Traumatol Turc. 2012;46(2):139-143.
46. Sen D, Satija L, Kumar KS, Rastogi V, Sunita BS. Giant intra-articular extrasynovial osteochondroma of the Hoffa's fat pad: a case report. Medical Journal Armed Forces India. 2012:1-4.
47. Evaniew N, Bayegan D, Popovic S, Parasu N, Ghert M. Infrapatellar Fat Pad Osteochondroma: Three Cases and a Systematic Review. J Knee Surg. 2014. "Forthcoming"
48. Edeiken J, Edeiken BS, Ayala AG, Raymond AK, Murray JA, Guo SQ. Giant solitary synovial chondromatosis. Skeletal Radiol. 1994;23(1):23-29.
49. Zlatkin MB, Lander PH, Begin LR, Hadjipavlou A. Soft-tissue chondromas. AJR Am J Roentgenol. 1985;144(6):1263-1267.
50. Priya PJ, Valiathan MV, Rao L. Extra-Osseous Osteochondroma of the Knee. Malaysian Orthopaedic Journal. 2010;4(1):39-41.
51. Kramer J, Recht M, Deely DM, et al. MR appearance of idiopathic synovial osteochondromatosis. J Comput Assist Tomogr. 1993;17(5):772-776.
52. Bernard SA, Murphey MD, Flemming DJ, Kransdorf MJ. Improved differentiation of benign osteochondromas from secondary chondrosarcomas with standardized measurement of cartilage cap at CT and MR imaging. Radiology. 2010;255(3):857-865.
53. Huang GS, Lee CH, Chan WP, Chen CY, Yu JS, Resnick D. Localized nodular synovitis of the knee: MR imaging appearance and clinical correlates in 21 patients. AJR Am J Roentgenol. 2003;181(2):539-543.
54. Hughes TH, Sartoris DJ, Schweitzer ME, Resnick DL. Pigmented villonodular synovitis: MRI characteristics. Skeletal Radiol. 1995;24(1):7-12
55. O'Connell JX. Pathology of the synovium. Am J Clin Pathol. 2000;114(5):773-784.

Source of Support: Nil, Conflict of Interest: None declared