ORIGINAL RESEARCH

Coexistence of Anterior Cruciate Ligament Ganglia and Mucoid Degeneration, with an Examination of Their Clinical Relationship

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ABSTRACT

Objective: Our research aimed to characterize the occurrence of anterior cruciate ligament ganglia on magnetic resonance imaging (MRI), as well as the coexistence of these ganglia with mucoid degeneration, and to investigate the clinical implications of these entities.

Materials and methods: A database search conducted over a period of two years on 1500 knee MRI tests found that 75 of the patients had recorded instances of anterior cruciate ligament ganglion or mucoid degeneration. Imaging criteria for ligament ganglion included the presence of fluid signal in the ligament that was disproportionate to joint fluid and shown mass influence on intact ligament bundles. It was determined how large ganglia were, where they were located, how complicated they were, and how much lobulation they had. The presence of ligament bundles that were difficult to identify on T1-weighted and proton density-weighted images but which seemed to be intact on T2-weighted images was one of the criteria for the diagnosis of mucoid degeneration. It was discovered that there were intraosseous cysts at the ligament attachments, as well as the presence of joint effusion. When clinically accessible, an evaluation of the degree of ligament instability was documented.

Results: 42 out of 75 tests that satisfied the imaging criteria exhibited distinct intraligamentous ganglia, 14 out of 75 examinations had mucoid degeneration, and 19 out of 75 examinations had signs of both. There was no clinical indication of instability in 49out of the 55 individuals whose data were available. At the time of the arthroscopy, twelve of the patients who had had the procedure had an undamaged anterior cruciate ligament.

Conclusion: On MRIs, anterior cruciate ligament ganglia and mucoid degeneration often occur together but are not generally linked to ligament instability.

INTRODUCTION

Caan made the discovery that there was a ganglion contained inside the anterior cruciate ligament in the year 1924 [1]. Before the development of MRI technology, the only way to

detect these anterior cruciate ligament ganglia was by open surgery or arthroscopy [2–4]. Ganglia of the anterior cruciate ligament have been regularly discovered incidentally without any linked anterior cruciate ligament symptoms [5, 6] as a result of the growing use of MRI to examine the knee. [5] This is due to the rising prevalence of the use of MRI. The mucinous degeneration of connective tissue has been suggested as a possible contributor to the pathogenesis of these ganglia [6–8]. Mucinous degeneration of the anterior cruciate ligament was mentioned as a possible risk factor for missing the diagnosis of a ligament rupture in a paper that was published not too long ago [7]. Although there is some speculation that mucoid degeneration and anterior cruciate ligament ganglia are connected, to the best of our knowledge, the confluence of these two conditions has never been investigated.

The goal of this research was to establish the frequency of coexistent mucoid degeneration of the anterior cruciate ligament and characterize the MRI characteristics of anterior cruciate ligament ganglia. We also attempted to establish a correlation between the results of the MRI and clinical evaluations of ligament instability.

MATERIALS AND METHODS

This was a research that looked back in time and had permission from the institutional review board. The results of 75 studies that demonstrated anterior cruciate ligament ganglia or mucoid degeneration were found after conducting a database search on all 1500 knee MRI exams that were carried out at our institution over the course of two years.

An unenhanced MRI of the knee was carried out with the assistance of a 1.5-T MR machine (Signa, General Electric Medical Systems) in conjunction with a specialized knee coil (Medrad), a 15- to 16-cm field of view, a 4-mm section thickness with a 1-mm gap, and a 256 192 matrix. The following sequences were used: axial T2 fast spin echo (TR range/TE range, 2,000–6,000/60–70; echo-train length, 8) with fat saturation; sagittal proton density (TR/TE range, 2,000/20–30; echo-train length, 4); coronal T2 fast spin echo (2,000–6,000/ 60–70; echo-train length, 8) with fat saturation; sagittal T2 fast spin echo (TR range/TE range, 2,000– Gadopentetate dimeglumine (Berlex Laboratories' Magnevist) was administered intravenously to eight individuals who underwent indirect knee arthrography. The dosage was based on each patient's body weight. After the IV contrast material was injected, the following sequences were carried out: sagittal T1 spin echo (400–800/8–16), sagittal T2 fast spin echo (2,000–6,000/60–70, echo-train length, 8) with fat saturation; coronal T1 (400–800/8–16); coronal T2 fast spin echo (2,000–6,000/60–70; echo-train length, 8) with fat saturation; axial T2 fast spin echo (2,000–6,000/ Two musculoskeletal radiologists reached a unanimous decision after seeing the MRI scans in question. Fluid signal in the substance of the ligament that met at least two of the following three criteria was considered to be indicative of an anterior cruciate ligament ganglia: mass effect on anterior cruciate ligament fibers; lobulated margins; and anterior cruciate ligament fluid that was disproportionate to joint fluid. The presence of anterior cruciate ligament fibers that were difficult to discern on T1-weighted or proton density sequences but were visible on T2-weighted sequences was one of the criteria for mucoid degeneration. On both T1- and T2-weighted sequences, the signal from the ligament is significantly increased [7]. To rule out the possibility of partial rips in the anterior cruciate ligament ganglia as well as the mucoid degeneration, both bundles of the ligament had to be examined and found to be intact from their points of origin to their points of insertion. Previous publications using MRI and histological correlation [6–9] served as the basis for these imaging criteria for anterior cruciate ligament ganglion and mucoid degeneration.

The size of the anterior cruciate ligament ganglion as well as its position inside the ligament were both taken into consideration. The complexity of the anterior cruciate ligament ganglion was graded as mild, consisting of two or fewer internal thin septations; moderate, consisting

of three to five internal septations; and marked, consisting of more than five internal septations. This was determined by counting the number of internal septations within the ganglion. The lobulation of the anterior cruciate ligament ganglion cyst boundary was classified as mild when there was a simple contour, moderate when there were less than three lobulations, and noticeable when there were more than three lobulations. The presence of intraosseous cysts as well as their size were recorded at both the femoral and tibial attachment points of the anterior cruciate ligament. When joint effusion was evident, the severity of it was classified as either minor, moderate, or big.

Knee MRI tests that did not fulfill the criteria for anterior cruciate ligament ganglia or mucoid degeneration were omitted from the study. Individuals who had a previous history of trauma were not subjected to examinations in order to exclude the possibility of include patients who had an injured anterior cruciate ligament. The patient's symptoms, the clinical evaluation of the anterior cruciate ligament performed by an orthopedic expert, and the arthroscopic reports were retrieved from the patient's medical records whenever they were accessible. Surgery with an arthroscope was performed on a total of twelve patients. Lachman's test was used by an orthopedist in order to evaluate the degree of stability provided by the anterior cruciate ligament. This clinical exam is the most accurate one there is for evaluating the rupture and stability of the anterior cruciate ligament. When the knee is kept at a flexion angle of 10–20 degrees, the proximal tibia is dragged anteriorly and posteriorly in opposite directions. An indication of laxity in the ligaments is anterior translation. In 22 of the instances, the clinical records could not be located.

RESULTS

Seventy-five different knee MRI tests satisfied the criteria for either anterior cruciate ligament ganglion or anterior cruciate ligament mucoid degeneration.

The population of the study consisted of a total of 70 people, with a mean age of 40 years old and 35 males and 35 females (range, 19–60 years). A total of 42 individualswere found to have separate intraligamentous ganglia.14 displayed characteristics that were exclusively consistent with anterior cruciate ligament mucoid degeneration. A total of 19 individuals, showed signs on MRI consistent with both anterior cruciate ligament ganglia and anterior cruciate ligament mucoid degeneration. 39 years was the average age of patients who had been diagnosed with distinct anterior cruciate ligament ganglia alone (range, 19–60 years). Patients who had coincident anterior cruciate ligament ganglia and mucoid degeneration had a mean age of 43 years when they were diagnosed (range, 30– 66 years). The patients who were exclusively diagnosed with mucoid degeneration had a mean age of 42 years (range, 22–66 years).

The diameter of the ganglia of the anterior cruciate ligament varied from 20 to 73 millimeters (mean, 31 mm). Ganglia were seen in the proximal half of the anterior cruciate ligament in 16 of the individual, in the distal half of the ligament in 9 of the individuals, and across the whole of the ligament in 30 of the records. On MRI, the degree of complexity and lobulation of ganglia ranged from little to significant (Table 1).

	Complexity and Lobulation of Anterior Cruciate Ligament Ganglia and Associated Size of Joint Effusions on MRI		
	No.of patients		
Aspect	**Mild**	**Moderate**	**Marked**
Complexity	23	23	19
Lobulation	32	21	24
Effusions	35	11	22

The average diameter of intraosseous cysts at the insertion of the femur was 4.2 millimeters (range: 2–20 millimeters), while the average diameter of intraosseous cysts at the insertion of

the tibia was 5.1 millimeters (range, 2–22 mm). Joint effusions were seen in 51 knees that had separate anterior cruciate ligament gan-glion cysts (Table 1). Five of the eight exams that were carried out following the intravenous injection of gadolinium revealed distributed enhancement (Fig. 2) of the anterior cruciate ligament ganglia, whereas the other three revealed only rim enhancement.

In an examination of 43 patient files that were easily available, 56 patients were found to have anterior cruciate ligament ganglia. These patients presented with a wide range of symptoms, some of which were knee discomfort, a clicking or popping sensation, and edema (Table 2).

	Recorded Symptoms and Clinical and Arthroscopic Findings of Patientswith Incidental Anterior Cruciate Ligament Gangliaor Mucoid Degeneration on MRI	
Symptom	**No.of Findings**	
	Interior Cruciate Ligament Ganglia	**Mucoid Degeneration Only**
Kneepain	33	10
Poppingor“givingway”	12	2
Swelling	14	7
NegativeLachman’stest	41	7
Noclinicalfollow-up	15	10
Arthroscopicsurgery	9	3
Intactligamentatarthroscopy	8	4

In a clinical examination, a Lachman's test was performed on forty individuals who had shown signs of anterior cruciate ligament degeneration on an MRI but had negative results. Three individuals with anterior cruciate ligament ganglia on MRI had an inconclusive Lachman's test on clinical assessment. Subsequent surgery verified that all three patients had intact anterior cruciate ligaments. Thirteen patients who showed signs of ganglia in the anterior cruciate ligament on MRI could not be located for clinical follow-up.

Following arthroscopy, all eight individuals who had been diagnosed with anterior cruciate ligament damage using MRI were found to have intact ligaments. At arthroscopy, the ganglia of the anterior cruciate ligament that were visible on the MRI were not present. In each of these cases, a standard arthroscopic procedure was used, and anterior portals were utilized. On MRI, these ganglia had a mean diameter of 22.2 millimeters with a range from 11 to 57 millimeters. They affected either the whole ligament or either the proximal or distal part of the ligament. During arthroscopy, a ganglion cyst of the anterior cruciate ligament measuring 12.2 millimeters in diameter was aspirated blindly with the use of MRI for guiding. This patient, whose MRI results were normal in all other respects, had complained of discomfort at the back of the knee for no apparent reason. Following arthroscopy, this patient's problems reportedly disappeared completely. During the arthroscopy performed on this group, the following findings were discovered: a tear in the medial meniscus, a tear in the lateral meniscus, patellofemoral osteoarthritis, and osteoarthritis in the medial compartment.

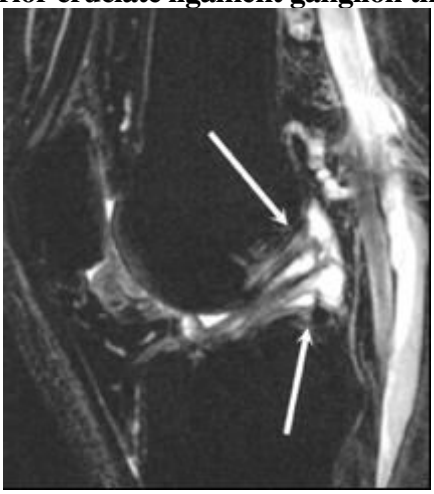
In 44 MRI tests, mucoid degeneration of the anterior cruciate ligament was seen. A coincident occurrence of mucoid degeneration and anterior cruciate ligament ganglia was found in 26 patients. In 41 out of 44 exams (93%), the whole anterior cruciate ligament was affected by mucoid degeneration. Mucoid degeneration only affected the distal half of the anterior cruciate ligament in three of the exams (7%). Associated joint effusions were categorized as moderate in nine (20%) exams, mild in 22 (50%) tests, and big in one (20%) examination. On 11 out of 25 exams, there was no sign of any considerable joint effusion. On 31 of the tests, or 70%, intraosseous cysts were found at the tibial insertion, while on 17 of the investigations, or 39%, found them at the femoral origin. At the tibial insertion, the

intraosseous cysts had a mean diameter of 3.5 mm, with a range of 1–13 mm; at the femoral origin, the mean diameter was 4 mm, with a range of 1–20 mm. Two individuals who exhibited indirect arthrograms and MRI findings consistent with mucoid degeneration showed diffuse increase of the ligament.

Review of the records of nine of the 18 patients with mucoid degeneration of the anterior cruciate ligament on MRI indicated symptoms including knee discomfort, "giving way," and edema. These symptoms were found in nine of the patients. During the physical examination, the anterior drawer test was negative for eight of the patients. At the time of the arthroscopy, the patient who had a positive Lachman's test during the clinical examination also had an intact ligament. With regard to the other nine individuals in this group, there was no possibility of clinical link.

Four out of the 18 patients who exhibited just mucoid degeneration on their MRIs were found to have intact anterior cruciate ligaments when they underwent arthroscopy. The results of the arthroscopy performed on this group included the discovery of a tear in the medial meniscus and the presence of medial compartment osteoarthritis.

Fig: 50-year-old man with posterior knee pain and stable anterior cruciate ligament on clinical examination and anterior cruciate ligament ganglion that was aspirated at surgery.



DISCUSSION

1.3% of patients have been reported to have intraarticular ganglion cysts on MRI, with roughly 20% of these cysts being connected to the anterior cruciate ligament [5]. In the population that we studied, we found that ganglion cysts of the anterior cruciate ligament occurred 1.3% of the time.

The clinical appearance that is linked with ganglion cysts of the anterior cruciate ligament may take a variety of forms, according to the research [5]. The majority of instances that have been documented are accidental discoveries that have no contributing symptoms [5, 9]. The existence of these cysts has been linked in several case reports [10–13] to a variety of symptoms, including discomfort along the median joint line, mechanical locking, clicking, and swelling. Patients in our study most often complained of knee discomfort as their primary symptom. However, this was a vague complaint, and the majority of patients' doctors believed that it was caused by other intraarticular conditions. Five examples of anterior cruciate ligament ganglion cysts were described by Calvisi et al. [14]; three of the cases were isolated finds, and two of the cases were connected with other intraarticular causes. Arthroscopy was used to uncover the cysts by accident. Meniscal tears and chondromalacia were the most common diagnosis made by our arthroscopy on the 12 participants in our research who had had the procedure. Despite the fact that arthroscopy revealed that all of the anterior cruciate ligaments were intact, neither the intrasubstance ganglia nor the mucoid

degeneration of the anterior cruciate ligament were mentioned in any of the papers generated by the procedure. This is consistent with previous results that were published in the medical literature that described how anterior cruciate ligament ganglion cysts and mucoid degeneration detected by MRI are typically not detectable during arthroscopy utilizing the traditional anterior portal technique. The conclusive diagnosis of anterior cruciate ligament ganglia and mucoid degeneration can only be made via an arthroscopic procedure by probing the ligament while utilizing an MRI as guidance. This procedure will often need a posterior portal approach [7–9]. MRI is superior to arthroscopy when it comes to distinguishing between entities that do not contribute to any significant abnormalities of the ligament surface [15, 16]. As a result, magnetic resonance imaging (MRI) may be used pre-operatively to help the orthopedist in aspirating the symptomatic ganglion that is not immediately visualized during arthroscopy. This was the case with one patient in our series.

There is still much debate on the reason why anterior cruciate ganglion cysts develop. During a routine dissection that took place in 1924, Caan [1] was the first person to characterize the anterior cruciate ligament ganglion. Although the actual etiology of ganglion cysts is still unclear, there are now two hypotheses that attempt to explain the pathophysiology of the condition [17–19]. The occurrence of ganglion cysts is attributed, according to the first idea [8, 19], to the mucinous degeneration of the connective tissue, which was a result of the process. The second idea proposes that it may be caused by the herniation of synovial tissue as a result of a defect in the joint capsule or tendon sheath, in a manner similar to that which is seen in conditions that originate in the wrist joint [17, 20]. Regarding both of these hypotheses, the connection to earlier traumatic experiences is unclear and has not been established. Levine [4] described the situation of a lady who was 23 years old and had had a knee injury by twisting her knee, which was then followed by a recurrence of edema, discomfort, and locking. An exploratory surgical procedure revealed a degenerative cyst in the patient's still-healthy anterior cruciate ligament. The researcher hypothesized that the ganglion developed as a result of a congenital defect or an accident that occurred in the patient's past [4]. Patients who had a history of severe trauma were not included in our research, which leads us to believe that the cause of these ganglion cysts might be either developmental or degenerative.

In individuals who have anterior cruciate ligament ganglia, the results of clinical evaluations of the anterior cruciate ligament (such as the Lachman's test) are often inconclusive or negative [3, 5, 13]. In our cohort, there were 48 individuals with accessible medical records who were found to have ganglia or mucoid degeneration in the anterior cruciate ligament, although their clinical examinations revealed no signs of ligament insufficiency. At arthroscopy, it was discovered that four patients had intact anterior cruciate ligaments, including one who had a positive result on the Lachman test during the clinical examination. The other three patients had inconclusive results.

There was a significant correlation between the presence of discrete intraosseous ganglia and the presence of intrasubstance ligament ganglia in 66% of studies and 77% of individuals with mucoid degeneration. It has been shown that the histological characteristics of intraosseous ganglia and soft-tissue ganglia are the same [21–23]. In most cases, they do not have any discernible channels of connection with the articular surface or the joint cavity [21]. In their study [22], Pope et al. documented four examples of intraosseous ganglia that were composed of myxoid material for the most part. In the aforementioned research, patients who had both anterior cruciate ligament intrasubstance ganglia and mucoid degeneration were found to have intraosseous ganglia at the femoral and tibial attachments of the anterior cruciate ligament. These ganglia were found at the femoral and tibial attachments of the anterior cruciate ligament. Kaatee et al. [17] explained how the constant pressure of a ganglion cyst against an adjacent hard surface may create a depression in the bone by the

process of progressive erosion, resulting in the formation of an intraosseous ganglion. The high prevalence of intraosseous ganglia in individuals who have either mucoid degeneration of the anterior cruciate ligament or in-trasubstance anterior cruciate ligament ganglia provides evidence that both of these conditions may have a similar etiology and may have comparable treatments. This study's limitations stem from the absence of clinical correlation in 22 of the participants. Due to the fact that it is a retrospective study, it is possible that mild instances of mucoid degeneration were not originally recorded, which would result in a lower estimation of the real incidence of this entity in our research. The number of anterior cruciate ligament ganglia that have been found, on the other hand, shows that they may have a larger incidence than what has been described in the past [3–5]. The outcomes of this investigation provide credence to the assertions made by earlier researchers that anterior cruciate ganglia are often symptomless [5–8]. According to the findings of previousstudies [3, 5–8], the symptoms that patients report are often attributed to other abnormalities discovered by MRI or arthro-scopy. This is the first large-scale investigation to provide conclusive evidence that ganglia are not linked to an increased risk of ligamentous instability. This study also demonstrates that anterior cruciate ligament ganglion cysts commonly occur in association with MRI features of mucoid degeneration, and that these entities are typically not associated with ligament insufficiency or patient symptoms. The study was carried out to investigate the relationship between the two. Anterior cruciate ligament ganglion cysts and mucoid degeneration have a strong relationship with intraosseous cysts at the femoral and tibial attachments. Both of these conditions may cause mucoid degeneration. These data add credibility to the hypothesis that anterior cruciate ligament ganglia may be part of a degenerative process and that these two entities may represent various manifestations of this continuum. In other words, these findings provide support to the theory.

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