Discoid Lateral Meniscus

An Essay Submitted for Partial Fulfillment of
Master Degree in Orthopaedic Surgery

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Introduction

Discoid lateral menisci were first described anatomically in the late 1800s. The normal configuration of a meniscus is that of a matured crescent moon, while that of a discoid meniscus generally is a thickened very early crescent moon. Variations of this general shape occur relatively rarely, and occasionally, the lunar appearance is also found in the medial meniscus. [3]

A disk-shaped or discoid meniscus is manifested by a wider than normal meniscal body. The discoid shape of the meniscus results in greater coverage of the tibia and is usually associated with increased thickness of the meniscus that may lead to abnormal shearing forces across the knee joint. [45]

One element in the differential diagnosis of knee pathology is a discoid meniscus. Discoid meniscus can manifest as an abnormal band, medial and lateral in the same knee, bilateral and medial, or more commonly as a discoid lateral meniscus. [3]

Discoid lateral menisci have been reported to occur at the rate of 1.5-3% in the general population, while discoid medial menisci have been reported to occur at the rate of 0.1- 0.3%. [4]

The Asian population has a slightly higher rate of occurrence. At the Tokyo Teishin Hospital, 16.6% of all knees examined arthroscopically had a discoid lateral meniscus. [4]

A discoid lateral meniscus results from a developmental anomaly before birth. After birth, no sudden change occurs in meniscal development. [12]

There are three types of discoid lateral meniscus complete, incomplete, and the hypermobile or Wrisberg lateral meniscus. [10]

The Wrisberg type lacks an attachment to stabilize the posterior horn to the tibia. It may also be of normal shape rather than discoid. The only attachment of the posterior horn is to the Wrisberg or meniscofemoral ligament. The general configuration produces an unstable or hypermobile lateral meniscus. [11] [45]

Patients present with any combination of pain, giving way, effusion, and clicking or snapping knee.[27]

Children aged approximately 7 years, present with a snapping knee joint. The snap can be seen and heard. Translation of the femoral condyle over a thickened posterior rim of lateral meniscus occurs. If the child remains otherwise asymptomatic, then only observation is necessary. [27]

Such a dynamic, however, greatly increases the chance of tearing the lateral meniscus, either by continued microtrauma or by a level of trauma that would not otherwise cause tearing. (27)

Surgical treatment varies according to the type of lateral discoid meniscus. Arthroscopic procedures are quite successful and are somewhat more technically demanding than are routine meniscal tear excisions because of the younger age, tighter joints, and less room available to manipulate the arthroscopic equipment. Surgical techniques vary, from sculpting and partial meniscectomy to complete removal, starting with removal of the anterior portion for better arthroscopic visualization.(32)

The indicated treatment for the discoid type I(complete) and type II (incomplete) as well as the central-holed or ring-shaped version, is removal of the central discoid and ring portions, including any areas of tearing, followed by arthroscopic sculpting of the remaining meniscus. (43)

Because of the hypermobility of the entire meniscus in the Wrisberg Type, sculpting the meniscus is ineffectual, and better results were reported with a near complete to complete meniscectomy. (42)

Some attempts have been made to avoid total meniscectomy by tying down the meniscus through drill holes in the tibia to correct the anatomic defect.[42]

The preoperative and postoperative management of a torn discoid meniscus is no different than that for a torn lateral meniscus with a normal anatomy. [50]

Embryology and Anatomy

Embryology

Embryologically, the menisci form from mesenchymal tissue and appear as distinct structures by the eighth to tenth week of gestational development. Initially highly cellular, the perinatal meniscus also has an abundance of blood vessels. Progressive and gradual changes occur from birth to mid-adolescence, consisting of decreasing cellularity, decreasing vascularity, and increasing collagen content. As the developing child becomes progressively more ambulatory, the collagen fibers become oriented in order to adapt to the weight-bearing stresses. [10]

Smillie in 1948 stated that, the shape of a normal meniscus is the result of gradual absorption during the latter half of foetal life of the central part of an originally complete plate, then it is reasonable to suggest that the more complete the disc, and the greater its breadth and thickness, the earlier the absorptive process must have ceased. The distinctive feature of the primitive disc is not so much its size, which varies within wide limits according to the age, sex, and built of the patient, but the lack of any suggestion that it was

ever intended to be a meniscus. The whole area where there is normally contact between the femur and tibia is filled in ; so that, not only is there no point of direct contact between the bones but, the opposing articular surfaces are actively separated by fibrocartilage of a thickness which may be as great as 6 millimeters. The central free margin is thick; it is short and it stretches almost directly between the anterior and posterior central attachments. The outline of the edge varies in form. It is often convex with a small notch at each extremity. [49]

Kaplan also found in (1957) that the fibrocartilages of the knee do not present at any phase of foetal development a disc-like appearance, either on the lateral or medial side, and he was unable to accept the statement that the discoid cartilage is the result of arrest of development. Kaplan's study covered embryos from forty days (14 millimeters) to birth and showed that the earliest development that could be considered the precursor of the semilunar cartilage took place at the periphery of the joint. [25]

The embryological study revealed quite definitely that at no time in the development of the human foetus does the lateral or medial meniscus assume a discoid form. The intermediate zone between the femur and tibia which appears very early in the development of the knee of the embryo is called the intermediate disc. This disc does not break up into separate medial and lateral discs, however, but develops early into two semilunar menisci.[25]

By dissection of fetal limbs, it was found that as early as the tenth week the cartilages have a form which closely resembles that in the adult, and nothing could be more distinct than the difference between the meniscal cartilage in the ten weeks old foetus and the discoid cartilage from adult. Further dissections confirmed that the cartilages retain this form throughout intrauterine life. [41]

It is perhaps inaccurate to say that the disc shape is never present in the normal development of a fibrocartilage. In an early phase of development there is an undifferentiated mass of mesenchyme between the cartilaginous precursors of the bones. This intermediate mesenchymal plate or blastemal matrix breaks down to form a space between the two bones by the end of the second month. Parts of the mesenchyme persist to form intraarticular structures such as the fibrocartilages in the knee. [41]

The discoid cartilage cannot truly be said to be a persistence of a normal phase in development because, from the time of differentiated mesenchyme, the cartilages have a semilunar form. As to the etiology of the discoid form occurring in the lateral cartilage, the form of the lateral cartilage with its two horns so closely approximated does tend to have rather a discoid appearance. [41]

The semilunar form of the lateral cartilage is indeed dependent on a very minute central breakdown of the blastemal matrix between the precursors of the bone, and if this fails to occur, then a discoid-like cartilage might result. The fact that a disc-like cartilage is more common on the lateral side than on the medial is in keeping with the greater absorption of the blastema that occurs normally during the development of the medial cartilage, and it is this greater absorption that results in the form of this cartilage. [41]

In the 30 mm fetus (8 weeks), the knee joint has a shape similar to that of the adult knee. The process of cavitation begins during the 10^{th} week of embryonic development. The intra articular synovial mesenchyme and the mesenchyme that separates the popliteus tendon from the lateral meniscus develop numerous vacuoles due to an increase in the amount of ground substance between cells. [33]

The cellular elements rarefy and separate but remain in contact through thin fibrillary extensions. The enlargement of the space between cells and their degeneration form the articular cavities. As it happens, the first cavity to be formed in the knee joint is located in the suprapatellar pouch and is called the porta. Another cavity, the popliteal bursa, forms in the mesenchymal layer between the popliteus tendon and lateral meniscus. [33]

In some cases of lateral discoid cartilage associated defects have been noted of the fibular side of the leg. These include high fibular head, defects in the fibular musculature, peroneal luxation and changes in the shape of the lateral malleolus. [41]

Anatomy

The menisci of the knee joint are fibrocartilaginous C-shaped discs that occupy the joint space between the femur and the tibia. The lateral meniscus is about four-fifths of a circle and of a uniform width .Its anterior horn is attached in front of intercondylar eminence of the tibia, behind the anterior cruciate ligament with which it partly blends. The posterior horn is attached behind the eminence in front of the posterior horn of the medial meniscus. From the posterior convexity of the lateral meniscus fibrous bands pass upwards and medially to the medial femoral condyle, in front of and behind the posterior cruciate ligament Fig. 1. [46]

In the human knee, the lateral meniscus is attached to the tibial surface in two places, on the anterior and posterior aspects of the lateral intercondylar tubercle. It is also known that the lateral meniscus is attached to the femur by a ligament known as the meniscofemoral ligament. In human anatomy this structure is known as the ligament of Wrisberg; it runs behind the posterior cruciate ligament, starting laterally at the posterior horn of the lateral meniscus and crossing the posterior cruciate ligament obliquely before reaching its point of insertion on the lateral surface of the medial condyle. In the French, German, and Russian literature, this ligament is known as Robert's ligament. An