

If your knee hurts (2nd edition)

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Cruciate ligament injuries

Cruciate-ligaments are the strongest type of ligament in the body, and are central to knee-joint stability. The articular capsule, menisci and the side ligaments affect the peripheral stability of the knee-joint. If these function correctly then the knee-joint will function correctly. The motion sequence of the knee is very complex as there is a rolling-sliding-movement. In principle, the knee-joint should not be looked upon as a hinged joint.

The front cruciate ligament protects the knee-joint when descending hills or steps by enabling a greater relative movement between the upper and lower leg allowing the lower leg moves forward. The rear cruciate ligament stabilises the knee-joint in its rearward direction and stops excessive force being exerted on the joint between the knee-cap and upper surface as well as in the inner-compartments of the joint. If the ligamentous apparatus of the knee-joint has been damaged, it will cause an unstable knee-joint. A patient with an unstable knee-joint asserts loadings on the joint in a completely different way to patients with stable joints.

Cruciate-ligament injuries prove very costly to health insurance companies. It is estimated that currently up to 1,000 people in Germany have had cruciate ligament reconstruction surgery. On top of this, there are approximately 50,000-60,000 front cruciate ligament injuries reported each year in Germany. Statistics show that between 3,000-5,000 front cruciate ligament injuries are treated surgically each year. In 1998, 190,000 front cruciate ligaments were successfully reconstructed (both in cases of acute and chronic instabilities). It is estimated that annually, there are over 75,000 cases of new front cruciate ligament ruptures in the USA. Also, in 2006, over 3,000 front cruciate ligament operations took place in Hungary.

In Germany, it is estimated that there are over 170,000 knee related sports injuries. After any sports injury or indeed knee related sports injury, the area must be inspected for signs of damage. These injuries sometimes aren't immediately apparent upon the first medical inspection. It has been well documented that this happens very often with knee related sports-injuries.

It is imperative that, after an accident involving the knee-joint, a thorough search for damage is carried out and the problem promptly diagnosed. It is particularly of note that a meticulous diagnosis is imperative in prescribing optimal and timely treatment, in order to prevent further damage to the joint that could cause restrictions in movement or progressive joint degeneration.

After a knee-related injury, it is necessary to carry out a detailed medical history, an assessment of the mechanics of the accident, and a standardised clinical investigation of the patient. If the results show any unclarities, either the same clinical assessment or further investigations must be carried out. It is important to know that knee contusions, strains or sprains can hide morphological damage, which can also affect the ligament apparatus. After the patient's medical history has been taken and upon completing a conclusive medical examination, a radiograph must be taken in order to eliminate the possibility of a bone-fracture in the joint, so that any signs of wear or even avulsed ligaments can be detected. Only then can specialist investigations of the knee-joint be carried out. Stress recordings should then be taken for injuries to either the front or rear cruciate-ligaments. By using these specialist radiographs the knee-joint can be examined under normal conditions using a pre-defined load in the direction of the load-bearing ligaments. It is then possible to check the relative displacement on the radiograph between the upper and lower-leg. After this, specialist investigations can be carried out, such as an MRI (magnetic resonance imaging) or CT (computed tomography).

Of particular importance is the definitive detection and classification of the ligament-injury. A competent investigator can then finally prognose the treatment to be carried out for the knee-injury. If there are any uncertainties in the diagnosis, arthroscopy (joint imaging) should be carried out on the knee, in order to come up with a more concrete diagnosis, and also to detect deal with any other problems that may occur during ligament reconstruction.

History

Cruciate-ligaments were first mentioned approximately in 3,000BC on rolls of Egyptian papyrus with information on them concerning the anatomy of the knee-joint. The author however was not mentioned. It was already known that ruptures in the knee-ligament apparatus lead to displacement in the joint, which caused instability. The complex biomechanics of a knee-joint, the ligament-controlled roll-slide mechanism as well as the fact, that the bundle of ligaments exerts differing tensions depending on angular positioning, was not mentioned until 1836 by the Weber brothers.

In 1853, Meyer looked into the complicated kinematics of the knee-joint, describing the stretching of the doubled external rotational moment of the tibia (tibial plateau). In 1845, Bonnet published

some works, in which he described what he'd learnt from studying mechanics of knee injuries. From this he learnt that lesions in the front cruciate-ligaments occurred a lot more than previously thought, and that the part of the ligaments close to their roots in the upper-leg were in most cases torn. It was found that when these snap, a loud cracking noise could be heard, and that in general, this trauma was combined with a hematoma in the joint.

This author would have carried out operative-stabilising of the knee-joint, but given the stance on surgery at the time and given the materials available, (except supports) there was little possibility of carrying out knee-joint endoprosthesis. For the first time, in 1875 a Greek doctor named Noulis described an investigation into methods involving stretched-positioning of the knee-joint, to account for a rip in the front cruciate-ligaments. This method was renewed in 1976 by Tork and his colleague, investigated, described, and then named after their teacher. This test of the knee-joint is nowadays widely known as the Lachman-test, and is a significant sign of a front cruciate-ligament injury.

The first in-depth description of the clinical symptoms of a new forward cruciate-ligament rupture was carried out by the French surgeon and gynaecologist Higont in 1879. For more than 100 years, surgical intervention has been carried out on the cruciate-ligaments. Many surgical techniques were trialled, used, and then later abandoned.

Nowadays we have a smaller spectrum of operative techniques in the plastic reconstruction of the front cruciate-ligaments. The first application of the front cruciate-ligaments with a free tendon-stripe comes from a publication from Saint Petersburg in 1914. Even until the 1970 there were very seldom operative interventions carried out on the ligaments. In this period they tended to use castings in order to treat knee-injuries, and surgical experience was gained from outside of the specialist knee-field, in the form of ways to redirect loadings acting upon the joint.

Since the 1980s the Brueckner plastic/ligament patella (knee-cap) has been used. For this technique to work, larger and more traumatic openings of the joint were required. During this period, plastics, cruciate-ligament replacement material as well as various synthetic materials were used. Nowadays, these are mostly not used, as they don't always provide the best results, and to an extent can have damaging effects on the joint-structure.

In the 90s, cruciate-ligament replacement was involving ever-smaller access wounds due to improved ligament-patellas (knee-cap), improvements in fixations-materials and through advancements in knee-examination techniques (arthroscopy). Finally, cruciate-ligament plastics were discovered that didn't require a large opening to be fitted, through using arthroscopic techniques, rendering fixation more secure. At the time, this happened through using special metal screws and specially-shaped bone-sockets, which was a spread-socket fixed into in the drilling channel of the upper and lower legs.

Towards the end of the 90s was the era of the weak-point transplant, in which flexor-tendons (semi-tendinosus) or quadriceps-tendons were taken as transplants for the cruciate-ligament replacement. The ability to do this was in connection to the improvements made in fixating these into the necessary drilling-canals in the upper and lower leg.

In the last few years, transplant-fixative surgery or orthopaedics has had different and ever improving fixations techniques at its disposal at an affordable price. The hybrid-fixation of the cruciate-ligament transplant in the knee is a very modern process. Several fixation-techniques for this can be exploited to our advantage in order to optimise the possibility of good anchorage of the transplant to the joint, with the aim of reducing any possible complications that could occur. The most accessible and safest anchoring technique for the tendons on the front-cruciate ligaments is done through using bioresorbable materials, which dissolve once the bone has healed to the transplant. Screws and pins which are used to fix the cruciate-ligament transplant into place dissolve after a period of time, meaning that after everything has healed, no foreign-bodied intervention will be needed to remove them from the drilling-channel. This method of hybrid-anchoring of the cruciate-ligament transplant to the bone is a very well-know and modern technique. It exploits the advantages know from various anchoring-techniques and limits any complications. From around 2005, techniques have been coming about that are better suited to the anatomy of the front cruciate-ligaments. These consist of 2 bundles or components that are isolated and bound together with a corresponding weak-point tendon-transplant, in order to replicate more the biomechanics of a healthy joint. These are, however, very complex and demanding operations of high responsibility.

In highly-invested scientific studies it still cannot be clearly established with certainty whether the double-binding technique will replace the single-binding technique, in which the cruciate-ligament transplant is replaced. Further case-studies will have to be collected and examined and we will have to wait for more highly-precise scientific studies to be carried out.

One step forward in front cruciate-ligament surgery has existed for several years, whereby the transplants, namely ligament-patellas (knee-caps) or weak-point transplants, like semitendinosus, are free of implants in the drilling-canal in the upper and lower-leg. This is a very difficult and

complex operation to carry out, that can only be carried out safely by using specialist instruments, and should only be carried out by a very highly experienced surgeon.

Regardless of which transplant is used, artificial ligaments should not be used, as this has been shown throughout scientific-literature that these can fail, as the successful front cruciate-ligament operation is dependent on precisely positioning the drill-canal on the upper and lower legs into which the transplant is to be inserted. It is quite important that the front cruciate-ligament as well as the rear are both placed and fixed on both levels as precisely as possible to the origin-region of the tibial-plate. The decision on which to use and which fixation-technique is used comes secondary. This is at the discretion of the surgeon.

There are currently more than 20 different surgical-techniques in front cruciate-ligament surgery, of which 5 have been well established.

The ligament-patella (knee-cap) using a bone-socket underneath the patella on the upper-part of the lower leg.

Weak-link transplant of the knee-squats (semitendinosus and/or gracilis tendon)

Quadriceps tendon from the upper-leg

Fascia lata (fascia-tendon from the upper-leg)

Corpse-transplant or allograft is an option if there are not enough transplants in either the healthy or damaged leg. Due to nature of the surgery, these transplants (allografts) require maximum medical-care. The possibility of this operation is obviously dependant on the availability of tissue in the tissue-bank.

Plastic- transplants should either not be used at all, or only used in extreme circumstances.

Surgical Techniques

Cruciate-ligament surgery has now become extremely surgically non-invasive due to developments in arthroscopy. Now, the knee does not have to be completely opened, and now you need only a small area in which to work in when using the previously-mentioned tendon-transplants. The knee-joint can be opened through just 2 or 3 incisions of approximately 5mm. Arthroscopy can then be carried out through one of these miniature openings (optics with camera). The micro-instruments can then be inserted into these other incision-canals to carry out the procedure. As has already been mentioned, the fulcrum and crucial point to of cruciate-ligament surgery is the precise positioning of the transplant. This has been learnt as experience has been gained in this field and through the corresponding operating-techniques. To position the drilling-canal and to apply the transplant precisely in the upper and lower-leg, specialist instruments are used. It is even possible to carry out scans during the operation if this becomes necessary.

Operating on cruciate-ligament injuries requires a high degree of responsibility. Each surgeon will have followed their own learning trend and must have gained a lot of experience. The best results come from surgeons that have specialized in this area, and who carry out this procedure many times per year. Dr. Heinz Juergen Eichhorn, of the Sporthopaedicum Straubing , a very proactive man in developing techniques the in cruciate-ligament field, put this very nicely in a German magazine entitled Focus, "Patients should find out on how many cruciate-ligaments their doctor operates on. " You can expect good work from a surgeon who carries out between 40 and 80 cruciate-ligament operations each year.

The best results in gaining optimum stability and good long-term results come about from experienced surgeons. As the saying goes, "Every patient is different, every knee is different." Therefore each patient requires their own personalized cruciate-ligament operation and their own personalized after-care. Obviously, any secondary injuries must be considered when treating cruciate-ligament injuries. Without taking this into consideration, you can't really expect much success from a front cruciate-ligament replacement. It is worthwhile to take note of the collateral ligament (both inner and outer), the rear cruciate-ligaments and any bone-damage present. The menisci should naturally be taken into consideration too.

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