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Injury of the Anterior and Posterior Cruciate Ligans of the Knee Joint (Review of Literature)

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Abstract This article is devoted to modern approaches to the diagnosis, treatment and rehabilitation of rupture of both cruciate ligaments of the knee joint. The knee joint is one of the largest joints in the body, which takes a lot of stress every day. The incidence rate is 50% of all joint diseases. Rupture of both cruciate ligaments of the knee joint is a complex pathology that leads to sagittal instability of the knee joint. Of all orthopedic injuries, this pathology is 0.02%, 10-20% damage to the ligaments of the knee joint. Based on the stress radiography and MRI examination, the diagnosis is established. In modern medicine, for the treatment of rupture of both cruciate ligaments of the knee joint, a minimally invasive method with arthroscopic assistance is used.

Keywords Rehabilitation, Sagittal instability, Bones, Ligaments, Tendons, Cartilage, Joint capsule

1. Introduction

Disease of the knee joint is a common pathology. Despite the fact that, in the past few decades, the CS has been the focus of many scientific studies, one in three people suffer from knee pain [6]. The high incidence rate is associated with a complex anatomical structure, which in daily activities takes a large amount of load. In addition, there are factors such as sports, traffic accidents and direct mechanical action that cause damage to the knee joint. [7,9] Of all articular injuries, 50% occur in the knee joint. [2] This pathology affects all age groups of the population, more often in young people of working age and in the elderly. [6]

The knee joint is one of the largest joints in the body, which is: bones, ligaments, tendons, cartilage, joint capsule. The interaction of these articular elements provides movement, stability and control during loads (jumping, running, playing sports). The knee joint moves in the sagittal (flexion, extension), frontal (internal and external rotation) and transverse (varus and valgus) plane. Intra-articular and extra-articular ligaments (primary stabilizers) provide stability to the joint, in addition, the muscles involved in the movement of the knee joint are secondary stabilizers of the joint [6,32,41]. The menisci protect the articular surface of bones by evenly distributing axial load [15,25].

Currently, the diagnosis and treatment of damage to the soft tissue elements of the knee joint has become easier, thanks to arthroscopic equipment. However, multiligament injuries (rupture of two or more ligaments [5,32,30,26]) of the knee joint are a difficult task in orthopedics, and require complex diagnostics, treatment, and rehabilitation measures [19]. Especially, rupture of both cruciate ligaments which is accompanied by dislocation [20]. Of all orthopedic diseases, this pathology is 0.02%, 10-20% damage to the ligaments of the knee joint [7]. It should be noted that this type of fracture often leads to disability and disability. When both cruciate ligaments are torn, there is a risk of vessel disorders, nerve damage, meniscus rupture, and sometimes fractures of the bones of the knee joint, which cause difficulty in treating such injuries [19,5,30]. When such complications exist, even after adequate treatment, some patients have persistent pain and joint instability [37].

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2. Materials and Methods

An important factor influencing the outcome of the injury is the early and accurate diagnosis of damage to the ligamentous apparatus of the knee joint. Despite the progress in the development of clinical diagnostic equipment aimed at determining soft tissue injuries, the percentage of incomplete and untimely diagnosis remains high. Multiligamentous injuries of the knee joint require complex diagnostics. Anterior drawer test, posterior drawer test, Lachman, Pivot-Shift, Godfrey, and recurvation test are used to identify cruciate ligament tears on clinical examination [16]. The final diagnosis is based on the results of instrumental examinations. In modern medicine, x-rays, ultrasound and MRT examinations are performed according to the standard. Stress X-ray is widely used in the early stages of diagnosis to determine sagittal instability of the knee [15]. Ultrasound examination also makes it possible to determine damage to

the ligaments and adjacent soft tissue. Ultrasound signs of ligament rupture: thickening and decrease in echogenicity, violation of the integrity of the fibers. Magnetic resonance imaging (MRI) is a highly effective method of radiation diagnostics, which makes it possible to accurately determine damage to the knee joint [14]. Multiprojectivity allows diagnosing even minor injuries and assessing the bone and soft tissue structure of the knee joint. MRI is 90.5% accurate in diagnosing knee ligaments [3,2,11].

Rupture of the anterior and posterior cruciate ligaments is a complex pathology. Accordingly, the management of ligaments targeted for reconstruction is also complex [41,17]. An analysis of the literature data showed that conservative treatment of such injuries by prolonged immobilization is ineffective (J). However, patients with a contraindication to surgery or concomitant (diabetes, cardiovascular insufficiency, hematogenous, etc.) disease are treated conservatively. [38]

In 1995, Montgomory et al conducted an outcome-oriented study of conservative and surgical treatment in patients with multiligamentous knee ligament injuries. The mean Lysholm score was 80 in the surgical group compared to the non-surgical group with a mean score of 66 [39]. Peshkun et al. in 2011 conducted a similar study, summarizing the results of surgical and conservative treatment of multiple ligament injuries over the period 2000-2010. The work included 855 patients after surgery and 61 patients were treated conservatively. The mean Lysholm score is 84.3 and 67.2, for the operated and non-operated groups, respectively. The median IKDC scores were 69.0 and 63.7, with the advantage of the surgical group. Return to work and sports was 80% and 50%, respectively, in operated patients, which are twice as high as non-operated patients [31,21].

With the development of surgical orthopedics, the rate of disability and incapacity for work after damage to the ligaments of the knee joint decreased. Surgical interventions aimed at reconstructing multiple ligaments of the knee joint require the surgeon to focus on balancing the joint in several projections, and it is also important to avoid interference. In addition, it is necessary to preserve the integrity of the neurovascular structures close to the knee joint [41].

The optimal timing, management, and rehabilitation of both cruciate ligament ruptures remain controversial [40]. There is a lot of controversy in the literature on the conduct of operations, this is due to the fact that the method of treating multiligamentous injuries is constantly evolving. Another topical issue is the tactics of surgical intervention. A number of authors suggest staged cruciate ligament repair [37,5]. They believe that with staged ligament plasty, the surgeon will be able to monitor and evaluate the condition of the patient and the graft. In addition, each restored ligament has its own rehabilitation subtleties and features [32]. Ohkoshi et al in their study performed a two-stage surgical reconstruction of the cruciate ligaments of the knee joint in 9 patients. In the first stage, the PCL was restored with a hamstring autograft. The next stage was carried out after 3 months. Patients were followed up for 40 months. As a result, passive flexion was 139.5 degrees, none of the patients had instability of the knee joint [29]. In other similar studies (Level II), Subbiah analyzed the surgical outcomes of 19 patients with multiligamentous injuries. As a result, the overall IKDC score was: B grade-15, C grade-2 and D grade-2 knees. One patient had a posterior drawer symptom, and another had persistent posterior flexion. As Subbiah's author noted, "ACL reconstruction is not necessary unless there is instability after PCL reconstruction, especially in non-exercising individuals."

But the main task of modern surgical medicine is low trauma, speedy recovery, avoid complications and repeated surgical interventions. To this end, studies have been conducted aimed at one-stage reconstruction of the cruciate ligaments of the knee joint [40].

3. Result and Discussion

Fanelli (1996) analyzes the results of treatment of 16 patients after simultaneous reconstruction of both cruciate ligaments of the knee joint. As a graft, the author used the Achilles tendon (for the PCL) and the osteopatellar ligament (for the ACL). The patients were followed up for two years. The results were evaluated using the Lysholm, Tagne and KT100 rating scales. As a result, 3 patients received a good result, 10 - satisfactory, 2 - unsatisfactory, 1 - poor [12].

In 1999, Japanese scientists (Kunio Hara and Toshikali Kubo) came up with: “A new arthroscopic method for the reconstruction of the anterior and posterior cruciate ligaments using the single incision technique. Simultaneous transplantation of autogenous semitendinosus and patellar tendons” [22]. In 2001 and 2008, scientific papers were published aimed at retrospective evaluation of patients who were operated on for torn both cruciate ligaments. At the final IKDC score, 20% of patients were grade A, 46.7% grade B, 20% grade C, 6.7% grade D. In addition, one patient had revision surgery and one had knee weakness. Only patients with grades A and B were able to participate in sports in the postoperative period [32,33].

In the course of studying complications after simultaneous cruciate ligament plasty, scientists came to the conclusion that the sequence of graft fixation and the position of the knee joint is the key moment of the surgical technique. Since, the maximum tension of the cruciate ligaments occurs at various levels of knee flexion [8,32]. Fayed et al reviewed clinical trials in 2021. In 17 of 19 studies, posterior cruciate ligament fixation was performed prior to anterior cruciate ligament fixation. The study proved that fixation of the ACL before the LCL leads to instability, contracture (flexion, extension) of the knee joint. Good results were obtained when the PCL was fixed at 45-90° flexion of the knee, the ACL was fixed at various levels of flexion 180-70° [7]. Rase A. and Amis A. in their study proposed the use of a double-bundle graft for fixation of the PCL to improve treatment outcomes [4].

Mohammad et al compared the results of one-stage and two-stage treatment of cruciate ligaments of the knee in their study. In 27 out of 41 patients, ligament reconstruction was

performed in one stage (group I), and in the rest in two stages (group II). Two eligible follow-up patients were assessed with the IKDS and Lysholm scale, drawer test, and range of motion was measured. All criteria were similar with a slight advantage of group I. But the author noted that "Single-stage operations are preferable because of the reduction in the duration of rehabilitation, patients are allowed full load after 9 months" [26]. A recent report by Brain C. (2022) showed that one-stage multiligament knee surgery resulted in fewer complications and reduced overall costs compared to two-stage treatment [10].

As noted above, injury to both cruciate ligaments is rarely accompanied by nerve and vascular injury [24]. In urgent vascular injury, the first priority is to prevent damage and repair the vessel [36]. In the following stages, the ligaments of the knee joint are restored. But with a rupture of both cruciate ligaments, without emergency conditions, there is a disagreement on the timing of the operation. Some authors recommend early surgical reconstruction of the ligaments [36,27], others believe that early surgical intervention is the cause of arthrofibrosis [36,19]. William et al., in 2009, analyzed 396 cases of surgery in patients with multiligament knee injury, including ACL and PCL rupture. A study showed complications such as instability, loss of flexion, and the likelihood of reoperation increased after delayed operations [27]. In delayed cruciate ligament reconstruction surgery, there is a possibility of cartilage and meniscus damage. According to Norwegian scientists, the risk of cartilage damage increases by 1% every month before surgery. French scientists, in 2021, conducted a meta-analysis (results of early and delayed operations on the knee ligaments), the conclusions showed that delayed operations not only increase the risk of cartilage damage but also lead to a decrease in the Lysholm score [36].

Another challenge for surgeons is to select a suitable graft for knee ligament repair. To date, there are a number of artificial and allografts, which have their own advantages and disadvantages. The advantage is that they reduce the time of the operation, less traumatic for patients, strength. But availability, shelf life, cost, and potential for disease transmission are disadvantages of such transplants [43,23]. Given these factors, many surgeons prefer to use autografts. As an autograft, the tendon of the fine muscle, the tendon of the four heads of the thigh muscles, the tendon of the semitendinosus muscle, the Achilles tendon, the bone tendon of the patellar tendon bone (BTB), the hamstring are used. Some surgeons recommend removing the graft from the healthy leg. But is it safe? In the study, Ibrahim et al used a hamstring from both legs while simultaneously injuring the ACL and LCL. As a result, one patient had a hematoma at the site of graft sampling in a healthy limb. Similar studies, Karsut et al., Zhao et al., observed complications such as: long-term pain, atrophy [42]. During the study of literature data, it was revealed that earlier some authors performed lavsanoplasty for one-stage plastic surgery of the cruciate ligaments of the knee joint [13].

The outcome of the injury is often unsatisfactory due to inadequate rehabilitation measures. Even after successful surgical intervention, the appearance of contracture, instability is often associated with rehabilitation [1]. At the moment, much attention in scientific research is directed to the treatment of rupture of both cruciate ligaments, but there is not enough information about rehabilitation methods and postoperative administration of patients [27]. Jacob et al recommended immobilization and weight restriction up to 6 weeks after surgery to protect reconstructive grafts. Another meta-analysis by Mook et al reported that early mobilization reduces the risk of posterior instability [19,30,35].

4. Conclusions

Thus, at present, there are different methods of plastic surgery of the anterior and posterior cruciate ligaments, each of them has its own advantages and disadvantages, has its adherents and opponents. All methods of surgery for the simultaneous restoration of the ACL and LCL are high-tech and are performed in a minimally invasive way using arthroscopic techniques. To date, for the surgical treatment of sagittal instability of the knee joint with cruciate ligament rupture, allo- and autografts are more often used. A large number of the above-mentioned surgical interventions for rupture of the ACL and LCL of the knee joint and the existence of unsatisfactory results prompt orthopedic surgeons to find new methods and techniques of surgery, to develop a rehabilitation program for torn ligaments of the knee joint. In our opinion, the main goal in the development of surgical interventions for rupture of the anterior and posterior cruciate ligaments of the knee is to find the optimal surgical method for the restoration of the cruciate ligaments of the knee, select a suitable graft, and prevent sagittal instability or contracture of the knee joint.

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