

The Factors Causing Knee Joint Strain in Sports and the Prevention

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Abstract: Knee joint strains are common in the knee joint injuries caused by sports project. Knee joint strain refers to subtle nutrition metabolic disorder induced by local fatigue of knee joint and micro-tissue damage caused by different loading cases when anatomical structures of knee joint has excess load in sports. Knee joint strain occurs frequently in causes of transition during acute phase, stop of training for many years, improper special auxiliary exercise and early special training. The general reasons are incorrect body posture, shortage of lower limb muscle strength, lack of muscle ligament relaxation or improper footwork swaps in sports. Injuries of patella, patellar ligament and meniscus are common in knee joint stain. Because of the difficulty of curing knee joint strain, positive prevention is the best measure to reduce the phenomenon of knee joint strain and the strain degradation.

Keywords: Knee joint strain, Ligament, Meniscus, Prevention, Sports.

1. INTRODUCTION

Knee joint strains are common in the knee joint injuries caused by sports project. Knee joint strain refers to subtle nutrition metabolic disorder induced by local fatigue of knee joint and micro-tissue damage caused by different loading cases when anatomical structures of knee joint has excess load in sports [1]. The clinical manifestations of knee injuries show integrated different degree of pain. In early stage, it shows that knee is sour and soft when someone has load; but in middle stage, it shows there's articular cavity effusion and feeling cold around the knee joint which is swelling, of pain and dysfunction. What's more, it shows cartilage necrosis, granulation tissue fibrosis, calcification and tendon of fibers hyperplasia, muscle imbalance, resulting in the pathological injury of joint [2, 3]. Knee injuries were caused by injury of long-term accumulation of fine structure, so it is difficult to cure [1]. Therefore positive prevention is the best measure to reduce the phenomenon of knee joint strain and the strain degradation. This paper attempts to study the causes of knee joint anatomical structure of knee joint degeneration mechanism and training of knee joint injury, and puts forward the preventive countermeasures.

2. THE ANATOMICAL STRUCTURE OF KNEE JOINT

Knee joint consists of femur, tibia, patella and fibula, its stability mainly depends on the support of soft tissue structure, including the static stability structure, such as cruciate ligament, joint capsule, ligament and meniscus, and the dynamic stability structure, which consists of muscle system (Fig. 1). At the outbreak of force condition, maintain the stability of structure function such as cruciate ligament,

ligament is easy to damage. Knee joint consists of two joint contact surfaces, which are the tibia articular surface and the patella articular surface. When walking, the maximum axial force is 2.3~7.1 times of the weight of tibia, patella joint force in normal gait is 0.2~1.8 times of the weight, but in running or jumping it can be increased to about 11 times of the weight. Stress is larger, easy to produce the articular cartilage of the acute injury and chronic injury, femoral condyle and tibial condylar structure [4, 5].

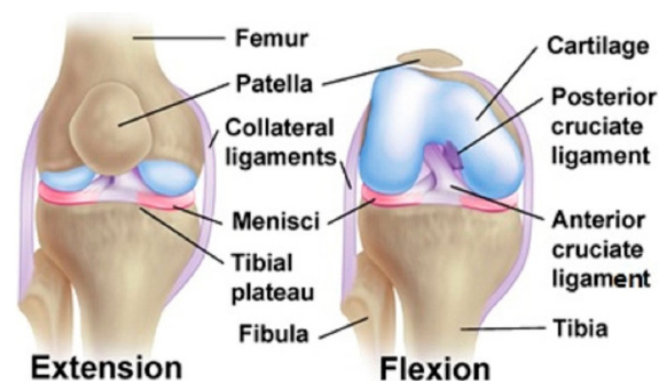


Fig. (1). The anatomical structure of knee joint.

The main function of the knee joint is flexion and extension movement. In the process of flexion and extension, it shows internal and external rotation, varus-valgus rotation, front-rear and inside-outside displacement. When the knee is flexional, tibia takes internal rotation relative to the femur part. On the contrary, when the knee is extensional, tibia is equivalent to generate external rotation of femoral. If excessive flexion and torsion action, it is easy to cause the injury of knee joint, including the tear of ligament, meniscus and articular cartilage. Knee joint often has great weight load of activities, and excessive exercise can cause chronic strain, especially the strain of articular cartilage, causing pain and joint degeneration [6].

3. CAUSES, TYPES AND MECHANISM OF KNEE JOINT STRAIN

3.1. The Causes of Knee Joint Strain

We have 34 cases of knee joint strain caused by five factors of investigation and statistics, see Table 1.

Table 1. Thirty four cases of knee joint strain which are caused by five factors.

| Factors | Number of Injuries | Strain Rate/% |
|-------------------------------------|--------------------|---------------|
| Transition during acute phase | 11 | 32.4 |
| Stop of training for many years | 8 | 23.5 |
| Improper special auxiliary exercise | 6 | 17.6 |
| Training and competition | 5 | 14.8 |
| Early special training | 4 | 11.7 |

3.1.1. Transition During Acute Phase

The treatment of acute knee joint injury, often take the non-operative therapy, if the function is arranged properly, it will turn into chronic strain. Take medicine, physical therapy and physical therapy and other means in the non-operative therapy, but the empirical theory and ontology used macro damage recovery of sensory evaluation, fuzzy, not completely cure. If the exercise and training load increased after injury, ligament and tendon, bone, nerve, blood capillary and micro structure, at the same time, due to anatomical structure of knee joint nutrition blood normal compensation is damaged, the damaged cells can't be restored, update, repair, micro damage accumulation of the formation of recurrent knee joint strain [7].

3.1.2. Stop of Training for Many Years

After stop of training for many years, the micro structure and the bone of knee joint should be quality greatly, ligament function, extension, flexor strength movement system decreased, but the movement skill the forgetting curve decreased slowly. If the strenuous exercise, sports system and the quality of the nervous system reaction step, after the completion of some difficult technical support, against the strong, easily induced chronic recurrence and knee strain injury.

3.1.3. Improper Special Auxiliary Exercise

Special auxiliary exercises can improve the establishment of special sports skills and related agonist, cooperation, fixed muscle, muscle against muscle coordination development, enhance the bone, ligament stress support. But the special auxiliary exercises of special structure of knee joint motion, link, flexion, extension of small muscles, ligaments, meniscus support anatomical structure such as the relative local load is too large, causing the accumulation of micro damage, resulting in knee joint strain [7].

3.1.4. Training and Competition

The characteristics of modern sports is sports technique structure change of athletes fast, nervous system excitability

and strain capacity, the knee, the link stress change fast; another feature of modern sports training cycle is shortened, the increase in the number of matches, which require athletes to complete the difficult skills in a relatively short period of time in the. The knee overload, the negative after the recovery period is short, the accumulated fatigue can't recover in time, or for a breach of rule by local acute knee injuries, and no attention to active treatment, to continue the game, will lead to knee joint strain.

3.1.5. Early Special Training

The children have not enough bearing capacity in development stage, especially the epiphyseal ossification is not over, early specialized training of knee joint local overload of epiphyseal ossification [4]. Patellar ligament tibial epiphysis distraction by extension and flexion of the knee joint often makes the damage and fatigue of the epiphysis of the tibia micro-tissue or the micro-organization around it, resulting in knee joint strain.

3.2. The Type and Mechanism of Knee Joint Strain

In training or competition, knee joint is often in a semi knee flexion, and the laxity of ligament decreases stability of joint. At the same time, the stability of knee joint patellar and femoral head mainly by four muscles to maintain. Patella aponeurosis and tendon can withstand pressure stretching patellar articular surface tension and the corresponding bearing is very large. Therefore, knee flexion support load than the upright to a large, easy to produce fatigue. In the movement, the injury of knee joint can be caused by the incorrect body posture, shortage of lower limb muscle strength, lack of muscle ligament relaxation or improper footwork swaps.

The sports injury of knee joint includes severe fracture and dislocation, ligament and meniscus injury, but often is cartilage, ligament, tendon and bursa injury caused by chronic strain. Therefore, sports doctors, coaches and teachers and students in colleges should have certain knowledge to deal with the knee joint strain in sports. Table 2 shows the status of sports injury of the knee joint in some sports events [8].

Knee joint strain often includes injuries of patella, patellar ligament and meniscus.

3.2.1. The Injury Mechanism and Symptoms of Kneecap Strain

Patellar strain refers to cartilage disease of the system and the patella strain. The injury incidence was highest in basketball, volleyball athletes. The main burden of knee joint is long-term excessive or repeated micro damage accumulation, but also by the local suffered a shock and traction caused by. Especially with the knee in a squat position, because the ligament relaxation, decreased the stability of knee joint, the knee stability depends mainly on the patella and femoral head four muscles to maintain, pull the tension and patellar ligament and fascia suffered femoral articular surface, corresponding to the large compressive stress [9]. If making force or torsion and tension in jump squat position, pulling more of patella aponeurosis under a nearby area, the articular surface of the patella dislocation will be

Table 2. Several kinds of sports injuries of knee joint.

| Types | Gymnastics | Jump | Throw | Running | Basketball | Football | Percentage/% |
|------------------------------|------------|------|-------|---------|------------|----------|--------------|
| Patella osteomalacia | 5 | 7 | 6 | 9 | 19 | 0 | 26.99 |
| Patellar tendon inflammation | 5 | 10 | 0 | 2 | 9 | 0 | 14.16 |
| Meniscus tear | 6 | 3 | 3 | 4 | 5 | 1 | 13.72 |
| Lateral knee pain syndrome | 2 | 0 | 1 | 4 | 4 | 2 | 14.16 |
| Fat pad injury | 4 | 6 | 1 | 3 | 3 | 0 | 1.5 |
| Ventral ligament damage | 1 | 4 | 0 | 0 | 1 | 2 | 3.98 |
| Traumatic sex arthritis | 1 | 0 | 0 | 1 | 3 | 0 | 3.54 |
| Patellar fractures | 1 | 0 | 0 | 0 | 0 | 0 | 0.45 |
| Others | 1 | 0 | 2 | 1 | 5 | 0 | 6.19 |

twist, impact and rubbing. If the force exceeds the physiological load cells, it will affect local metabolism, which causes the tissue and cell degeneration and necrosis, and then causes a series of pathological changes, such as hemorrhage, degeneration, calcification of tendon fibers and swelling, cracking, peeling of cartilage cell [10].

3.2.2. The Mechanism and Symptoms of Medial Collateral Ligament Injury of the Knee Joint

Knee joint ligament on both sides have strengthened, in order to limit the knee varus or valgus. The medial collateral ligament was a bottom triangle bridge forward between the femur and tibia condyle and internal condyle. In the knee extension or flexion, medial collateral ligament are relatively tight, only in the semi flexion (150 degrees) when the relative relaxation. The medial collateral ligament is relatively weak but of very important function, can prevent the abduction and external rotation of the leg, which is an important

means to maintain the stability of the knee, and other injuries of the knee in the portal [11-13].

3.2.3. The Mechanism and Symptoms of Knee Joint Meniscus Injury

When the knee is in flexion in sports, the knee medial meniscus would be damaged caused by leg fixed on the abduction, external rotation, internal rotation and adduction and thigh suddenly. If the leg is fixed on the thigh adduction and internal rotation, external rotation and abduction of a sudden may cause injury of lateral meniscus. In addition, the knee joint extension of suddenly with tendon can cause the position of meniscus injury or meniscus edge separation (Fig. 2) [14].

Meniscus injury is often associated with synovial injury, or meniscus synovial activities stretch caused severe pain, especially in the injured side was significantly. Blood swelling appears in the early stage due to acute traumatic

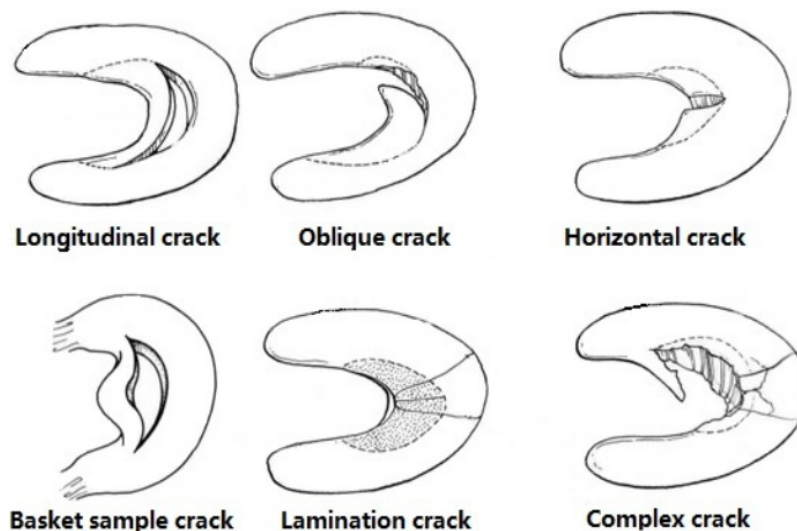


Fig. (2). The types of knee joint meniscus injury.

synovitis and joint ligament injury, while a small amount of effusion may appear in chronic stage because of meniscus abnormal activities stretch synovial [15]. Crisp sound can be heard at injury side accompanied by pain when knee joint activities. In walking or doing a movement, the "locking" phenomenon that knee joint can't make flexion and extension will appear because of the rupture of the meniscus and being stuck in the femoral condyle and the platform.

4. PREVENTION OF KNEE JOINT STRAIN

Li's study shows, the proportion of knee joint injury in sports injury of college students caused by sports activities accounted for 25.4% [14]. In sports, athletes need to use knee to stop, turn and jump for long time and high strength, which tends to cause the injury of knee joint. In addition, the complexity of the knee joint structure determines its slow and difficult repair. The damage of a small structural of knee joint will affect the work capacity of the whole joint and the quality of muscle action. Therefore, prevention of knee joint injury is particularly important, especially pay attention to the prevention of injury in the usual teaching and training [16].

Countermeasures to prevent knee injuries are listed by: (1)dynamic and static exercises in preparing stage, stretching the knee flexor extensor and link, enhancing the elasticity and flexibility of the knee joint muscles; (2)enhancing the extension, flexor strength, elongation, and paying attention to the coordinated development of the flexor muscle strength; (3)reasonable arrangement of movement rhythm load, and relaxing the stock four muscles after the load in time; (4) testing knee joint injury in acute stage by various methods, such as X - ray, swing, grinding test, to evaluate the function of knee joint and treat it thoroughly in the acute phase; (5)avoiding doing some complex action, which needs knee joint to support, after years of training.

4.1. Strengthening the Strength Training of Quadriceps

Strengthening the strength training of quadriceps is of important significance for prevention and treatment of knee joint injury. Specific methods are: knee extension and flexion, going stairs, squat, squat jumping, squat standing, static weight squats or resistance joint activities [17].

Methods of strengthening the strength training of quadriceps are:

(1) Autonomous exercise of quadriceps: sit, then in the knee extension state, the lower extremity is lifted, and based on the enhancement unit four biceps strength and increase the suspended weight [18].

(2) Static squat: this method is a basic skill in Wushu athletes, which has certain effect to enhance the muscle strength of quadriceps. Practice is the feet shoulder width apart, toes and knees toward the front knee squat, semi-squat about 130 degrees, upper body upright, center of gravity slightly back, don't slam the chest abdomen, neck relaxed, head upright, shoulders relaxed, arms straight in front, back extension, to bend or hand hold on the thigh, breathing should be uniform. After maintaining this posture for 20 minutes, gradually reduce the squat angle (but not less than 90 degrees), or use a

squat to increase the intensity of exercise, and the weight load increases gradually from 20 kg to 50~60 kg.

4.2. Paying Attention to Protection of Sports

(1) Before exercise, athletes should make full preparations, improve joint flexibility, strengthen the awareness of protection and self-protection, to prevent sports injury. Don't participate in strenuous exercise or reduce the amount and difficulty of exercise when tired.

(2) During exercise, athletes should grasp the right movement technology, such as grasping the take-off and landing, not in a squat position long time weight training, not too much to repeat the exercise, avoiding excessive fatigue of lower extremity; pay attention to the environmental health, should not be in the field of excellent, especially the cement and asphalt for running and jumping exercises; minimize the collision of knee. Raise awareness of self-protection and protection in the process of movement. Stress on morals, abide by the rules, not be flagrant foul to others, not do dangerous actions.

(3) After exercise, athletes should wipe sweat on the knee, pay attention to keep warm, avoid cold and dampness invasion, especially should not take cold bath; do relaxing activities, timely terminate local fatigue, do self or mutual massage.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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