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ANKLE INJURIES. DIAGNOSIS, PREVENTION AND SURGICAL TREATMENT

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ABSTRACT

The incidence of ankle injuries is extremely high. Football, baseball, basketball, volleyball and rugby players as well as gymnasts are most exposed to them. The most common ankle injuries are sprains. The majority of them are not severe albeit the severe ones lead to long-term immobilization, intensive rehabilitation and can be associated with incomplete recovery. The aim of the present paper was to describe injuries of the tarsotibial joint and to characterize diagnostic and preventive management based on the available literature and our experiences. Clinical examinations and tests are useful for the diagnosis of ankle injuries. Sprains are generally treated with full limb support, rest, cold poultices and elevation of the affected limb. In factures, surgical treatment depends on their stability.
Early ambulation after surgery hastens the return to physical activity, reduces the risk of re-fractures and accelerates tissue healing. Many sports injuries can be avoided the activities are deliberately supervised, rules followed, protective clothes and equipment as well as proper training used.
Key words: ankle injuries, diagnosis, prevention, surgical treatment.

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INTRODUCTION

The incidence of ankle injuries is very high. According to estimates, they affect about 6% of all active young individuals, particularly those involved in sports. Football, basketball, baseball, volleyball, rugby players and gymnasts are most exposed to them [1].

The risk factors of ankle injuries include obesity, diabetes mellitus and types of physical activities.

The most common ankle injury is its sprain. It is believed that the majority of ankle sprains regard articular lateral ligaments.

Supination- and inversion-induced injuries damage the anterior joint capsule, anterior talofibular ligaments and calcaneofibular ligaments. Lateral injuries to the group of ligaments result from supination and tibiofibular sprains from dorsiflexion of the foot; 1-18% of ankle sprains are accompanied by tibiofibular syndesmosis [2].

The majority of such injuries are not severe; however, 1/3 of them require fixation. More severe sprains are associated with long-term immobilization, intensive rehabilitation and can lead to incomplete recovery [2].

The aim of the study was to describe tarsotibial injuries and to characterise diagnostic and preventive management based on the available literature data and our experiences.

ANKLE SPRAINS

Tarsotibial sprains involve the capsular disruption without dislocation of articular surfaces [5]. They occur in 14-33% of all sports injuries and most commonly result from landing with the lower limb gliding in plantar flexion and foot inversion. The above mechanism induces strain or complete disruption of soft tissue structures, i.e. the articular capsule and ligaments. The most frequently injured ligament is the anterior fibulotarsal ligament. The mechanism of injuries to the medial ligament involves plantar flexion with inversion[3].

Three degrees of tarsocrural sprains are distinguished. In the first-degree sprains the ligaments are injured, the function is slightly impaired, slight pain, swelling and tenderness of peri-articular tissues are experienced yet there is no mechanical instability.

The second-degree sprains involve partial ligament injuries and are characterised by the lack of mobility and function, slight instability, extensive swelling (above 4 mm in the ankle circumference), subcutaneous haematomas.

The third degree sprains are characterised by the loss of ligament integrity, joint function and its mobility. Mechanical instability, large swellings and extensive subcutaneous haematomas develop. Patients experience severe pain [4].

The diagnosis of ankle sprains is based of examinations and clinical tests. History taking is essential as it enables to determine the mechanism in which the injury was sustained as well as observation of patients during lying, sitting, standing as well as active and passive movements with resistance.

Moreover, palpation and several tests, including the anterior drawer, foot inversion, squeeze and external rotation tests, are of importance.

The anterior drawer test assesses the anterior fibulotarsal ligament. The foot inversion test reveals whether the continuity of the fibulocalcaneal ligament is preserved. The squeeze and external rotation tests evaluate the continuity of the tibiofibular syndesmosis.

The additional examinations include X-ray pictures, magnetic resonance imaging, computed tomography and ultrasound procedures.

ANKLE FRACTURES

Several classifications of ankle fractures are available.

The Lange – Hansen classification evaluates the type of fractures based on X-ray picture, including the mechanisms of ligament injuries.

The mechanisms include supination-adduction, supination-inversion, pronation-abduction, pronation-external rotation [5].

The disadvantage of this system is the difficulty the patients have to determine the movement on injury. Arimoto and Ferrester devised an algorithm based on this classification, which should help radiologists to diagnose accurately fractures and disruptions of ligaments [5].

The Danis Webera classification regards fibular fractures and distinguishes three types of them.

Type A involves the distal fibular fractures with unaffected tibiofibular syndesmosis and the median ankle whereas type B – distal fibular spiral fractures extending from the joint line proximally and distally to the fibular diaphysis. In most cases, the tibiofibular syndesmosis is intact. The medial ankle or the posterior border can be disrupted or remain intact. The medial ankle is not broken; the deltoid ligament can be fractured.

Type C includes fractures of the proximal fibula with injured tibiofibular syndesmosis; it also contains medial ankle fractures or deltoid ligament ruptures [5].

The Maisonneuve fracture is not confined to the ankles. Beside the fracture of the medial ankle, the fibular fracture can be observed, sometimes very high. Moreover, the tibiofibular syndesmosis is disrupted, in some cases accompanied by the fibular head subluxation.

The Maisonneuve fracture of the fibula (MF'F) is often considered one of the most unstable ankle injuries, which results from the fact that the syndesmosis and interosseous membrane are damaged from the ankle to the level of fibular fracture. Such injuries result from indirect high-energy damage.

The fracture in question is caused by the pronation-rotation mechanism and leads to injuries of the deltoid ligament of various severities or avulsive fractures of the medial ankle apex. Subsequently, the anterior, distal and interosseous tibiofibular ligament is injured. This results in breaking off the posterior border of the tibia, disruption of the interosseous membrane and tarsotibial sprain [6].

The Maisonneuve fractures can affect multiple sites, i.e. the medial ankle, posterior border of the tibia and proximal metaphysis of the fibula. However, this kind of fracture can injure only soft tissues (including the deltoid ligament, tibiofibular syndesmosis, interosseous membrane and ligamentous-capsular apparatus) of the proximal tibiofibular joint [7,8, 9].

DIAGNOSIS OF ANKLE INJURIES

The most common ankle injuries include epiphyseal, distal fractures of the tibia, tri-plane

cartilaginous-osseous fractures, injuries to the ankle bone, subluxation of fibular tendons, fractures of the base of the fifth metatarsal bone and sprains of the metatarsus. Generally, they are diagnosed based on physical examinations and X-ray pictures.

The functional tests may also prove useful; the most common are the tests of the anterior drawer, forced inversion of the ankle fork trochlea in ½ of the tibia, and anklebone rotation in the joint fork assessing competence of the inferior tibiofibular ligament.

The anterior drawer test is performed by stabilizing the distal tibia with one hand and holding the posterior heel, pressing the heel anteriorly trying to sprain the ankle anteriorly. Extensive anterior protrusion or even detectable shifting of joint surfaces indicates the positive test result [2,10].

The positive anterior drawer test, pain and haematoma suggest transverse disruption of the articular ligament. To establish a reliable diagnosis, the patients should be examined twice: immediately after and 4.5 days after injury [2]. In ankle injuries, the Kleiger's, squeeze, and external rotation tests are applied.

The Kleiger's test is used to determine if there is instability caused by a sprain. The patient is examined in a seated position (at the end of the examining table), with knees bent and feet relaxed non-weight bearing. The physician stabilises the leg above the ankle with one hand and the metatarsus with the other hand and everts the foot. Pain evidences the injury to the tibiofibular syndesmosis [11].

The Squeeze test can confirm the injury to the tibiofibular syndesmosis. It is performed by compressing the fibula and tibia and is considered positive when the pain occurs distally to the tibia and fibula [10]

The external rotation test serves to identify the injuries to the tibiofibular syndesmosis. The patient's knee rests on the table border. The examiner stabilizes the proximal crus; with the other hand he holds the metatarsal region (toes on the plantar side) and rotates the foot exteriorly to the tibia. When this movement is accompanied by pain, the test result is positive [10].

The forced eversion sign enables to assess the superficial layer of the deltoid ligament, particularly the tibiocalcaneal and tibiotarsal parts.

The rotation sign assesses the competence of the tibionavicular part and the deep layer of the deltoid ligament [2,10]

In eversion injuries, the evaluation of the deltoid ligament and inferior tibiofibular syndesmosis is essential.

During the physical examination, it is important to assess the blood flow, which is evidenced by normal flesh skin colour and detectable pulse.

The additional tests to evaluate ankle injuries are ultrasound (dynamic), stress radiograms, computed tomography, nuclear magnetic resonance and arthrography, which is however increasingly rare. In acute injuries, the clinical assessment is optimal when performed immediately after trauma before the development of swelling, pain and muscle guarding. In old injuries and chronic instabilities, the presentation can be inexplicit and requires verification with auxiliary examinations [12].

Imaging diagnostic procedures of ankle injuries should be started with X-ray pictures. The knowledge of radiological anatomy, biomechanics and radiological symptoms of the pathology enables accurate interpretation of X-ray pictures. In many cases, the X- ray graph eliminates the need for further imaging. However, such examinations as computed tomography (CT) and magnetic resonance (MR) are needed to complement the diagnosis of injuries. Routine radiological evaluation of the ankle consists of X-ray pictures in the anteroposterior (AP) projection and „mortise view" (AP picture with external rotation by about 10-20 degrees, where the tibia and fibula do not overlap).

The picture is taken in the axial projection.

TREATMENT OF ANKLE INJURIES

Ankle sprains are usually treated with complete lack of weight bearing of the affected limb, rest, cold poultices and elevation of the limb.

In open fractures, first the wound and then the broken bones should be secured. The fracture stability decides about surgical treatment [13]. The instable fractures include, tri-osseous fractures and some single fractures of the fibula with the fracture fissure visible above 5 mm or widening of the syndesmosis [14].

Surgical intervention should be undertaken within 48 h after injury, which reduces the risk of complications, e.g. blisters or swelling. Moreover, the postoperative hospitalization is shortened. Total statistical hospitalization of patients undergoing surgery within 48 hours after the diagnosis was found to be 5.4 days whereas in patients operated on later – 9.5 days [1].

If the deltoid ligament is injured, its reconstruction should with considered to enable the evaluation of the tarsal and tibial bones as well as the posterior border of the tibia, where bone and cartilage contusions develop.

The reconstruction enables early mobilisation and weight bearing, which stimulates the cartilage growth and collagen repair. If the deltoid ligament injury causes even 1-mm transverse dislocation of the ankle, the common area of the junction decreases by 42%. The lateral dislocation of the ankle by more than 2 mm results in over 90% probability of degenerative changes, unless properly secures [1].

Postoperative complications are similar to those in all orthopaedic surgical procedures and include infections and reactions to the material used for osseointegration [15].

The next stage of fracture treatment is rehabilitation. Mobilisation of the ankle after injury is essential for optimal treatment outcomes [5].

PREVENTION OF ANKLE INJURIES

There are several rules thanks to which people involved in sports can reduce the risk of ankle injuries. Before the training, warm–up exercises to stretch the muscles should be performed. The time devoted to sports activities should be gradually lengthened within several weeks, which enables to increase muscular strength and mobility [16].

One of the best ankle injury preventive programmes is based on the rule of 10 minutes of exercises 5 times a week over 10 weeks on a multi-plane wobbling board.

1) The patient stands on the wobbling board, initially on both legs, and makes rotational movements to the left and right of the hip joints and thoracic spine. The lumbar rotation should be limited.

With time, the patient exercises on one and then the other leg, adding the load, e.g. a ball.

2) The exercises performed as described above, yet the BOSU ball should be used instead of the wobbling board.
3) The eccentric squatting on the flat surface 2-3 times a week; 15 repeats for each limb, in 3 series, gradually increasing the load by holding dumb-bells. The patient standing on one limb swings the other leg forward with the rotation axis in the iliac joint bending the knee of the limb he stands on. Subsequently the patient returns to the initial position and performs further swings at the angle of 45 degrees to the left and right. This kind of exercises enables to obtain the rotation and eccentric work of muscles around the tarsotibial joints. With time, the patient can exercise on the BOSU ball.

Exercises are performed on the platform with about 18 cm slope [16].

DISCUSSION

The ankle joint structure is complex; a number of ligaments, muscles and the structure of articular surfaces and capsules themselves ensure its stability and proper functioning.

Ankle injuries are the most common sports traumas. Ankle sprains are also the most frequent injuries to the osseous-articular apparatus in humans. Sprains result from joint overload in its improper position, e.g. during running, jumping, fast marching over an uneven ground [3].

Sports activities are associated with increased risk of injuries; therefore, prevention is essential. The preventive programmes should be continued after returning to sports activities to reduce the probability of re-injuries. Although complete prevention of sports injuries is unreal, once suitable rules are followed, the total number of injuries can be markedly reduced.

Many sports injuries can be avoided by conscious supervision, following the appropriate rules, protective clothes and equipment as well as proper training. The major elements of training include: dynamic warm-up, functional eccentric training of active stabilizers of the tarsotibial joint and proprioception exercises.

It is believed that early ambulation of patients after surgeries results in quicker return to physical activity and reduces the risk of re-injuries. Moreover, early ambulation is to eliminate negative consequences of immobilization and to accelerate tissue healing.

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