Rehabilitation Following Ankle Arthroscopy

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34.1 Introduction

Ankle arthroscopy (AA) is a surgical technique widely used for many diseases [1]. The first description of AA was reported in 1931 by Burman [2, 3]. Unfortunately, this first attempt for ankle joint arthroscopy in vivo failed. The author justified the failure with the fact that, in his opinion, the ankle joint was not suitable for arthroscopy because its interarticular access was too much narrow. We had to wait until the 1970s, when the technology concerning the optic fibers, which are part of the arthroscopy devices, substantially improved. Consequently, this technical improvement was described by Watanabe [4] in the early 1970s in the first AA series, which consisted of 28 surgical interventions. Several more publications followed, and nowadays AA represent an irreplaceable diagnostic and therapeutic instrument. In orthopedic practice, the most frequent AA indications are the treatment of anterior impingement syndrome, talar osteochondral defects, removal of loose bodies and ossicles, adhesions, and synovitis [1, 5, 6].

34.2 Rationale of Rehabilitation Following AA

The rationale that guides the rehabilitation following AA should be based on three main points:

1. Improving joint stability and proprioception.
2. Improving muscle strength.
3. Improving range of motion.

These three points are strongly interconnected and interdependent. In fact, during all movements such as running, sprinting, jumps, and change of direction, the ankle joint and its extrinsic and intrinsic muscle–tendon units are subjected to stresses that require an optimal proprioception, a high level of coordination, a significant production of strength, and a full range of motion (ROM). Thus, a loss in any of these biomechanical characteristics may cause a restriction or a true deficit during sport activities. For this reason a rehabilitation program following AA should not only necessarily be based on the these three points but the rehabilitator should be able to identify the point/s that show/s more deficit and build a specific rehabilitation path.

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34.3 Improving Joint Stability and Proprioception

Proprioceptive training (PT) represents a fundamental rehabilitation method after AA [7]. Nevertheless, PT is usually based on proprioceptive exercise performed in a semistatic condition or, at least, in low dynamic conditions (i.e., exercises performed in single-limb stance, balance-board exercises, and coordination exercises performed on teeter boards, etc.) [8, 9]. However, there are no precise indications in the literature, or any kind of consensus, indicating the exact dosage, intensity, and frequency of the PT [10]. However, it is generally accepted that to achieve a positive outcome, PT should be performed for a minimum period between 4 and 6 weeks, for three to five weekly training sessions [8, 9]. But at this point, in our opinion, it is important to offer a constructive criticism concerning PT in its classic interpretation. As previously mentioned, PT is usually performed at low execution speed, easily controllable by the subject, and, sometimes, in visual feedback conditions with the use of specific computerized equipment. These training situations are not only facilitated by, but enormously different from, those that may be found during sports activities. Indeed, it is important to underline that the muscular responses against an external stress are of three types:

1. A “reflex type muscular response” that shows a medium latency response and needs about 60 ms for its execution.
2. A “reflex type muscular response” that shows a long latency response and needs about 140 ms for its execution.
3. A “voluntary type muscular response” that requires not less than 200 ms for its execution.

In addition to this, it should be remembered that all human movements can be managed in two different modalities: open circuit modality (OCM) (Fig. 34.1) and closed circuit modality (CCM) (Fig. 34.2) [10]. During the movement realized in CCM, the information transmitted to

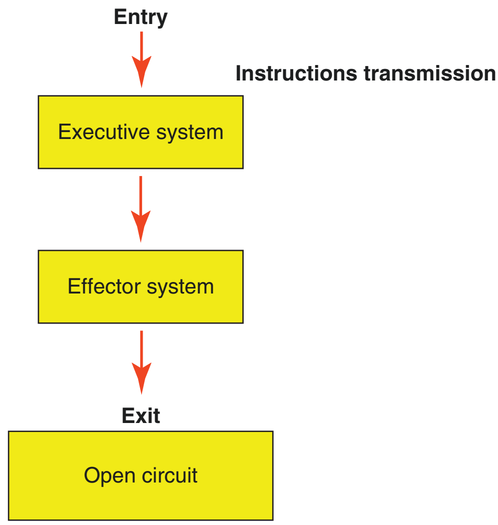

Fig. 34.1 The open circuit modality (OCM) is typical of very fast action. In OCM the transmission shifts directly from the execution system to the effector system, without being able to perform a corrective feedback mechanism

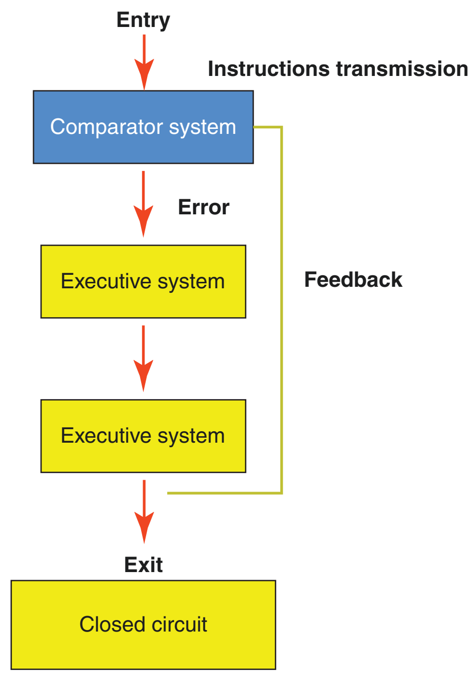

Fig. 34.2 In the closed circuit modality (CCM), the outgoing movement is continuously returned for the control of action to the comparator system that, through a feedback mechanism, is able to correct the movement during its execution

the central nervous system (CNS) is sent directly to the effector system (i.e., the muscle–tendon unit, MTU) without correction during the movement. Conversely, during a movement realized in OCM the information transmitted to the MTU is filtered by the so-called comparator system (CS). The CS compares the movement execution during its course and, if necessary, changes the movement in intinere. It is important to underline that only the movement performed with a voluntary muscular response (>200 ms) may be carried out by OCM. For this reason, if we consider that if an external force is applied on the ankle joint, the "failure time" (i.e., the time required to the mechanical rupture) for the anterior talofibular ligament is approximately 30 ms and the time required to perform a voluntary response able to counteract the inversion movement is approximately 215 ms [10, 11], it is clear that the protective effect offered by a classic PT is ineffective. In such dynamic conditions the only effective solution for stabilizing the ankle joint is to increase the stiffness of the ankle MTU. The increase in stiffness may be obtained through the systematic execution of dynamic proprioceptive training (DPT) [10]. You can find some example exercises in Video 34.1, scanning via QR code. The DPT is based on proprioceptive exercise, performed under a single form or circuit, inducing a preactivation of the MTU ankle joint and increasing its stiffness. This stiffness increase makes the ankle joint most stable and best suited to withstand violent and sudden mechanical stresses. It is clear that DPT represent the last step of PT and must be proposed only after a correct progression training. An example of DPT is observable in the following films.

34.4 Improving Muscle Strength

The foot has a total of 32 muscles, 13 of which are intrinsic and 19 are intrinsic. The intrinsic muscles are those most implicated in the force generation of the talotibial and the subtalar joints [12]. The movements generated by the foot muscular complex are dorsal and plantar flexion and the inversion and eversion movements. Furthermore, the soleus and gastrocnemius muscular complex shows the most important propulsive function and consequently are the strongest plantar flexors [12]. Many sport activities require great foot muscle force level [13]. During sport activities based on running, sprinting, jumps, and cutting movements, both maximal strength and stamina are required [14]. Furthermore, it is important during the rehabilitation plan to obtain an optimal balance between agonist and antagonist muscles. Indeed, an incorrect muscular balance between eversion and inversion muscles (with the eversion muscles too weak in comparison to the inversion ones) may predispose the subject to lateral ankle ligament injuries [15]. We must consider that the immobilization period after AA and the resulting reduced muscle activity cause a sharp weakening of the foot muscles. The degree of muscle atrophy and weakness is related to the duration of the immobilization period and the position in which the immobilization is performed: with the muscles immobilized under tension, atrophy is significantly less than when they are immobilized in a relaxed position [16]. It is important to note that a joint effusion also may cause a reduction in muscular strength as well as in pain [17]. For all these reasons, strength training should start as soon the clinical condition of the patient permits the beginning of muscular application.

Isometric strength training could start when the patient is pain free. The strength training in concentric and eccentric modalities should be started only when the patient is pain free and shows full ROM. In any case, it is important to remember that a reduction in muscle strength may persist for years after the AA because of the mechanism of reflex inhibition caused by disuse [17].

34.5 Improving Range of Motion

A reduction of ankle ROM may penalize participation in many sports activities and even make some of them impossible. In any case, a strong reduction of ankle ROM may interfere with normal daily living activities. For example, if the subject is not able to dorsiflex the ankle joint at least 10° beyond the neutral position, lameness will be seen during normal walking. In the literature, the passive ROM of the talotibial joint (TTJ) varies in relationship to the different methods used in the different studies. The TTJ dorsiflexion values are between 10° and 23° and the plantarflexion values vary between 23° and 48° [18]. It is important to remember that the most important restraint concerning passive dorsiflexion is the stiffness of the Achilles tendon, whereas in passive plantarflexion the main restraint is represented by both the stiffness of anterior MTUs and posterior bony impingement [18]. Regarding the subtalar joint (STJ), it important to note that it rotates around a biomechanical axis that is continually changing during ankle and foot movement. In the sagittal plane this axis shows an inclination equal on average at 42° with a medial deviation; if observed in the horizontal plane, it is equal on average at 32°. The STJ passive ROM is on average 30° in inversion and 10° in eversion [19]. If the purpose of AA was to remove the cause or causes of ROM restriction, the purpose of the rehabilitation plan will be to restore the normal ROM. In any case, is important to underline the fact that any type of AA causing a period of relative immobilization (that causes capsular contracture and an increase in passive muscle/tendon stiffness) reduces both passive and active ankle ROM. For this reason, ROM recovery is an important step of the rehabilitation following AA. The recovery of the passive ROM is based on so-called joint manipulations (JM). In general, the JM techniques such as the Maitland mobilizations [20], the Mulligan mobilizations [21], and high-velocity/low-amplitude thrusts [22, 23] seem to give the most important evidence of effectiveness concerning the ankle joint. Some studies report an immediate improvement of the ankle passive and active ROM following a single session of manipulative therapy carried out immediately after the removal of the immobilizing cast [24]. However, we must remember that in the current literature studies that compare the effectiveness of the various mentioned manipulative therapies are lacking. Finally, we would like to report that the weight-bearing lunge test (WBLT) is an interesting and reliable test to measure ankle dorsiflexion during weight-bearing [25].

34.6 Conclusions

The rehabilitation plan following AA must necessarily be based on the need to improve stability, proprioception, strength, and ROM of the ankle. Furthermore, it is particularly important that the rehabilitation plan is based on the joint biomechanical requirements of the sports activity carried out by the patient. Unfortunately, to date there are no studies in the literature comparing the effectiveness of the various rehabilitation plans used. For this reason, more studies with good evidence that clarifies the various aspects of the problem are required.

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