Sports Rehabilitation

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9.1 Introduction

Sports injuries, such as damage to the muscles, ligaments or bone, often require surgery as well as a developed rehabilitation protocol. The rehabilitation process should be focused on the initial diagnosis of the injured athlete and include a wide number of therapeutic approaches. The primary aim is a return to sports at a preinjury physical and emotional level and, with injury, prevention as key point. However, tissue healing after injury as the natural healing process should be considered while developing a rehabilitation programme.

Focuses on sports rehabilitation are physiotherapy, performed by an experienced therapist, medical training therapy and sports-specific training. Further therapies such as ergotherapy, massage, electrotherapy, hydrotherapy, kinesiology and osteopathy should be considered individually in each rehabilitation protocol. Modern rehabilitation protocols require teamwork and proper rehabilitation planning, with sports physiotherapist and sports physician in leading positions. The team should be completed by an experienced athletic (strength and conditioning) coach and, in some cases, a sports psychologist and a dietitian.

Close coordination with trainers and coaches and the understanding of injury and subsequent problems by athlete and coaches are key in each rehabilitation protocol. Injury prevention during the reconditioning phase is crucial and requires data maintenance by teams and trainers.

Rehabilitation protocols should be focused on early passive mobilization considering the initial diagnosis of the patient. An experienced physiotherapist should guide the patient through the different phases of rehabilitation. Understanding the sports, biomechanical and physiological demands are crucial.

Rehabilitation includes immediate immobilization up to early, passive postoperative and early active exercises such as shoulder pendulum exercise or slight knee extensions/flexions. Meta-analyses of randomized clinical comparative studies showed no significant differences between early and delayed passive exercise in terms of clinical outcome and re-rupture rate regarding shoulder injuries. The full range of motion (ROM) can be achieved more quickly after early passive exercise. However, early aggressive active exercise can affect the healing and should not be performed in the first weeks after injury or surgery. Athlete and therapist should take into account the change of biomechanical properties of the injured part of the body in the first weeks and months. The length of immobilization varies

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between 4 and 8 weeks. The orthosis can be used to avoid aggressive active exercise or inappropriate movements, especially in patients with reduced compliance. Regarding shoulder injuries such as rotator cuff lesions, studies showed increased blood circulation in the repaired tendon and significantly reduced stress on tendon-suture construct in patients with abduction (15–45°) orthosis. Therefore, immobilization in slight abduction should be considered.

Recent studies investigated different rehabilitation approaches, especially in patients suffering from ACL injuries. Criterion-based protocols seem to be significantly superior in athletes after undergoing ACL surgery than time-based protocols. Time-based protocols are standardized rehabilitation protocols with fixed time tables and deadlines. Patients undergoing a time-based protocol seem to undergo less physiotherapy and shorter rehabilitation time which leads to a quicker return to sports. Risks and complications such as ACL elongations, re-rupture or injuries can be the causes. Patients undergoing criterion-based programmes need to achieve fixed goals in order to proceed in their rehabilitation. For example, running can only be allowed after finishing strength or coordination training. This leads to a more individualized rehabilitation protocol, taking into account the different characteristics of the athlete as well as the initial diagnosis, in order to decrease potential injury risks.

9.2 Physiotherapy

The first principle of the rehabilitation should take into account the different diagnoses and surgeries of the injured athlete. Physician or surgeon should define a postoperative protocol for the upcoming weeks which takes into account the different stages of wound healing, as well as the biomechanical aspects of the sport, injury and/or surgery.

The second principle pays careful attention to signs or indications of progressive overload, overtraining or stress. First hints of overloading can be signs of inflammation such as dolour, rubor, calor, tumour or functio laesa. This also includes general symptoms of exhaustion and fatigue (tiredness, fatigue, lack of motivation), caused by too much training or too intense rehabilitation.

The third principle of a rehabilitation protocol is seen as the "cause-effect chain". In other words, rehabilitation should take into account the complex reactions and compensation strategies of the body after injuries or surgeries.

As injured athletes tend to be impatient after long injuries or absences from sports activities, secondary dysfunctions seen as the "cause-effect chain" can cause problems during rehabilitation. The body and the related diagnosis or surgery should be seen as a whole complex unit. Injured parts of the body are linked to physical dysfunction in a chain of effects. An experienced therapist has to take care of dysfunctions and include them in training.

Core stability is seen as the fourth principle in physiotherapist protocols. A well-trained core is essential to optimal force flow in the kinetic chain (Figs. 9.1 and 9.2), as all the force couples are generated from our core. Injured athletes should be aware of the importance of core stability and

Fig. 9.1 Training of the leg axis with combined training of core strength

Fig. 9.2 Proprioceptive training of the lower extremity

include coordination, core strength and functional training in their rehabilitation protocol.

The fifth principle includes continuous communication between the patient and the whole rehabilitation team such as physiotherapist, physician or coaches.

The athlete should be informed in detail about his injury, the biomechanical aspects of his injury/surgery or the planed therapies. The more the patient brings understanding about the details, the higher should be the compliance, especially in activity restriction or absence from sports.

As those five principles are the spine of each rehabilitation protocol, physiotherapist should be aware of compliance, subjective feeling and pain of the athlete. Furthermore, each rehab can be classified into four phases. Immediately after injury or surgery, the first phase is defined as the post-injury or acute postoperative phase. During this time, the importance should be set on rest and reducing inflammatories such as swelling with ice and cold therapy and compression. Medication can also be taken into account. Recent studies also showed the importance of clean and healthy eating and adequate water supply during this time. This can help to eliminate metabolites much faster and increase recovery time.

Soon after completing the first phase, the inflammatory phase in injured athletes starts. Anti-inflammatory measures can also be applied.

The proliferation phase is seen as the third phase in physiotherapy. While starting with mobilization, the therapist should start with light endurance activities in order to increase the oxygen input.

Functional training and return to sports-related activities or movements are seen as the remodelling phase.

In summary, therapist and athlete should work on individual rehabilitation protocols with the main focus on personal aspects of the injured patient. All the activities should be performed without greater pain (VAS 1–3). Communications between all people included can prevent overtraining, dysfunction or reduced compliance.

Key Facts

- Criterion-based protocols are superior than time-based protocols.
- The five principles of physiotherapy are diagnosis, indications of overload, cause-effect chain, core strength and communication between athlete and rehabilitation team.

9.3 Manual Therapy

While completing the different stages of physiotherapy, the rehabilitation process is enhanced by manual therapy. Manual therapy involves examining, detecting, assessing and treating reversible disorders of the locomotor system. This means that the therapist must be familiar with the mutual influence of arthrogenous, muscular and neurogenic structures, filter out the primary symptomatic structure, consider possible contraindications and recognize the sensitivity of the structure to be treated, in order to be able to draw up an individual treatment plan. Medical training therapy is an equipment-supported form of training for

Fig. 9.3 Technique of manual therapy to detonize the pectoralis group

Fig. 9.4 Proprioceptive training and strengthening of the shoulder muscles

strength, endurance, coordination and movement under medical supervision. The objective of medical training therapy (MTT) is to regain and stabilize a person's physical capabilities.

The main focus should be set on optimizing the quality of the movement. As soon as an optimal quality of the movement, rhythm and extent is achieved, the load can be increased. The physiotherapist and the athlete should work on coordination, proprioception (Figs. 9.3 and 9.4) as well as the interaction between different muscles and core. In addition to passive and active exercises, fitness equipment can be a useful asset in manual therapy. It allows working step by step on strength, power and endurance. An experienced athlete can even perform their training after an appropriate introduction and under constant control.

9.4 Core Strength

Core training is vital for each rehabilitation protocol. It provides stability and increases efficiency in force production as well as movement patterns. The literature showed that strong extremities in combination with weak core strength result in less force production and muscular dysfunction. It helps reducing pain in the lower back, sacroiliac joint, hamstring, shoulders and groin. Elite athletes require much higher levels of core stability, in order to maintain and maximize sports performances and promote efficient biomechanics. Core stabilization exercises should be integrated in rehabilitation programmes, as it shows decreased injury rates, especially for the lower extremity.

Core musculature can be divided into local and global categories. Muscles attached to the lumbar vertebrae are defined as local muscles. They can influence intersegmental motion and improve the coordination and proprioception. Global muscles attach to the hips and pelvis and increase the mobility of the spine. If there is a dysfunction in one of the local muscles, this can cause a significant imbalance between all the muscles involved. This leads to inefficient movements and increases the risk of injuries, with a high number of musculoskeletal injuries. The abdominal muscles such as rectus abdominis, transversus abdominis and internal or external obliques are the key muscles in positioning spine and pelvis correctly. Up to this, intra-abdominal pressure, as well as stabilization of the spine, is guaranteed by the transversus abdominis and the thoracolumbar fascia. The thoracolumbar fascia is seen as the connection of the upper and lower extremities. It maintains the kinetic chain and guarantees an optimal force couple for the extremities involved. Trapezius, latissimus dorsi, deltoid and pectoralis major can be seen as axial-appendicular attachments, which transfer force and momentum between extremities and core.

Even the diaphragm plays its own role in core strength and stabilization by contracting and increasing intra-abdominal pressure and generating a co-contraction of the pelvic floor muscles

Fig. 9.5 Training of core strength combined with proprioceptive training

Fig. 9.6 Training of core strength combined with proprioceptive training

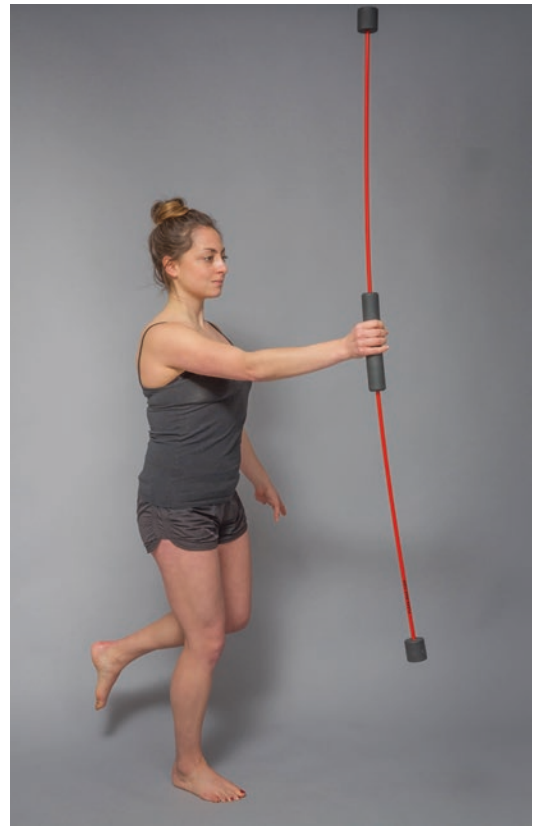

Fig. 9.7 Training of core strength combined with proprioceptive training

prior to limb movement. Diaphragmatic breathing exercises can improve core stability, as it serves as the superior boundary of the abdominal cavity.

The lumbopelvic hip complex, like the gluteal muscles, pelvic floor and hip girdle, provides a corset-lie stabilization on the trunk and spine. Gluteus maximus and medius, hip adductors, rectus femoris and iliopsoas are seen as the core stabilization muscles.

The focus on core stability lays on keeping a neutral spinal alignment, optimal trunk position and the transfer of loads along the kinetic chain.

Core stability needs be trained in a progressive way (Figs. 9.5, 9.6 and 9.7) beginning with recruitment of local muscle, moving it to core stabilization and total body dynamic movements. Overall deficiencies in core stabilization and load transfer muscles are be related to lower extremity function and injury.

9.5 Mobility

Stretching and continuous increase of flexibility and mobility should be part of each rehabilitation protocol, as it increases muscles length and full range of motion.

Reduced joint flexibility or range of motion can be caused by many reasons or factors such as muscles or capsuloligamentous structures surrounding the joint.

The anatomy of a muscle provides both passive and active tension. The passive tension is dependent on the surrounding fascia as well as

the anatomic properties of the muscle. Active tension is given by dynamic muscle contraction and results from neuroreflexive properties as peripheral motor neuron innervation and reflexive activation.

Athletes often describe a stiff muscle as muscle "tightness". In fact, muscles can become significantly shorter due to contraction or spasm. Overall, this can prevent optimal healing during rehabilitation or cause muscle or joint damage and lead to absence from sports.

In sports rehabilitation, three muscle stretching techniques are applied and described in the literature: static, dynamic and pre-contraction. Static stretching can be either performed actively by the subject or passively by a partner and is the most common type of stretching. A specific position is held with the muscle on tension to the point of a stretching feeling and can be repeated from seconds up to few minutes.

Dynamic stretching is described as active or ballistic stretching. While active stretching is performed in order to restore the full range of motion of a limb while moving it through its full range of motion to the end range, ballistic stretching includes rapid or alternating movements at end range of motion. Studies showed an increased risk of injury for ballistic stretching which is no longer recommended in sports rehabilitation.

The third form of stretching is described as pre-contraction stretching. While stretching, the muscle should be contracted up to 75–100% of maximal contraction. One of the most described techniques is proprioceptive neuromuscular facilitation (PNF) stretching.

In terms of orthopaedic and sport orthopaedic injuries, stretching should be seen as effective physiotherapeutic tool. In patients with hamstring strains, one of the most common injuries in soccer players, static stretching is seen as more effective as dynamic stretching. In addition, intensive stretching was shown as more effective than by less intensive stretching. Overall, studies showed that 6–8 weeks of static stretching is sufficient to increase hamstring length.

9.6 Nutrition

During sports rehabilitation, nutrition is seen as one of the most important factors in the overall healing and post-injury performance. Injuries, which limit limb or body mobility, will lead after few weeks to a significant lower metabolic turnover. Athletes can suffer from an increase of muscle strength or neuromuscular control by losing proteins or carbohydrates. Deficiencies of energy, protein and other nutrients should be avoided, as it can lead to a longer absence from sports. The right diet, in combination with the right rehabilitation protocol, should see the athlete back to his performance faster than expected.

During injury, immobilization or reduced physical activity can be divided in two main stages. The first stage is seen as the healing and recovery phase with inflammation, proliferation and remodelling. The second stage is the return to activity with increased activity and rehabilitation. Both stages can be influenced by nutrition or a right diet.

In severe injuries, the metabolic outcome can decrease up to 20%. In order to prevent muscle loss, a small weight gain can be beneficial. If there is a loss in energy, muscle growth can be limited, and the overall loss can be greater. During the rehabilitation, protein (2–2.5 g/kg/day), carbohydrate and fat intake (esp. omega-3) as well as vitamins (esp. vitamins A and C) and minerals should be part of each diet. Sports beverages, gels, sodas, concentrated sweets and alcohol should be avoided.

Key Facts

- Manual therapy treats reversible structures in the locomotor system.
- It is important to restore the perfect interaction between core stability and mobility in order to achieve the best possible result of the rehab.
- Unfortunately, often neglected, a balanced diet supports sports rehab in all areas.

Take-Home Message

Rehabilitation protocols require teamwork, steady communication between athlete, medical team and coaches as well as a detailed understanding of injury or surgery. Vital to each rehabilitation are physiotherapy and manual therapy. Signs of overtraining, stress, inflammation or pain should be considered carefully. Core strength, mobility and nutrition should be seen as the key facts in order to prevent from injury through dysfunction. Criteria-based protocols should be favoured in injured athletes, as time-based protocols do not take individual characteristics of patients into account and increase risks of failure or injury.