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CASE STUDY

GRAD 2 MEDIAL MENISCUS INJURY WITH POSTERIOR HORN CONTUSION

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ABSTRACT

Objective: To discuss treatment plane of Grad 2 Medial Meniscus Injury with Posterior Horn Contusion.
Design: Case Study
Main Outcome Measures: The management plan was structured into separate stages of progress between 3 different weeks. The improvement for each stage was measured.
Results: At the end of the treatment plane the footballer gained full stability during multi-planned movement and he was able to balance on unstable-based devices. Likewise, his stability during landing developed to the same level of the non-injured leg and the injured knee valgus angle, which was equal to 92% of the non-injured knee. In addition, he was able to complete 30 minutes of fitness running, and his sprints, acceleration and deceleration were all pain free. Moreover, he showed sufficient control of ball training. Furthermore, he became able to work at 80 percent of MHR for 30 minutes. However, the strength of the injured leg is 85% of the non-injured leg and there is minor limitation in the movement velocity level comparing to pre-injured level. Similarly, the crossover hop test showed that there is a minor shortage to the hop distance in the injured leg. Indeed, this was anticipated, as it had been previously stated that the development of speed could take months and the improvements in the strength may develop within weeks
Conclusion: Focus on the problem list and building a coherent treatment program usually lead to satisfactory results, which will save the athletes' time to return for practical phase.

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INTRODUCTION

Nature of the injury

The subject of this study is a male 20 year old defensive midfield football player, who was suffering from acute knee injury. During the beginning of the season, in a daily exercise session, he experienced a knee injury resulting from competitive contact with another player, which led to a right knee twist (dominant leg, or the preferred leg of the player when kicking a ball). Consequently, a sudden, strong, internal rotation of the femur was incurred with a partially flexed knee, while the foot was firmly positioned. After 24hoursthere wasa major complaint of knee swelling and the pain inthe medial joint line increased during bothcomplete knee joint extension and hyper-flexion. Therefore, the antalgic gait was presented with limitation of the active Range of Motion (ROM), althoughneither knee locking was, nor other health problems or injuries were reported. Moreover, the subject wasnot using any medication.In fact, the player's attitude was very positive, as he remained convinced that the injury would heal with good management,together with his dedication to improve. McMurray's test was implemented, where the physiotherapist applied a valgus stress to the flexed knee whilst the other hand rotated the leg externally and extended the knee to induce pain that could indicate a torn medial meniscus. Moreover, a positive reaction toApley's test during compression and rotation of the knee is most likely to highlight a meniscus injury. Furthermore, to evaluate the knee by a dynamic clinical examination test, the physiotherapist used the Thessaly test at 5° and 20° degree knee flexion, which was uncomfortable for the injured player. Both the Lachman Test and Drawer Test were negative, although Magnetic Resonance Imaging (MRI) found Grad 2 (Transverse) medial meniscus injury with posterior horn contusion. Consequently, due to the nature and grade of injury, an agreement was concurred by the physician, the footballer and the physiotherapist to treat a meniscus tear non-operatively.

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Problem list

The injury to the footballer needed to be fully analysed, as with any sporting requirement of rehabilitation. It was imperative to understand the potential issues that would arise due to the knee injury and how they would actively affect the full rehabilitation towards subsequent return to practice.

1-Knee pain

The pain localized in the area of the medial knee joint line is often worse during twisting or complete extending motions and hyper-flexion. Hence, the footballer is prevented from remaining active in their normal functions, such as training, comfortable walking, or even driving a car. VAS current pain at rest = 2, whilst driving a car = 3 and when completely extending the knee = 8 and with complete knee flexion = 4.

2-Knee Swelling

The right patella was not completely visible due to some swelling, as measured by Girth Measurement. At the joint line the differences between RT knee and LT knee was 4cm, whilst at 5cm above the joint line it was 2cm. The swelling disappeared at 10cm above the joint line and at 15cm below.

3-Lack of ROM

Full knee flexion and extension led to pain increasearound the medial joint line. The medial knee pain at end of ROM (VAS rises to 4 on full flexion and 8 on full extension). Therefore, the injured knee remained bent, resulting in the tightening of the hamstring and stiffness of joint.

4-Muscle weakness

One of the effective factors on the injured athletes is muscle strength, endurance and power. Muscle weakness may appear during rehabilitation stages because the injured athlete has disability to move his limb by same range and strong that before injury. By using hand-held dynamometry, the therapist found that, the injured player loss around 50% of quad and hamstring muscles strength compared by non-injured leg.

5-Neuromuscular control

Reestablishing neuromuscular control is a necessary concern in the overall process of sporting rehabilitation programs. This is because the central nervous system remains dormant from injury-induced rest and immobilization, which results in muscle and joint mechanoreceptors not functioning as prior to the injury. Hence neuromuscular control is a vital concept in the final stage of returning to sporting activity.

6-Cardiorespiratory fitness

Cardiorespiratory fitness commonly decreases rapidly following a lack of training due to injury.Subsequently, thestructured rehabilitation period must incorporate cardiorespiratory fitness at the earliest possible stage or the final return to sport will result in shock.

Management plan

The management plan was structured into separate stages of progress between 3 different weeks, in order to identify a more precise formulation of measured improvement.

Phase	Problem	Action	Timed goal	Measurement
Early rehabilitation phase	Knee pain and swelling	. Rest . knee brace locked at 10 degrees of flexion . Ice . Electrical stimulation . Isometric muscles setting . Pain free AROM	Short term: . Enhance healing process 2/7 Short term: . No pain at rest by 2 days . No pain during movement by 7 days . No greater than 1cm swelling increase between different measure times by 3 days . Reduce the swelling to 2cm by 7 days	. pain level (VAS) . For swelling: Joint circumferential measurement
	LE muscle weakness	. Isometric/muscle sets (quadriceps, hamstring)	Short term: . strength will be 60% of the non-injured leg by 7 days . Preventing muscle atrophy 7/7 . Reduce swelling 7/7	hand-held dynamometry
	Cardiorespiratory fitness	. Cardiorespiratory endurance training (alternative activity)	Short term: The player will be able to work at 60 percent of MHR for 20 minutes 7/7	. Heart rate during cycling
	ADL limitation	. Environmental modification	Short term: . Dealing with possible activity 7/7	
Medium rehabilitation phase	Problem	Action	Timed goal	Measurement
	Knee pain and swelling	. Ice	Medium term: . Total pain relived by 10 days . No more than 1cm swelling by 10 days	. pain level (VAS) . Joint circumferential measurement
	ROM and Flexibility	. Progression AROM programme . Static Stretching . Ballistic Stretching	Medium term: . Full pain free Functional AROM by 10 days AROM will be same the non-injured leg by 14 days	Goniometer . Straight Leg Raise . Sit and Reach test
	LE muscle weakness	. Progressive resistive Ex . Progression loading program . proximal muscles training	Medium and long term: . strength will be 75% of the non-injured leg by 14 days and 95% by 21 days . knee valgus angle will be ≥ 90%of the non-injured leg by 21days	. Hand-held dynamometry . Drop jump with 2D video analysis
	Cardiorespiratory fitness	. progressive Cardiorespiratory endurance training	Medium term: The player will be able to work at 70 percent of MHR for 30 minutes by 15 days	. Heart rate during cycling
	Neuromuscular control	. static proprioceptive	Medium term: . Able to control his postural and coordinate his movement by 14 days	. Romberg test

Final rehabilitation phase	Neuromuscular control	. Dynamic proprioceptive Ex. . Balance and perturbation training . Progressive plyometric training	Long term: . Full stability during movement in multi-planer by 17 days Long term: . Able to balance on unbalance based devices by 17 days Long term: . movement velocity will be equal to pre-injured level by 21 days . stability during landing will be same the non-injured leg by 21 days	. BESS score unilateral test . T- test . Crossover hop test
	Fitness and FP	.progressive Cardiorespiratory endurance training . Progression agility and FP programme	Long term: The player will be able to work at 80 percent of MHR for 30 minutes by 21 days Long term (by the end of 21 days): . complete 30 minutes fitness running . free pain sprints, acceleration and deceleration . distance of crossover hop will be same the non-injured leg .sufficient Control of the ball	. Heart rate during fitness running . Carioca test .Acceleration/ deceleration course . ball control

AROM= Active Range of Motion, LE= Lower Extremity, VAS= Visual Analog Scale for Pain, ADL= Activity of Daily Living, EX= Exercises, BESS= Balance Error Scoring System, FP= Functional Performance, MHR= Maximal Heart Rate.

Justification and critical appraisal of management plan

Early rehabilitation phase 7/7

It is important that the initial process of rehabilitation is formulated immediately following knee meniscus injury, to focus on pain and swelling reduction, with a view to full activity of the affected muscles, by using the following treatment methods:

Restricted Activity (Rest)

A period of up to 2 days rest prior to pain free AROM has been proposed, as the healing process, which begins immediately after injury, is negatively affected when unnecessary strain is applied directly after an incident (Prentice, 2004).

Knee brace locked at 10 degrees of flexion

Prentice (2004) states thatin order to minimize the amount of swelling around the injury, the area must be protected from additional harm. Therefore, a knee brace locked at 10 degrees of flexion was used to protect the injured knee, which prevented full knee extension toprotect healing, andminimization of knee pain.

Ice

Athletes suffering from injuries to the musculoskeletal system generally desire cold treatment as their initial choice (Prentice, 2003). In rehabilitation, colddecreases pain and promotes local vasoconstriction, which actively controls hemorrhages and edemas, as well as reducing the metabolism and oxygen demand in the injured tissue, resulting in hypoxia reduction (Prentice, 2004). Nevertheless, Prentice states thatcold treatmentalso functions for uninjured tissue, as it prevents the spreading to adjacent normal cellular structures, together with the reduction of spastic conditions following pain. Therefore, ice was used as a cold application to reduce the pain and swelling of the knee.

Electrical stimulation

Electrotherapeutic stimulationmay improve muscle reactions, as ithas demonstrated strength improvementafter inhibition, together with as lowering edema (Thornton *et al*., 1998). Moreover, Bird *et al*. (1997) recommend using electrical stimulation to relieve musculoskeletal pain.

Pain free AROM

Following the period of rest the player will asked to start doing pain free AROM to maintain the available range and prevent any more loss of knee motion. The therapist focused on pain free range, asthe pain indicatesan excessive load that is detrimental to therepair or remodel of the tissue (Prentice, 2004).

Isometric muscles setting

Isometric exercises are commonly performed in the early phase of rehabilitation asthe immobilization of a joint reduces strength and endurance, because they aid the function of resistance training through a full ROM that might otherwise prove harmful; additionally, isometric improves static strength and assists in helping muscle tissue improvement, as well asinducing swelling reductionthrough removing fluid and edema in the affected area (Prentice, 2004).

Cardiorespiratory endurance training

Through various different techniques, an injured athlete, due to a lack of training, is required to improve upontheir decreased cardiorespiratory fitness at the earliest opportunity (Magnusson *et al*., 1995). Cardiorespiratory endurance provides the base in rehabilitation to regain pre-injury levels of fitness, which makes it vital for the therapist to implement alternative activities (Prentice, 2004). Hence, the therapist applied alternative activities, such as cycling or swimming, whilst avoiding full ROM of the injured knee by focusing on pain free movement. This was based on MHR in order to develop the cardiorespiratory endurance of the athlete. Nevertheless, the athlete is required to exercise for a continuous 20 minutes (Swain and Leutholtz, 2002), with a required heart rate to a minimum of 60 percent of their MHR (Astrand and Rodahl, 1986; Koyanagi *et al*., 1993) in order to assess the minimal development in cardiorespiratory endurance. Likewise, the American College of Sport Medicine (2001) has advised athletes when training in a continuous fashion of 20-60 minutes to perform 60-90% of their MHR in order to develop cardiorespiratory endurance.Indeed, a sustained heart rate of 85 percent is easily maintained by a trained athlete (Swain and Franklin, 2002). Furthermore, Prentice (2004) has demonstrated that a training period of 45 minutes should be the minimum for a competitive athlete.

Environmental modification

Dealing with possible activities throughenvironmental modificationto maintain the positive attitude of the injured footballer is an essential part of treatment. The therapist made walking easer by using the knee brace and advising the player to move his car seat slightly forward in order to be more comfortable through not extending the leg or a need for a brace.

The reflective of early rehabilitation phase

Therapeutic techniques reduced swelling to become less than 2cm in the joint line, instead of 4cm, which disappeared above the knee joint, while the pain was mostly relieved in all directions,except for the full extension wherethe pain was around 2 (VAS), which might have been caused by new healing tissue. In addition, the athlete became able to work at 60 percent of MHR for 20 minutes. Moreover, the footballer avoided muscle atrophy by isometric exercises as muscle strength became 60% of the non-injured leg, which enabled the next step of rehabilitation.

Medium rehabilitation phase 2/52

Rehabilitation through this stage maintainsthe gainsfrom the earlier stage and completes the progression ofrehabilitation. The therapist used the cold therapy until swelling and pain was eradicated. Furthermore, ROM and flexibilitythat are usually affected after knee injuries are focused upon. Additionally, muscle actions (both concentric and eccentric) were implementedtogether with isotonic exercises, as the therapist used static proprioceptive to improve the performance and biomechanical stability of the player.

Progression ROM programme

An athlete, through the rehabilitation progress, must develop pain-free active ROM in the frontal, saggital and transverse parts of the joint in order to enableperformancefor all the necessary movements of the sport, as well as toactively contract the affected muscle with the antagonist muscles (Liebenson 2006). Therefore, the therapist applied a progression ROM program to regain full pain free AROM.

Stretching techniques (flexibility)

Through the use of a flexibility programme, stretchingmust be avoided during the initial 72 hours post-injury, although for more severe injuries this duration can be 7–10 days (Neidlinger-Wilke *et al*., 2002). Similarly, Comfort and Abrahamson (2010) state that joint flexibility may develop againafter a few days. Therefore, the therapist applied a flexibility programme in this stage of treatment in order to optimize ROM at the joint.

Progressive resistive exercises and loading

An athlete must provide a force capable of initiating muscle actions (both concentric and eccentric) during isotonic exercises, whilst handling a permanent external load. Hence, rehabilitation can utilize various forms of isotonic exercises, whichmay include dumbbells, weights, and resistance bands (Beam, 2002). Therefore, based on the early rehabilitation phase, which showed pain and swelling minimization, the footballer became ready to start his isotonic exercises.

Proximal muscles training

The correlation between the trunk lateral flexor and gluteal muscles' weakness and excessive knee valgus has been proven (Willson *et al*., 2006). Moreover, the connection between excessive knee valgus and a variety of knee injuries was also documented (Hewett *et al*., 1999). Therefore, the plan of treatment should include strength training for the trunk lateral flexor and gluteal muscles, whichdecrease and control theknee valgus angle (Comfort and Abrahamson, 2010).

Static proprioceptive

Neuromuscular control training has been shown to improve performance and biomechanical stability, which actively decreases injury risk (Myer *et al*., 2005). Comfort and Abrahamson (2010) state that during isotonic exercises, which are initiated by the development of neuromuscular control, the athlete requires slow movements which permitimproved neural responses to the functioning muscles. Moreover, before an athlete can progress to a more dynamic proprioceptive training programme, theyare required to focus on their posture, alongside modifying static proprioceptive training (Liebenson, 2006). Therefore, the therapist began with exercises that promoted a stable base with static proprioceptive development, while increasing minimal movement.

The reflective of medium rehabilitation phase

At the end of this stage of treatment, the pain was relived, while the swelling became less than 1cm. Moreover, the full pain free AROM and flexibility was achieved. However, the strengthening measurement showed that the muscles' strength had become 75% of the non-injured leg. In addition, the player became able to work at 70 percent of MHR for 30 minutes. Moreover, the footballer maintained posture control, whileperforming various modifications to static proprioceptive training.

Final rehabilitation phase 3/52

Rehabilitation at this stage tends to improve the balance and coordination by employed dynamic proprioceptive training and progressive stability-balance exercises. Moreover, the therapist implemented plyometric training to develop the capabilityfor dynamic movement through muscular power, which also enhanced the footballer's functional performance.

Dynamic proprioceptive exercises

In order to improve the muscle capability and motion of the injured joint, as well as stabilize the body through various directional movement, dynamic proprioceptive exercises can be performed (Myer *et al*., 2006; Stracciolini *et al*., 2007; Pasanen *et al*., 2008; Subasi *et al*., 2008). The progress through the dynamic neuromuscular control exercises must be monitored, and the intensity and frequency adjustedto any new required level, in order to increase overall development. Hence, theadaptive changes that occur within the neuromuscular system can lead to improved running exercise balance and leg coordination, as well as an increased ability to perform plyometric based exercises (Cameron *et al*. 2007). Therefore, the therapist prepared neuromuscular exercises to progress the footballer's rehabilitation through to dynamic plyometric training.

Balance and perturbation training

The athletemust receive encouragementto maintain maximumalignment of the pelvis-hip-knee-ankle whilst performing balance training on unstable apparatus, such asrocker-boards (Comfort and Abrahamson, 2010). In fact, to deliberately unbalance the injured athlete the therapist can tap or knock the apparatus as well as unsettle the rhythm of the athlete by pushing and pulling, through perturbation training. Nevertheless, this form of exercise does not incorporate impact forces, so it isnecessary to comprehend this methodprior toincluding exercisedrills of extensive impact (e.g. plyometric).

Progressive plyometric training

A type of resistance training which incorporates exercises of high-velocity through quick eccentric (lengthened) followed by rapid concentric (shortened) muscle contractions are known as plyometric training, which is achieved through a process referred to as the stretch-shortening cycle (SSC) (Shiner *et al*., 2005). Through the process of motor-unit recruitment improvement, as well as sensitivity and development of the neuromuscular system, power production is enhanced, which ultimately increasesthe efficiency of neuromuscular control (Newberry and Bishop 2006). Furthermore, plyometric activities advance on the tendons, muscles and fascia development, together with the improved motor recruitment that is caused by the stretch reflex. Therefore, progressive plyometric training was utilized by the therapist in order toenablethe progress in the speed of movement.

Progression agility and FP programme

Rehabilitation with sporting injuries helps athletes to redevelop their abilities to be able to cope with the specific demands that their sport entails, which is developed through a process of defined exercises for challenging progression. Moreover, the therapist should use the activities that comprise the patient's sport and study the individual intricacies involved within them, as to emphasise more focus on predesigned individual parts of the game prior to a full combination through an uncontrolled scenario to simulate full competition (Prentice, 2004). Hence, the therapist included more complex and unpredictable exercises, which had higher velocity and load, in order to enhance better sporting performance. Furthermore, the therapist focused on specific football tasks, such as: running for fitness, sprints, acceleration and deceleration runs, shuffle slides progressing to shuffle run, carioca and ball work (i.e. turn/stop the pass; turn/mark opponent; mark/steal/; two-touch and shoot; one-touch and shoot; passing, etc).

The reflective of final rehabilitation phase

At the end of this stage, the footballer gained full stability during multi-planned movement and he was able to balance on unstable-based devices. Likewise, his stability during landing developed tothe same level of the non-injured leg and the injured knee valgus angle, which was equal to 92% of the non-injured knee. In addition, he was able to complete 30 minutes of fitness running, and his sprints, acceleration and deceleration were all pain free. Moreover, he showed sufficient control of ball training. Furthermore, hebecame able to work at 80 percent of MHR for 30 minutes. However, the strength of the injured leg is 85% of the non-injured leg and there is minor limitation in the movement velocity level comparing to pre-injured level. Similarly, the crossover hop test showed that thereis a minor shortage to the hop distance in the injured leg.Indeed, this was anticipated, asit had been previouslystated thatthe development of speed could take months and the improvements in the strength may develop within weeks (Comfort and Abrahamson, 2010).

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