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FUNCTIONAL MOVEMENT SCREEN FOR FOOTBALL PLAYERS OF MUSAN SALAMA

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Satakunnan ammattikorkeakoulu
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The purpose of this thesis was to assess movement patterns by performing the Functional Movement Screen (FMS) protocol for football players of Musan Salama 2nd division team. The thesis was done in cooperation with the first team of Musan Salama RY. The practical part of this thesis was done as a quantitative study examining the muscle balance of the test subjects. The Functional Movement Screen was conducted on fifteen players of the team. The scores of the screening were recorded and analysed using Microsoft Excel. The focus of the analysis was to compare the test results with the hand and leg dominance of the participants.

The topics discussed in the theoretical part of the thesis cover football and injuries related to the sport, different injury factors, the effect of muscle balance, mobility and asymmetries related to these injuries, and the information related to the Functional Movement Screen.

The results and conclusion of the thesis cover the outcomes of the study. The analysis with the Excel Spreadsheet displays that the football players have movement dysfunctions and asymmetries based on the Functional Movement Screen. Some of the dysfunctions recorded in the tests were compensatory movements, limited range of motion, limited balance and movement asymmetries. Correlation between the hand and leg dominance of the athletes was also discovered in some of the tests.

Through these results, the coaches and physiotherapists of the team can design the physical training of the players according to the dysfunctions discovered in the tests. The players were also educated about the effects their FMS score can have on their level of risk to be injured.

CONTENTS

1 INTRODUCTION

Participating in sports and exercise have positive long-term effects on health. As football is currently the most popular team sport in the world, it is important to find a balanced approach between injuries and the health benefits while participating in the sport. (Fuller, Junge & Dvorak 2012, 11) The fact, that physical activity and sports present a certain risk of injury is known well (Cumps, Verhagen, Annemans, Meeusen 2008, 767). This is why injury prevention is an important aspect of sports physiotherapy. There are different concepts and frameworks created for reducing the incidence of injuries and managing the risks associated with sports injuries. (Finch 2006, 4) This Bachelor's thesis discusses some of the risk factors affecting football players and how movement quality, muscle balance and movement asymmetries can have an effect on sports injuries, and how to screen these elements.

Muscle balance and movement asymmetries have been noticed to have an effect on sports injuries in football because of the asymmetric nature of the sport (Fousekis, Tsepis & Vagenas 2010, 265-372). Poor muscle balance in young athletes has been noticed to cause growing number of musculoskeletal problems as a result of reduced strength, muscle tightness and repetitious movement patterns (Seppänen, Aalto & Tapio 2010, 101).

Athlete screenings are widely used in the field of sports to recognize possible movement dysfunctions and muscle imbalances to reduce the risk of injuries during training and match situations. In case, an athlete is discovered to present movement compensations during screening or pain in the tests, a more profound assessment is completed to find the explanation behind these factors. (Ahonen & Sandström 2011, 342-343)

There are different kind of tools created for screening athletes. The screening method used in this thesis was decided to be the Functional Movement Screen (FMS). The FMS contains seven movement tests that require balance between mobility and stability. (Functional Movement Systems 2015, 4) The Functional Movement Screen was found to be a simple and practical test battery to conduct with a large number of athletes. The screening is also widely used in the field of professional sports, like National

Football League (NFL) so it was interesting to gain more knowledge on the topic (Slone, Karas, Shani, East & Barfield 2016). There has also been studies on the reliability of the FMS when comparing it among different testers. The test battery has proven to be reliable so the test scores are comparable among novice and expert raters. (Gulgin & Hoogenboom 2014, 14-17) The screening is planned to help the players to understand the effect of muscle balance and movement quality on risk of injuries and help the team staff to plan the physical training sessions accordingly.

2 PURPOSE AND AIM OF THE THESIS

The purpose of this thesis was to assess movement patterns, by performing the Functional Movement Screen (FMS) protocol for football players of Musan Salama 2nd division team. The aim of the thesis was to examine the movement patterns of the players from an injury prevention perspective. Research questions for the thesis were determined to be: Do the players have movement dysfunctions or asymmetries according to FMS? If so, are the asymmetries related to the hand or leg dominance of the athlete?

3 FOOTBALL AS A SPORT

Football is currently the most popular sport worldwide. It involves a variety of different movements including walking, jogging, running and sprinting. A combination of football and education about lifestyle changes have been found positive when researching the effect of physical activity on obesity and cardiovascular diseases on recreational football players. Football has been recorded to possess multiple health benefits through physical activity. (Parnell, Cope, Bailey, Krustrup & Curran 2016, 1-5) In football, there are two teams of 11 players who attempt to score a goal to win the match. The time of the game is 90 minutes, consisting of two 45 minutes halves. (Laws of the Game 2015, 18-30)

The physical demands of football are complex because of the changing nature of the sport. Elite football players can cover a total distance of 9-11 kilometers per game, depending on the position played. Most of the sprinting distances have been observed to be 5-10 meters, per interval. (Datson, Drust, Westong, Jarman, Lisboa & Gregson 2016) These findings support that a football player requires adequate aerobic capacity, as well as strength and power to sprint short distances. Movements like turning, jumping, kicking the ball and tackling are also essential physical aspects of the game of football. (Arnason, Sigurdsson, Gudmundsson, Holme, Engebretsen & Bahr 2004, 278)

For a football player, fundamental skills to master are ball control, passing, dribbling, shooting and defending. These skills, combined with tactical awareness, which involves understanding your role, having positional awareness on the field and having good decision-making, make up a good football player. (Website of Livestrong 2015) Four components of football, according to the website of US Youth Soccer, are tied together for both the player and the team as a whole (Figure 1).

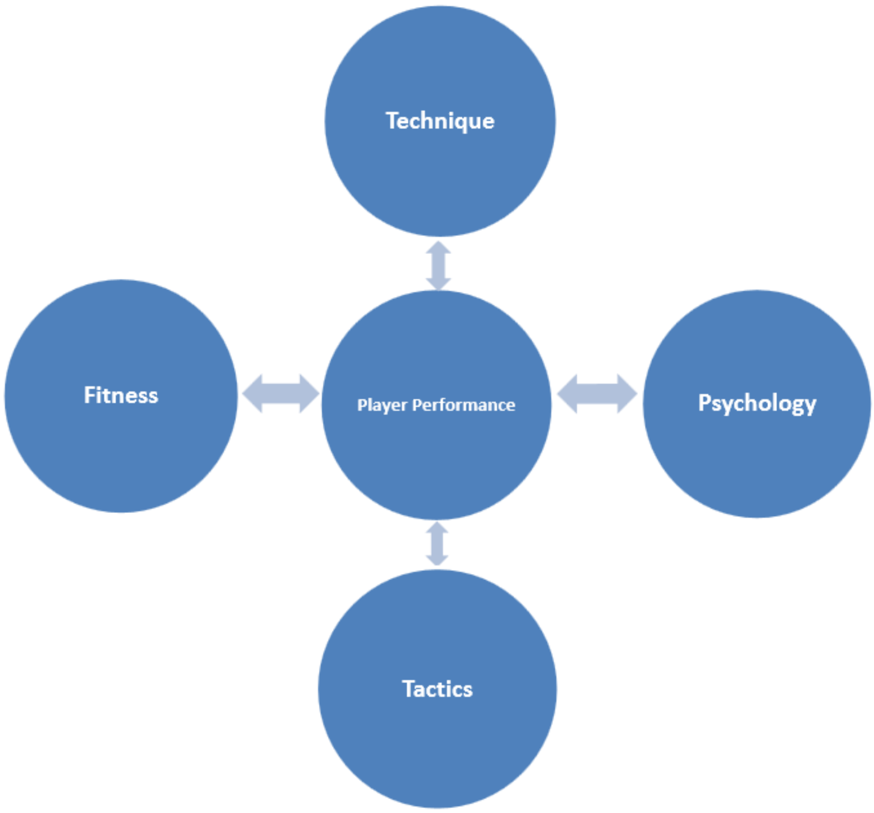


Figure 1. The four components of football. (Website of US Youth Soccer 2012)

For Finnish football players over the age of 13, a recommended time for a practice session is from 75 minutes to 120 minutes. The session should consist of aspects (Figure 2) that enable players to combine basic skills to be competitive in match situations. These practice session segmentations develop over time, from the start of the sport. Emphasis is to improve the necessary skills to thrive in the sport of football. The last phase of the player development step, according to Hakkarainen, et al (2009, 386), is learning the culture of winning. This last phase ties together the previous steps and enables the players to focus on winning under high physical, tactical and psychological demands. (Hakkarainen, Jaakkola, Kalaja, Lämsä, Nikander & Riski 2009, 385)

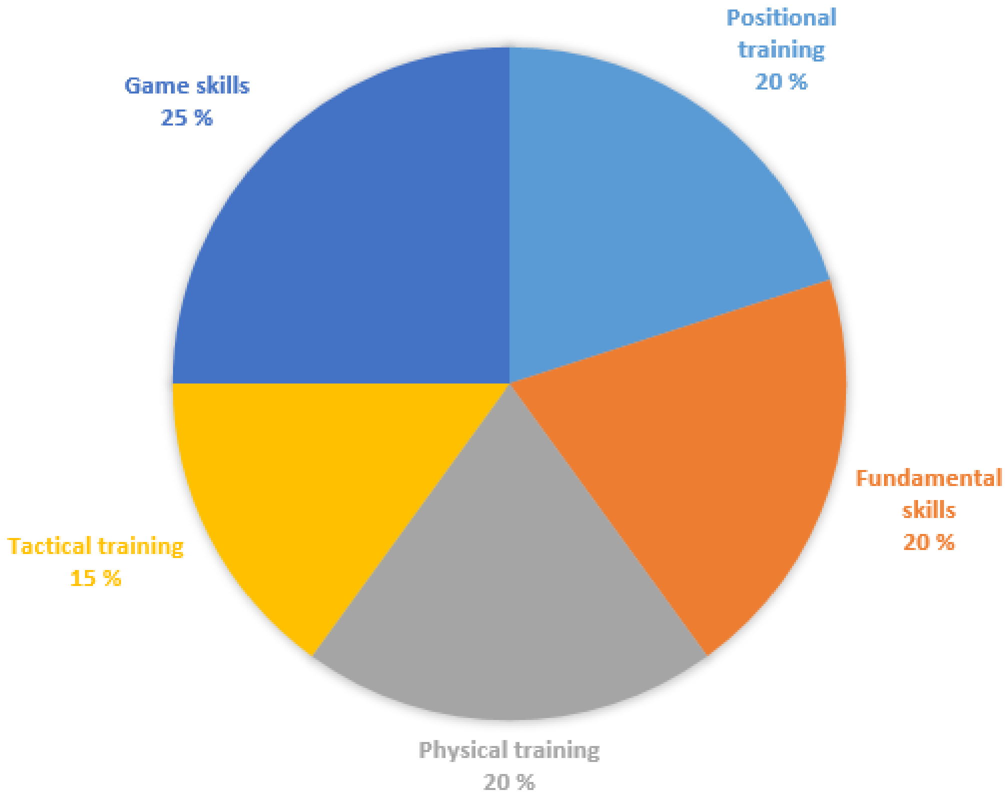


Figure 2. Segmentation of a single practice session of over 13 year old football players. (Hakkarainen, Jaakkola, Kalaja, Lämsä, Nikander & Riski 2009, 385)

From the point of view of an individual player, football as a sport challenges the players to perform complex movement patterns. Combining running, walking, sudden changes in movement direction, jumping and colliding with other players demands a lot of coordination and motor control. (Lehto & Vänttinen 2010, 4) Because of the variety of the game, different forms of injuries are common. The most common injuries in the FIFA World Cup 2014 affected the lower extremities (65,4%), followed by the head/neck (18,3%). (Junge & Dvorak 2015) It is assumed that the game of football has become faster, more intense and aggressive over the years. This places more stress on the demands of an individual athlete such as physical fitness, psychological factors, technique and tactics. This increases the risk of injuries and the sequelae from previous injuries. (Arnason et al. 2004, 278)

4 FOOTBALL & INJURIES

According to Arnason et al (2004), injuries in football are more common when compared to other types of sport. Some studies have indicated that person-related factors such as age, career length and previous injury history increases the risk of injuries. The numerous factors associated with injuries require profound understanding of the individual risk factors, in order to develop preventative measures. (Arnason, Sigurdsson, Gudmundsson, Holme, Engebretsen & Bahr 2004, 5)

Football players playing on a competitive level experience 13-35 injuries per 1000 playing hours. Most of the injuries are caused as a result of trauma, typically from player contact. (Walls, et al. 2016, 8) The cause for injuries can also vary in different situations (F-MARC Football Medicine Manual 2009, 73). The causes of injury during training are more often acute and non-contact related. In match situations the injuries are typically caused by player contact. Low injury rates have been discovered to improve the success of a football team. Exact reasons are not clear but it has been hypothesized that low injury rates lead to high availability of players in matches and the injuries of individuals might also have a psychological effect for the whole team. (Hägglund, Walden, Magnusson, Kristenson, Bengtsson, Ekstrand 2013, 12)

Most of the injuries occurring during football matches are located in the lower extremities, with the knee and ankle being the most common structures to be injured. The thigh, neck and head are also responsible for 10 % of all injuries in both men and women. These injury statistics do not vary much between youth, amateur and professional players. The ankle is the most common structure to be injured in both men and women. The distribution of match injuries by type have some differences between males and females. The three most common types of injuries are joint/ligament injuries, muscle/tendon injuries and contusions from player contact. (F-MARC Football Medicine Manual 2009, 69-70)

4.1 Risk factors for injuries

Football can be played by anyone, requiring minimal equipment: a ball, two goals and enough people to play with. Most of the research is conducted with professional football players but the number of risk factors for injury are the same for recreational and professional players. These risk factors are divided into two sub-groups; extrinsic (situation or event-based) and intrinsic (player-based) factors. Creating an effective injury prevention program requires to have an understanding of multiple risk factors and their impact on the injury incidence and nature of the injury. (Figure 3) (F-MARC Football Medicine Manual 2009, 14)

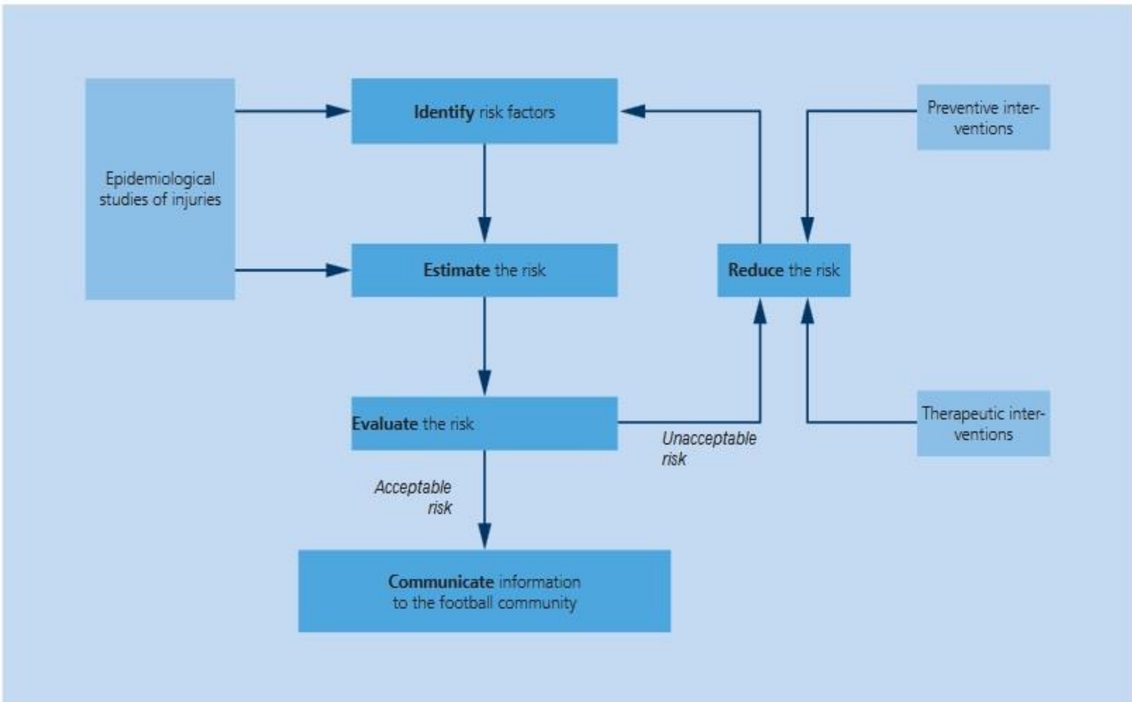


Figure 3. Framework for managing the risk of injury. (F-MARC Football Medicine Manual 2009, 14)

4.2 Intrinsic factors

By intrinsic factors the literature refers to the factors that are related to a single athlete. These factors can be listed as for example previous injuries, age, gender, flexibility and hand/leg dominance. More factors can also be listed but these issues are presented in this thesis. (F-MARC Football Medicine Manual 2009, 14)

4.2.1 Previous injuries

Previous injuries have been noticed to increase the risk of injury occurrence (highest risk out of all the intrinsic risk factors). Previous injuries predispose athletes to new injuries, especially for lower limb muscle, tendon and ligament injuries. (F-MARC Football Medicine Manual 2009, 73)

Injuries do not only cause disruptions in the muscles through pain and loss of strength, but may also cause altered proprioception. For example, an injury in the anterior cruciate ligament (ACL) of the knee can be associated with compromising the neuroreceptors that innervate the joint. For this reason an adequate rehabilitation program should be performed to address the proprioceptive capabilities as well. If the rehabilitation is not sufficient, the athlete may be predisposed to an increased risk of re-injury, through muscular weakness and imbalance, impairment of ligaments and fear of new injury that could lead to altered muscle recruitment strategies. (Murphy, Connolly & Beynnon 2003, 18-19) It has been noticed that previous injuries can compromise the function of joints by reducing the amount of mechanical stability, neuromuscular control, or muscle function (Engebretsen, Myklebust, Holme, Engebretsen & Bahr 2008, 2).

4.2.2 Age

Age has been noticed to increase the risk of football injuries in the lower extremities. Studies have found that athletes over the age of 25 have a higher occurrence of injuries in the knee, foot, ankle, thigh and back area. It appears that for female football players, dances, netball players or track and field athletes, the age is not a risk factor for injury.

Accordingly, there seems to be differences between genders. (Murphy, Connolly, Beynnon 2003, 16)

4.2.3 Gender

The test subjects for this thesis were all males, but the importance of gender as an injury risk factor was found to be essential, so it was also included in this theory. Studies have found that female athletes are more prone experiencing a serious knee injury, like an anterior cruciate ligament injury (ACL). Studies have not found a clear difference between other lower extremity injuries, except the ACL injuries. There has been debate over why female athletes suffer more knee injuries. Differences in anatomical, hormonal and neuromuscular factors have been proposed but it is still unclear. (Murphy, Connolly, Beynnon 2003, 17)

4.2.4 Hand and leg dominance

One of the study questions for the thesis was determined to be if hand/leg dominance played a part in the results of the functional movement screen. In certain sports, athletes only use a specific side, dependent on their dominance. For example, football players tend to favor one side more than the other. Several studies looking into risk factors have reported that dominance plays a part in which limb might be injured. It has been reported that football players have a higher risk of ankle injuries on their dominant leg. Although, some studies have reported that there has not been an association between limb dominance and the place of injury in muscle or ligament injuries. This indicates that the relation between dominant side and risk of injury is still unclear. (Murphy, Connolly, Beynnon 2003, 20)

4.2.5 Flexibility

Moving joints always requires flexibility that enables smooth, unrestricted range of motion. (Kisner & Colby 2007, 66) Muscle tightness can be an important risk factor promoting muscle-tendon injuries in lower extremities. Most common locations for muscle-tendon injuries in football are hamstring and quadriceps muscle groups. Lack of muscle flexibility can predict development of muscle-tendon injury in hamstring and quadriceps injuries. (Witvrouw, Danneels, Asselman, D'Have, Cambier 2003, 43)

4.3 Extrinsic factors

As intrinsic risk factors are related to an individual athlete, the extrinsic risk factors list issues that affect the football player from the outside. These issues can be, for example, equipment the game is played with, contact situations with other players, or condition of the playing environment. These factors are related to the sport itself. (Turunen 2007, 12)

4.3.1 Playing equipment

Playing equipment has an effect on the occurrence of injuries. The amount of equipment used in football is relatively small. Appropriate footwear for different football fields is essential. (Kiuru 2015, 14) Ankle braces have also been noticed to reduce the amount of injuries in football players. Braces are used to give more mechanical support for the ankle joint. These braces and sports tape can be used during training and matches to reduce the risk of ankle sprains. (Turunen 2007, 12)

4.3.2 Contact situations

One of the biggest reasons for injuries during matches is contact with another player. These injuries are a result of tackles or collisions. During training sessions, injuries typically do not occur because contact situations are fewer than during matches. This can also be due to increased level of fatigue during matches, or a more aggressive way of playing during games. (F-MARC Football Medicine Manual 2009, 71-73)

4.3.3 Condition of the playing and training environment

Environment for matches and training can be considered to include factors like the weather, altitude and playing surface. Cold weather can increase the risk of muscle injuries. (Turunen 2007, 13) Football can be played on different kind of surfaces. Of these, the most common are natural grass and artificial turf. The effect of playing surface as a risk factor has been studied after artificial turfs became more common. According to Ekstrand et al (2006, 2) the playing surface does not increase the risk of injuries. However higher incidence of ankle sprains was recorded in the studies. This is likely due to increased friction between the artificial turf and the footwear used.

5 MOVEMENT PATTERNS

Movement is necessary to carry out activities of daily living. Simply said, muscles help bones move in different patterns and range of motions. The nervous system controls the movement, which moves the body. (Kisner & Colby 2007, 43) As mentioned before, football as a sport requires various movements at different speeds and different directions of movement. These movement patterns require a combination of working elements. These elements can be divided into four categories: base, modulator, biomechanical and support. Base consists of muscular and skeletal systems, modulator is the nervous system, biomechanical is the static and dynamic system and lastly support consists of cardiac, pulmonary and metabolic systems that are required to maintain the functionality of rest of the body. All these elements are crucial for the body to move correctly. Each one has a role in movement and is also affected by the movement. (Sahrmann 2002, 9)

Movement patterns should be optimal so the body can handle functional and postural demands that are essential in daily life. This requires balanced control from the whole system and when it is achieved it can be maintained during activities of daily living, working life and sports. (Comerford & Mottram 2012, 3)

Functional Movement Systems describe human movement patterns using a pyramid to illustrate the needed movement types. Foundation for the pyramid is the ability to move through fundamental patterns. On top of this are two more layers. The second platform is performance. After having the ability to move well, performance is about adding power to it. The top of the pyramid consists of skill. Once you have acquired good movement qualities and athleticism, it is time to add sport-specific skills to the combination. (Functional Movement Systems 2017, 68)

5.1 Muscle balance

Elements listed by Sahrmann (2002, 9) require balance between each other for movement to occur in a controlled manner. Balance can be achieved through good posture and body awareness, flexibility, mobility and stability of the joints, gliding of the nervous tissue and the ability of the body to react to external factors. (Ahonen & Sandström 2011, 341) Repeated motions and long-term positions that are present in activities of daily living can also cause unwanted changes in muscular and skeletal systems. These changes can induce disturbance in the balanced system. (Sahrmann 2002, 13-14)

Muscles can be considered to either move the bones or stabilize them through generated force. Force of the muscles control the balance between posture and movement. By stabilizing bony structures muscles uphold the posture by creating a balance of competing forces. When movement occurs, the forces are unbalanced in a regulated way. If muscle balance is disturbed, movement cannot happen in a regulated way which can cause musculoskeletal disorder for an individual. (Neumann 2002, 41)

5.2 Mobility

Mobility of joints is comprised of the flexibility of muscles, tendon and ligaments as well as the function of the nervous system. Thus mobility is not only about function of the muscles, but the whole system. (Seppänen, Aalto & Tapio 2010, 106) Mobility has to always have the support of muscle strength, endurance and neuromuscular control to allow a person to be functionally mobile. If the body is lacking one of these features, the risk of injury during physical demand can be increased. (Kisner & Colby 2007, 65)

5.3 Asymmetries in movement patterns

This thesis refers to asymmetries as differences in function between the right and left side of the body. The body can develop asymmetries while doing daily activities that might feel insignificant, for example carrying a bag on the same shoulder every time. The same effect can occur in sports that emphasize one side more than the other. Most of the population have a preferred dominant side that they use more than the other. (Seppänen, Aalto & Tapio 2010, 101) This also happens in football: the players favor one leg over the other one in kicking and passing. Activities like this create different loading for the dominant and non-dominant side. (McLean & Tumilty 1993, 260-262)

6 FUNCTIONAL MOVEMENT SCREEN

Athlete screenings are simple and fast physical examinations, and can be applied readily to a large number of individuals. Usually the screening includes examination of the posture of an individual, range of motion, muscle strength and functional based tests. Screenings are used to make sure athletes do not have issues with movement. If problems occur during the screening, a more profound inspection is conducted by a physiotherapist, to focus on the pain or dysfunction found. (Ahonen & Sandström 2011, 342-343)

According to Football Medicine Manual by FIFA (2009, 24), a medical assessment should be performed before athletes start to participate in sports. As mentioned earlier, the most important risk factor for an injury is a previous injury. An interview is also an essential component during an athlete screening, to carry out asking about previous injuries and musculoskeletal issues that the athlete may have experienced.

The Functional Movement Screen (FMS) was created to screen and assess dysfunctions of movement, to minimize risk of injury. The book, written by Cook et al (2010, 15), proposes that movement patterns should be screened before training them. If movement patterns are trained with poor quality, this can promote risk of injury in athletes and in the general population. The FMS aims to identify imbalances and limitations within the patterns, because these are related to a greater risk of injury. The screening is designed for individuals who do not have current pain or known injuries. Pain can change the way an individual moves and this is taken into consideration while assessing an individual.

The screening consists of seven separate tests, as well as three clearing tests. The movement patterns are the Deep squat, Hurdle step, Inline lunge, Shoulder mobility, Active Straight leg raise, Push up and Rotary stability. The first three tests are described to be functional, and the last four tests fundamental. This is because, the first three tests are conducted in a standing position and represent the three primary foot positions. The last four tests are done in supine, prone or quadruped positions. According to the FMS material, the fundamental movement patterns should be correct before training the functional patterns. (Cook, Burton, Kiesel, Rose & Bryant 2010, 92-93)

All the tests are scored separately from zero to three and then summed together, twenty-one being the maximum score for the screening. Three points is received if the pattern is performed without compensations or pain. Two points can be marked if the subject perceives no pain, but presents movement compensations. One point is received, if there is no pain, but the participant cannot perform the actual movement pattern. Score of zero is marked, if the subject experiences pain in any of the seven tests, or in the three clearing tests. (Cook, Burton, Kiesel, Rose & Bryant 2010, 94) According to research by Kiesel, Plisky and Voight (2007, 151), a score under fourteen in the Functional Movement Screen indicates a greater risk of injury on professional American football players.

6.1 Deep Squat Movement Pattern

The deep squat pattern is essential to many functional movements. Even though full deep squats are not often needed, active people still need the basics to perform a deep squat. Mobility of the extremities, postural control and stability in pelvic and core regions are needed in the movement pattern. The movement is used to test bilateral, symmetrical, functional mobility and stability of the lower extremities. The test includes using a stick held overhead. This addition to the test requires mobility and stability of the shoulders, scapular region and thoracic spine. (Cook, Burton, Kiesel, Rose & Bryant 2010, 107-109)

The test begins with the test subject standing with feet at shoulder width. The subject places their hands on the dowel so that the elbow joint is in 90 degree flexion when the dowel rests on top of the head. The subject is instructed to push the dowel directly up, while squatting down. The heels should be in contact with the floor during the whole movement. Head and chest should be vertical and the dowel aligned above the head. The subject repeats the movement three times. If a score of three is achieved as illustrated in Picture 1 below, no further tests are needed. In case the subject is not able to perform the pattern like this, a board provided by the FMS kit can be placed under the heels, and the test is repeated. Using the board gives the subject score of two, upon satisfactory completion of the movement pattern. If the subject is unable to perform the movement with the board, a score of one is given. (Cook, Burton, Kiesel, Rose & Bryant 2010, 90)

Picture 1: Three point deep squat movement pattern (Cook, Burton, Kiesel, Rose & Bryant 2010, 91)

The subject is observed from the frontal and sagittal planes to see the angle of the torso and placement of the dowel. During the screening, the reason behind possible compensations is not assessed, and if there is doubt in the scoring, the FMS manual instructs to always score low. (Functional Movement Systems 2017, 10)

6.2 Hurdle Step Movement Pattern

The second test in the FMS screen is the hurdle step. The function of this test is to reveal possible compensatory movements and asymmetries during the step. It challenges the body in a mechanical way and requires balance to stand on one leg during the step. The pattern requires good coordination while the other leg is stationary and the other one is lifted over the hurdle. If the subject has hip mobility, good stability, postural control and balance, compensatory movements should not be necessary to perform the test. (Cook, Burton, Kiesel, Rose & Bryant 2010, 92)

Before testing the pattern, the height of the hurdle must be determined by measuring the distance from the floor to the tuberositas tibiae of the test subject. The starting position of the test has the subject stand behind the hurdle, with toes touching the board, the dowel behind the neck with hands holding it. When the starting position is correct, the subject is instructed to step over the hurdle touching the floor with the heel and returning to the starting position in a slow and controlled way. (Cook, Burton, Kiesel, Rose & Bryant 2010, 92)

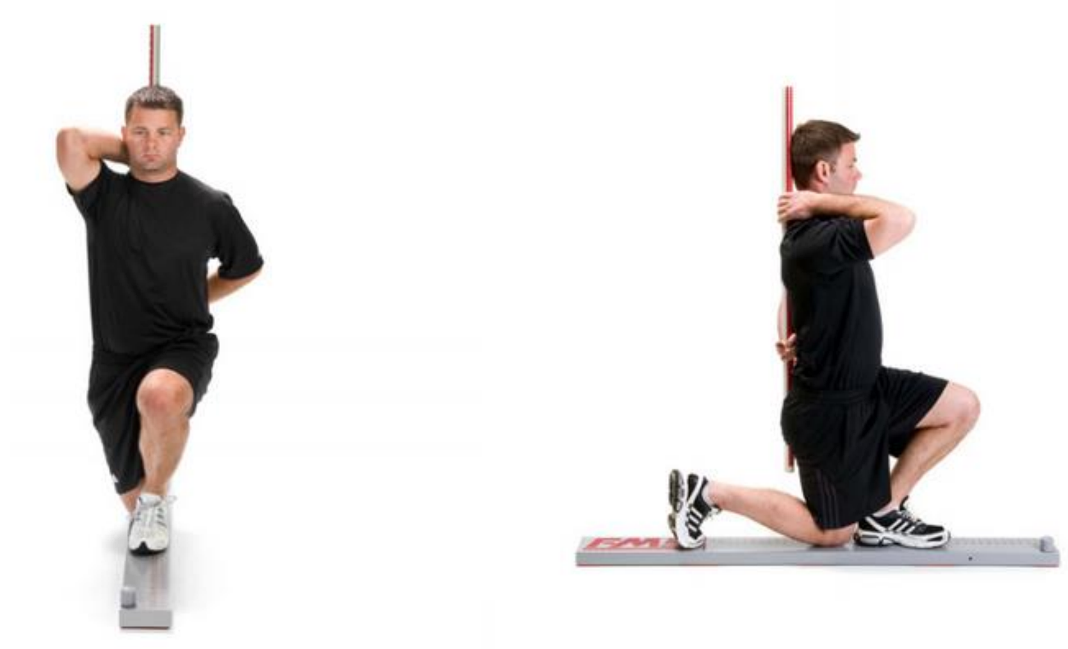
The test is viewed from the front and side and the tester should pay close attention to the stability of the movement pattern. The test is performed for both sides and the score is determined by the leg stepping over the hurdle. Picture 2 below shows the correct movement pattern, which gives a score of three. In case of compensations the score of the test can also be two and if the subject cannot perform the test, the score is zero. (Cook, Burton, Kiesel, Rose & Bryant 2010, 92)

Picture 2: Three point hurdle step movement pattern (Cook, Burton, Kiesel, Rose & Bryant 2010, 93)

6.3 Inline Lunge Movement Pattern

The inline lunge is the third test of the FMS screening. It provides insight on the function of the both sides of the body. It is a component of the deceleration movements needed in many sports, exercises and daily activities. The pattern requires balance in the starting position and continuous control from the pelvic and core region as the pelvis is placed asymmetrically. The inline lunge as a test challenges the mobility and stability of the foot, ankle, knee and hips, as well as the flexibility of multi-joint muscles like latissimus dorsi and rectus femoris. (Cook, Burton, Kiesel, Rose & Bryant 2010, 94)

In the inline lunge, the feet of the subject are placed in a split-stance position while the upper extremities are positioned in a reciprocal manner. The upper arm is placed behind the cervical spine holding the dowel and the lower arm is holding on to the dowel behind lumbar spine. The dowel is meant to be touching the head, thoracic spine and sacrum of the subject during the whole movement. The feet of the subject are on the board, so that the distance between the heel of the front foot and the toes of the back foot is same as the tibia measurement of the subject. The subject is instructed to keep the posture vertical, with the dowel touching the three points of contact, and to lunge down so the knee touches the board as can be seen from Picture 3 below. (Cook, Burton, Kiesel, Rose & Bryant 2010, 94)



Picture 3: Three point inline lunge movement pattern (Cook, Burton, Kiesel, Rose & Bryant 2010, 93)

6.4 Shoulder Mobility Movement Pattern

The shoulder mobility movement pattern provides insight into the mobility of scapular, thoracic spine and ribs during a reciprocal movement of the upper extremities. The movement demonstrates mobility of both shoulders at the same time. The arm, placed behind the back from above is in flexion, external rotation and abduction as the one coming from below is in extension, internal rotation and adduction. (Cook, Burton, Kiesel, Rose & Bryant 2010, 96)

Prior to the movement test, the hand is measured from the wrist of the subject to the fingertips. This is used as a reference measure in scoring the test. The subject is instructed to place both hands in a fist and placing both hands behind the back. Other one from above as low as possible and other one from below as high as possible. The subject repeats the movement three times. The distance between the fists is measured to score the movement pattern as is illustrated in Picture 4. (Cook, Burton, Kiesel, Rose & Bryant 2010, 96)

Picture 4: Three point shoulder mobility pattern (Cook, Burton, Kiesel, Rose & Bryant 2010, 97)

Both sides are measured and the score is determined by the side that is placed from the above. A score of three is marked when the subject is able to place their hands so close to each other that the distance between is under the measure of one hand. A score of two is marked when the distance is under one and half hands. A score of one occurs when the distance is over one and a half hands. (Cook, Burton, Kiesel, Rose & Bryant 2010, 96)

After the shoulder mobility movement pattern, the FMS screening includes performing a “clearing test” for the shoulders. This is done in order to reveal possible impingements around the glenohumeral joint. The clearing test is carried out as a provocation test for both shoulders. The athlete is instructed to place one hand on the contralateral shoulder and lifting the elbow towards the ceiling while maintaining contact of the hand and shoulder (Picture 5). If the subject experiences pain during the test, a score of zero is marked for the shoulder mobility test as well. (Cook, Burton, Kiesel, Rose & Bryant 2010, 94)

Picture 5: Shoulder clearing test (Cook, Burton, Kiesel, Rose & Bryant 2010, 97)

6.5 Active Straight-Leg Raise Movement Pattern

The active straight-leg raise is used to examine control of the pelvic and core region, as well as mobility of the hips while the lower extremities are placed in a reciprocal manner. This pattern requires flexibility from gluteus maximus, tractus iliotibialis, hamstring muscles and hip flexor muscles. (Cook, Burton, Kiesel, Rose & Bryant 2010, 98)

The subject begins supine on the floor, hands placed next to the body, with palms facing up. The board from the FMS kit is placed under knees and the lower extremities are in a neutral position. The anterior superior iliac spine (ASIS) and mid-patella are palpated and the dowel is placed in the middle of these two landmarks vertically, to help with determining the score for the test. The subject is instructed to lift one leg up as high as possible, whilst keeping the leg straight. The other leg should be in contact with the board during the whole movement. The test can be performed three times for both sides. (Cook, Burton, Kiesel, Rose & Bryant 2010, 98)

The score for the active straight leg raise movement pattern is marked for the raised leg. When the subject has lifted the leg as high as possible, the vertically placed dowel is used as a reference point to examine where the lateral malleolus of the ankle is placed. If the malleolus is between mid-thigh and ASIS, the subject receives a score of three as happens in Picture 6 below. If the vertical line of the malleolus is between mid-thigh and patella, the score is two. In case the malleolus is below mid-patella, the score is one. (Cook, Burton, Kiesel, Rose & Bryant 2010, 98)

Picture 6: Three point active straight-leg raise movement pattern (Cook, Burton, Kiesel, Rose & Bryant 2010, 99)

6.6 Trunk Stability Push-Up Movement Pattern

The trunk stability push-up test provides information on the core control of the test subject. The movement is used to test stability of the spine in the sagittal plane, using closed kinetic chain and symmetrical loading of the upper extremities. The most common compensatory movements in this pattern are extension of the back and rotation. (Cook, Burton, Kiesel, Rose & Bryant 2010, 100)

The starting position of the test is different based upon the gender of the subject. Men place their thumbs on the level of their forehead (Picture 7) and women place their thumbs on the level of their chin. Knees are in full extension for both genders and feet are touching the floor. From this position the subject is instructed to perform a push-up. If the subject is not able to do the test, the hand placement is changed. Men place their fingers on the level of their chin and women place their thumbs on the level of their clavicle. (Cook, Burton, Kiesel, Rose & Bryant 2010, 100)

Picture 7: Start and finish of a trunk stability push-up movement pattern (Cook, Burton, Kiesel, Rose & Bryant 2010, 101)

The test can be performed three times and the subject is to raise the trunk simultaneously, so that the chest and abdominals rise at the same time. A score of three is marked if the subject is able to perform the movement from the starting position first described. If hand placement needs to be altered, then a score of two is marked. In case the subject cannot do the push-up, a score of one is given. (Cook, Burton, Kiesel, Rose & Bryant 2010, 100)

After the trunk stability push-up movement pattern, an extension clearing test is conducted. The test is performed from a push-up position by straightening the arms. The upper body is lifted from the floor and the back and spine is extended as portrayed in Picture 8. If the subject experiences pain during the extension, the clearing test is positive and the score for trunk stability push-up movement pattern is zero. (Cook, Burton, Kiesel, Rose & Bryant 2010, 100)

Picture 8: Extension clearing test (Cook, Burton, Kiesel, Rose & Bryant 2010, 10)

6.7 Rotary Stability Movement Pattern

The rotary stability movement pattern is used to test control of the hips, core and shoulder girdle area during a combined lower and upper body movement. During the movement pattern weight is shifted in transverse plane. The test is complex and requires proper neuromuscular control to perform. (Cook, Burton, Kiesel, Rose & Bryant 2010, 102)

In the rotary stability movement pattern the subject is instructed to go into all-fours position, so that the board is placed longitudinally between hands, knees and feet. The subject is instructed to keep contact with the board with the hands, knees and feet in the starting position. The hips and shoulder should be flexed to a 90-degree angle in relation to the torso. Ankles should be in neutral position, so that soles are perpendicular to the floor. The instruction for the subject is to lift the hand forward while simultaneously lifting the leg backwards, like flying (Picture 9). After this, the ipsilateral knee and elbow should be in contact. The arm and leg should then be extended one more time, before instructing the subject to return to the starting position. (Cook, Burton, Kiesel, Rose & Bryant 2010, 102)

Picture 9: Three point rotary stability movement pattern (Cook, Burton, Kiesel, Rose & Bryant 2010, 103)

The test can be performed three times but even one successful execution is enough. The score in the rotary stability test is determined by the side of the moving arm. If the subject cannot do the three point version of the test, the subject is instructed to repeat the pattern by moving contralateral arm and leg. In case the movement cannot be performed without compensatory movements, a score of one is marked. (Cook, Burton, Kiesel, Rose & Bryant 2010, 102)

The last piece of the FMS screen is a flexion clearing test. The test is conducted after the rotary stability test. The purpose is to provoke possible pain in spine. The subject is instructed to go into crawling position and rock back, placing the body on the legs. The glutes should touch the heels of the feet, the chin is directed towards the legs and arms are reaching forward as far as possible (Picture 10). If the clearing test presents pain, the score for the rotary stability test is zero. (Cook, Burton, Kiesel, Rose & Bryant 2010, 102)

Picture 10: Flexion Clearing test (Cook, Burton, Kiesel, Rose & Bryant 2010, 102)

7 THESIS PROCESS AND METHODS

The process for the thesis started in the autumn of 2015 by thinking of possible topics to choose from. The reasons behind choosing this topic formed from a number of sources. The goal of the author is to work as a physiotherapist with athletes, so the topic of the thesis stemmed from the field of sports physiotherapy. In October 2015 the author was asked to join the football team of Musan Salama as a physiotherapist, after which the opportunity to carry out a practical Bachelor’s thesis formed. Injury prevention in sports has always been an interesting topic to the author, so the aim was directed towards the risk management of sports injuries.

The Functional Movement Screen has been familiar for the author for a few years now. The idea of screening the players of the first team was suggested to Musan Salama RY. The football club agreed to cooperate with the author and covered the costs of the Functional Movement Screen Level 1 Online course, which was completed during spring and summer of 2016.

The screening of fifteen players was implemented during spring and summer of 2016. During this time, studies using FMS were researched to figure out research questions for the thesis. Articles and books were also explored on injury prevention to narrow down the topic focusing on, if the players had any functional dysfunctions or asymmetries based on hand or leg dominance. During the autumn and winter of 2016 most of the theory was written and the practical part of the written text was documented during 2017 winter.

The study design of the thesis was chosen to be quantitative since the topic was to find out if the football players have functional dysfunctions or asymmetries according to the Functional Movement Screen. The FMS screening tool scores the tests by numerical values so they were able to be compared statistically using Excel spreadsheet program.

The quantitative research method is based on number and percentages, with large enough sample sizes. Standardized research forms are usually applied in quantitative researches, as well as visualizing the results of the study. (Heikkilä 2008, 16)

8 IMPLEMENTATION

The screening was conducted on fifteen players in total. The testing was done during the preseason and season of 2016. During the time of screening, the age of the players varied from 16 to 33 years old. Average age of the participants was 24,7 years and players from all playing positions were included in the testing. The players were scheduled to come to the testing space on Wednesdays, because that day was free of training.

By this, the goal was to minimize the variability of results, because training fatigue and muscle tightness may impact the screening.

The subjects arrived to the testing space individually to meet the tester. One screening lasted for approximately 20-30 minutes, with explanations of the screening results. The screening began by filling out a consent form and signing it (Appendix 1). Some of the players in the screening were under 18 years old, so their parents were asked to sign the consent form. A questionnaire was also filled that included information about height, weight, playing position, hand/leg dominance, previous injuries, when the injury happened and how long it lasted (Appendix 2). This questionnaire form also contained the table for scoring the tests.

In the testing situation, there were the subject and the tester. The tester gave instructions according to the FMS manual and made sure the subject understood the directions. After this the subject performed the test, per the verbal instructions. The tester marked the scores of the movement pattern during the screening. The testing kit used was self-made using the dimension provided by the Functional Movement Systems.

9 RESULTS

The research questions for the thesis were determined to be: Do the players have functional dysfunctions or asymmetries according to FMS? If so, are the asymmetries related to the hand or leg dominance of the athlete? The test results that presented asymmetries based on hand or leg dominance are examined more closely with column charts comparing the sides.

The number of test subjects was fifteen in total. The total scores were distributed according to the Figure 4 seen below. The red line represents the score of fourteen, which means that the risk of injury is higher, if the score of the screening is under this line. Two (13,3 %) of the athletes received a score of twelve and two (13,3 %) a score of fourteen. Rest of the test subjects, eleven (73,3 %) were given a score above 14. Minimum score of twelve and maximum score of nineteen were recorded in the tests. The average final score for the whole research group was calculated to be 15,93.

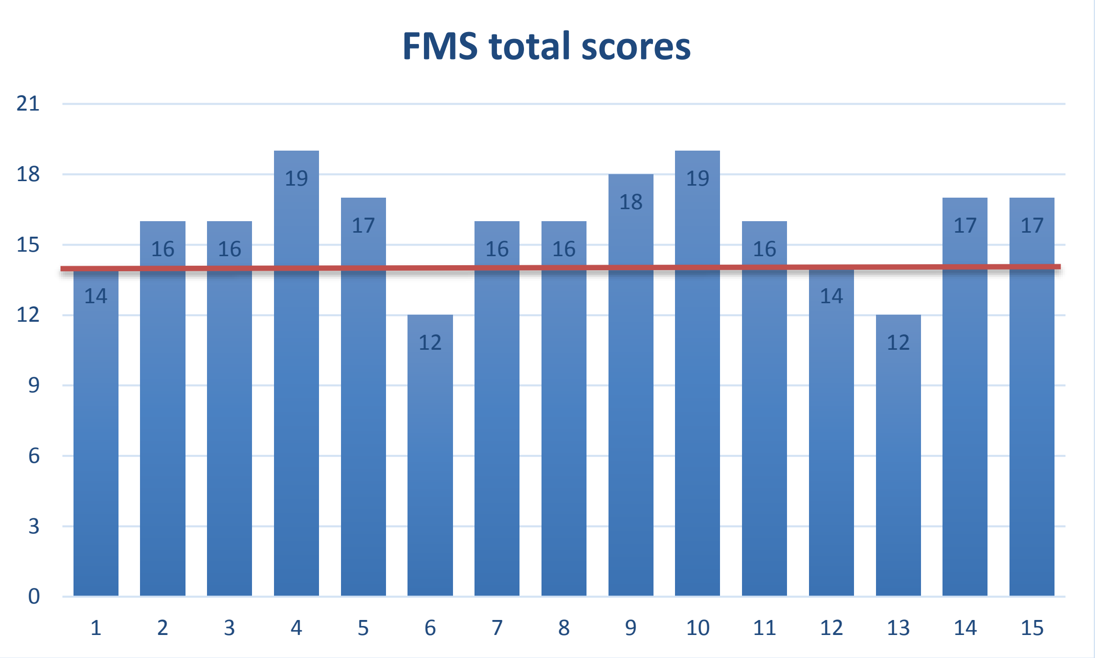


Figure 4. Total scores of individual subjects (n=15).

Asymmetrical movement patterns were witnessed in 73 % of all the participants. The rest of the test results of the players, 27 % were symmetrical (Figure 5). The maximum points for a single test was 3 and minimum 0 points, if pain was perceived during the test. The order of presenting the test scores will be so, that the symmetrical movement patterns are first (Deep squat and Push-up) and the asymmetrical movement patterns after (Hurdle step, Inline lunge, Shoulder mobility, Active straight-leg raise and Rotary stability).

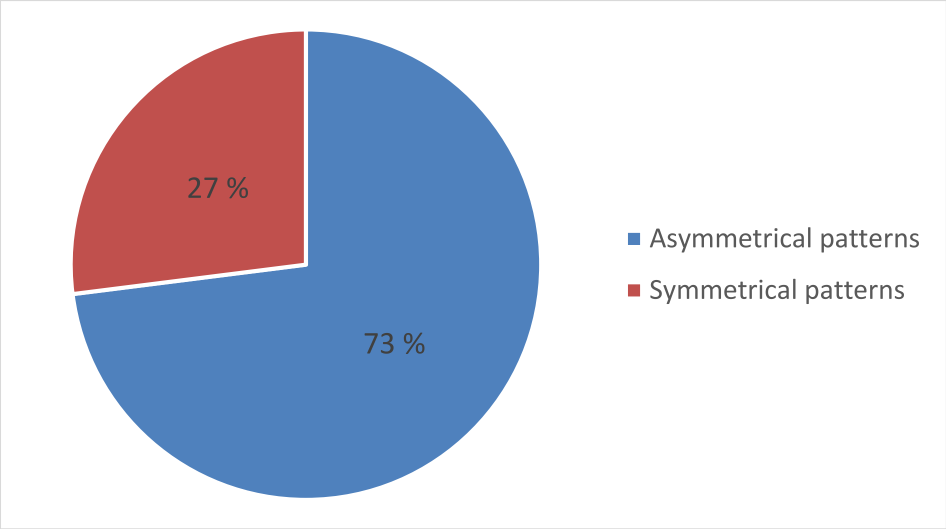


Figure 5. Segmentation between symmetrical and asymmetrical movement patterns (n=15).

9.1 Symmetrical movement patterns

Two tests out of seven in the FMS examine the movement patterns in a symmetrical way. These tests are the Deep squat and the Push-up. Three subjects (20 %) received score of three in the deep squat movement pattern as rest of the test group, eleven participants (73,3 %) received score of two and one player got a score of zero because perceived pain during the movement. For the push up movement pattern test thirteen (86,7 %) athletes received a full score of three, one (6,7 %) subject received a score of two and one player got a score of zero because of perceived pain in the extension clearing test.

9.2 Asymmetrical movement patterns

The total amount of fifteen test subjects were divided into two groups based on their dominant side (nine right legged players and six left legged players). With the shoulder mobility test, the subjects were also compared based on their dominant hand (thirteen right handed players and two left handed players). Even though the final FMS scores are received based on the side that receives a lower score, the preliminary scores were recorded for both sides to compare differences based on the side dominance.

9.2.1 Hurdle Step Movement Pattern

In the hurdle step, final scores were distributed so that eight (53,3 %) subjects received score of two and the remaining seven (46,6 %) received a score of three. Asymmetries were found in three (20 %) players in the hurdle step test. In the right-legged group, two of the subjects presented asymmetries. Both of them had a higher score on the dominant side (Figure 6).

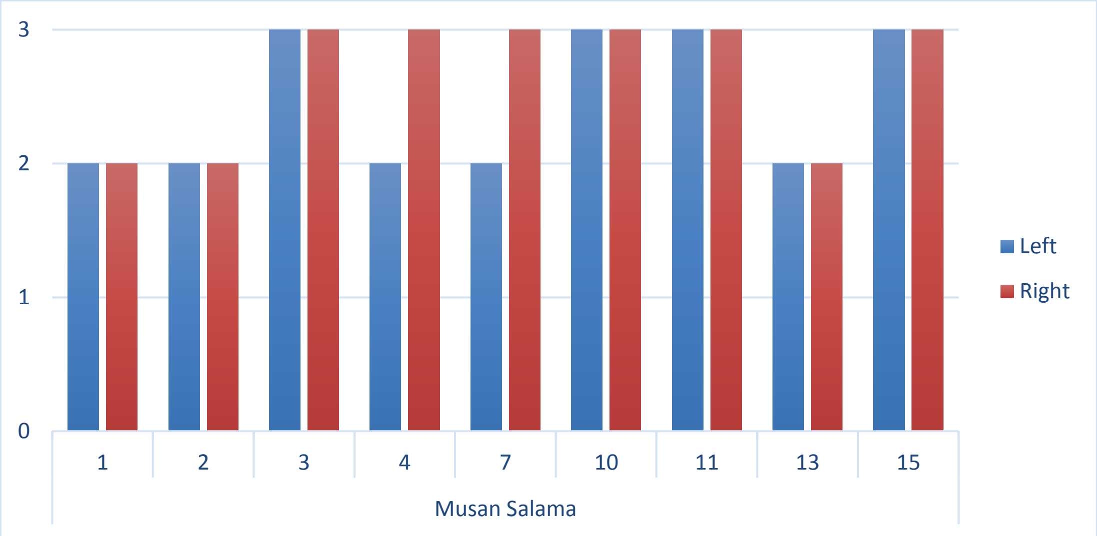


Figure 6. The hurdle step movement pattern scores for right legged players (n=15).

In the left-legged group, only one participant presented an asymmetrical score. Non-dominant side scored higher when compared to the other side (Figure 7).

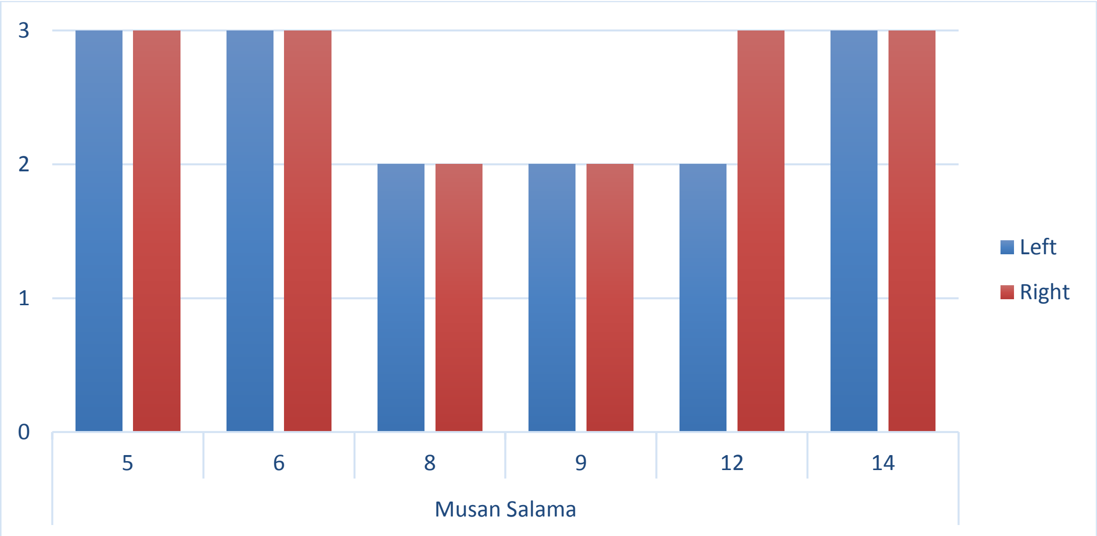


Figure 7. The hurdle step movement pattern scores for left legged players (n=15).

9.2.2 Inline Lunge Movement Pattern

In the third test of inline lunge movement pattern, three (20 %) subjects received a score of two as the rest of the group, 12 (80 %) athletes received score of three. Asymmetries were recorded with two (13,3 %) players. The scores did not present any correlation in relation to the dominant side.

9.2.3 Shoulder Mobility Movement Pattern

In the shoulder mobility movement pattern, the scores were compared with the dominant hand instead of leg. In the test group, there were two left-handed persons and the remaining thirteen were right-handed. Out of the right-handed group one (6,7 %) received a score of one, nine (60 %) received the score of two and the remaining three (20 %) got three points. Asymmetries were found in six (40 %) subjects. Out of these six persons, four had a lower score on their non-dominant side as the remaining two subjects had a lower score on their dominant side (Figure 8).

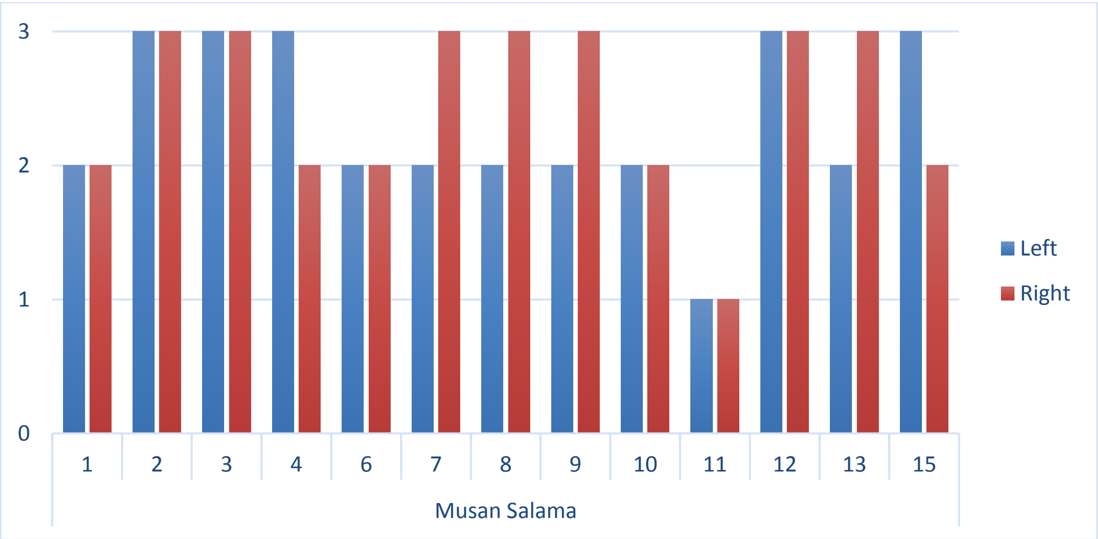


Figure 8. The shoulder mobility movement pattern test scores for right-handed players (n=15).

The left-handed group with two subjects received a score of three without any asymmetries (Figure 9).

Figure 9. The shoulder mobility movement pattern test scores for left-handed players (n=15).

9.2.4 Active Straight-Leg Raise Movement Pattern

The active straight-leg raise movement pattern showed differences in scores between the right- and left-legged groups. In the whole study group, only one participant (6,7 %) received a final score of zero because of perceived pain, one subject (6,7 %) received a score of one, ten (66,6 %) players got the score of two and the remaining three (20 %) were given the score of three. In three (20 %) out of nine right-legged athletes, there were asymmetries involved, the non-dominant side was recorded to have a lower score compared to the right side (Figure 10).

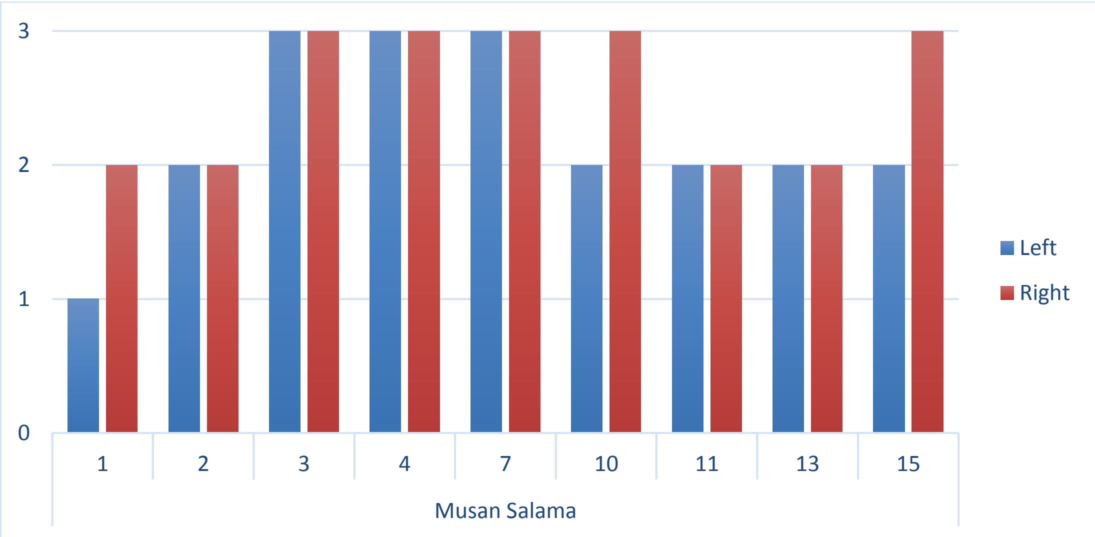


Figure 10. The active straight-leg raise movement pattern test scores for right-legged players (n=15).

Asymmetries were also present in the left-legged group: three subjects out of six displayed differences in sides. Two (13,3 %) of these three players had a lower score on their non-dominant side and one (6,7 %) of the players had a lower score on the dominant side (Figure 11).

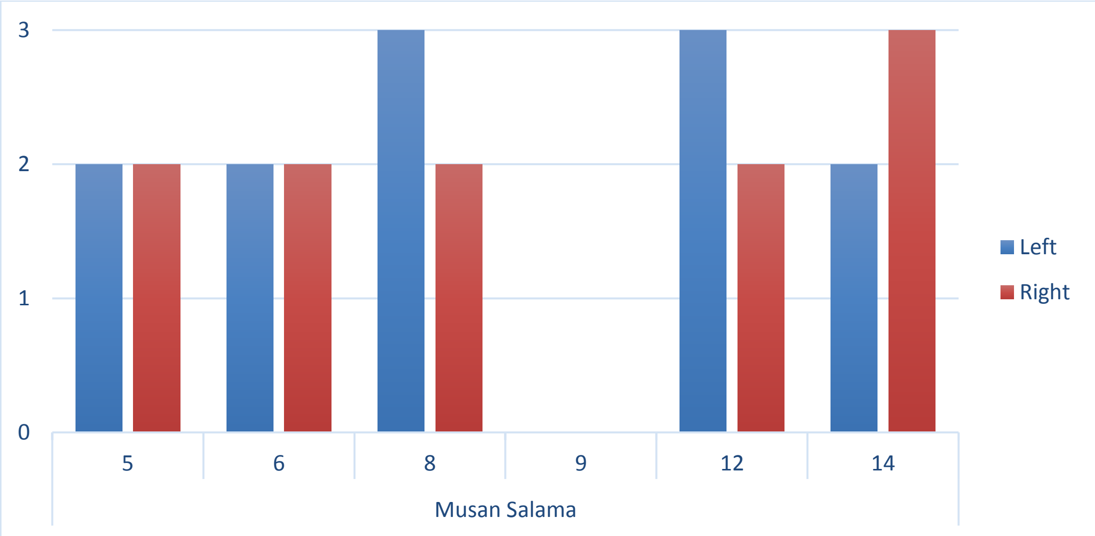


Figure 11. The active straight-leg raise movement pattern test scores for left-legged players (n=15).

9.2.5 Rotary Stability Movement Pattern

For the final test of the FMS screening, rotary stability movement pattern, only one (6,7 %) subject received a score of three. Thirteen subjects (86,7 %) got a score of two and one player was marked a score of zero because of perceived pain in the flexion clearing test (Figure 12).

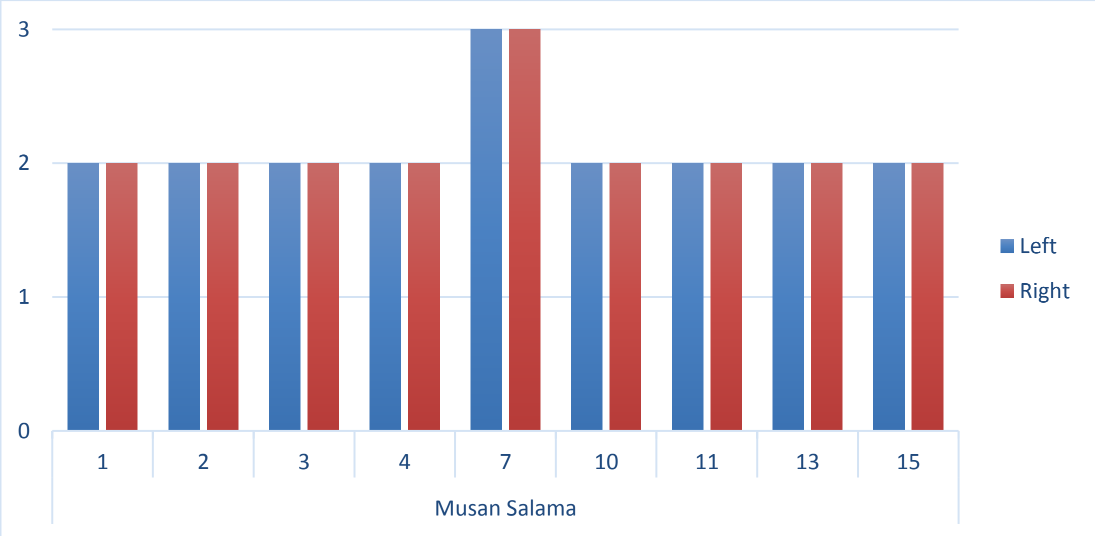


Figure 12. The rotary stability movement pattern test scores for right-legged players (n=15).

The right-legged group did not present any asymmetries between the sides but the left-legged group of six had two participants that displayed a higher score on their dominant side (Figure 13).

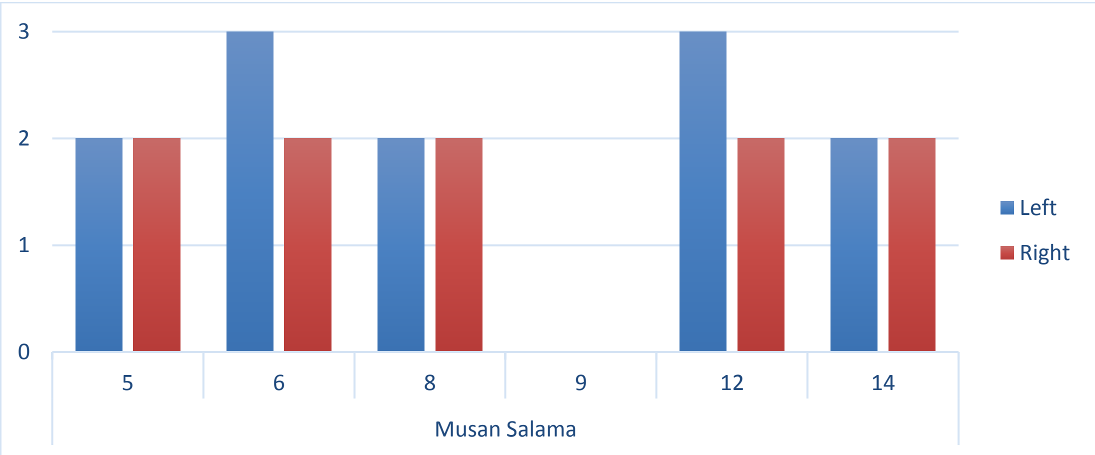


Figure 13. The rotary stability movement pattern test scores for left-legged players (n=15).

10 CONCLUSIONS

One of the research questions of the thesis was determined to be whether the football players of Musan Salama display any movement dysfunctions or asymmetries according to the FMS screening. Fifteen players were tested using the screening and none received the full score of twenty-one. Based on the tests, the players have movement dysfunctions in some areas. If the score of an individual test is not three, then some movement compensations are present.

The lowest average score was recorded from the rotary stability test. Based on this, it can be concluded that the football players might have movement dysfunctions in their core, hip and/or shoulder girdle. The stabilizers of these muscle groups are essential to maintain posture, as mentioned previously.

The second research question was defined as, if the players have asymmetries, are they related to the hand or leg dominance of the athlete. Based on the analysis, some of the tests present some correlation between the recorded asymmetry and side dominance. Asymmetrical tests like the hurdle step, shoulder mobility, active straight-leg raise and rotary stability showed signs, that hand/leg dominance might play a part on the score distribution, but it is hard to say for sure based on study sample this small.

In the right-legged group of hurdle step test, two of the subjects had a lower score when their dominant leg was balancing on the ground. In turn, in the left-legged group, one subject also had asymmetry in the movement. This asymmetry was on the same side as the right-legged group had. Based on this result, it cannot be concluded that side dominance had an effect on the scores.

In the shoulder mobility movement pattern, the subjects were divided based on their dominant hand instead of dominant leg. The left-handed group of two persons showed no asymmetries in the movement, but the right-handed group presented asymmetry in six subjects. Out of these six, four presented a lower score on their dominant side. The test measures the range of motion on both shoulders, so it is not possible to say, based on this screening which shoulder was the restricted one, the extended or the flexed one. Further assessment would have been needed to examine, which shoulder was limited in range of motion. Despite of this, the FMS results imply that hand dominance might have an effect to the score distribution.

The active straight-leg raise displayed most asymmetries based on the side dominance of the participants. The right-legged group had three subjects out of nine with asymmetries in the movement and all of them had lower score on the non-dominant side. The left-legged group presented asymmetries on three out of six players, which of two had lower score on their non-dominant side and one had lower score on the dominant left leg. These results imply that the football players might have limited range of motion on their non-dominant side. Non-dominant leg is usually the supporting leg, which is under a greater stress when kicking or passing the ball. This additional loading could be the cause of movement restrictions in the active straight-leg raise movement pattern.

Last test of the screening was the rotary stability movement pattern. The right-legged group did not present any asymmetries in this test. The left-legged group had two subjects out of six that had asymmetries between the scores. These two had a higher score when they were instructed to lift their left side up. This result might be caused by better control on the non-dominant side that was grounded during the movement.

11 DISCUSSION

Athlete screenings are widely used in the field of sports to identify possible dysfunctions prior to starting the training of the specific sport. Off-season practice should be based on the screening results to improve the performance capabilities of an athlete, as well as reduce the risk of injuries. (Kiesel, Plisky & Butler 2009, 1) The FMS screening provided information for myself as the team physiotherapist about the quality of movement of the players. The screening aided me in understanding the compensatory patterns of the players. Through this understanding, it has been easier to plan physical training for individuals, as well as the whole team.

The idea behind this Bachelor's thesis was to familiarize myself with athlete screenings, because the field of sports physiotherapy is where I want to work in the future. The purpose was also to educate the players of the team about how the quality of movement, movement dysfunctions and asymmetries can have an effect on their performance and risk of injury. The theoretical background of the thesis observed the facts surrounding this topic and gave more insight on injury prevention of athletes, specifically football players.

The Functional Movement Screen as an injury predictor has been criticized and questioned in some studies. According to a systematic review and meta-analysis done in 2015, the diagnostic accuracy of the FMS to predict injury is low. By this, the study implies, that the validity for predicting an injury based on the FMS score is limited. (Dorrel, Long, Shaffer & Myer 2015, 532-537)

Based on my personal experiences working with the football team, I relate to the conclusion of this systematic review. One of the players who received the lowest score, experienced an injury and took twelve weeks to rehabilitate. But on the other hand, one of the athletes who received on the highest points, suffered from minor lower body injuries throughout the season. Both of these cases were non-contact related injuries. My personal opinion after this process is that athlete screenings are an essential tool when working in sports physiotherapy, but it is impossible to take all the variables into consideration when working towards injury prevention.

The most time consuming area of the thesis was to collect reliable background information and references to write from. I also felt that it was a challenge to decide what topics I wanted to include in the theory. I believe the theory part could have been even wider since injury prevention involves so many different areas in addition to injury factors, movement quality, motor control, the actual screening options and muscle balance.

The idea of deciding to compare the scores between the dominant and non-dominant sides came early on during the thesis. Through empirical experience, I found that football players tend to have different musculoskeletal issues depending on their leg dominance. This led me shaping my research questions to examine this phenomenon more closely.

As a follow-up for this thesis it would be interesting to test the players again, plan an intervention based on the results and re-test them to measure the level of progress they have reached. This was an idea, but it was ruled out because it would have been too extensive for a Bachelor’s thesis. As a possible Master’s thesis topic, collecting more data from football clubs and examining larger sample size would also be an interesting subject for a thesis.

In the future, I plan to educate myself more on different athlete screening tools and continue applying those in my future work. I am happy I decided to choose the topic of the thesis as I chose. The process has been interesting and I feel I have learned a lot on athlete screening using the Functional Movement Screen.

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APPENDIX 1

Suostumuslomake FMS-kartoitukseen

Hei,

Opiskelen Satakunnan ammattikorkeakoulun englanninkielisessä fysioterapian koulutusohjelmassa. Teen opinnäytetyön Musan Salama ry:n edustusjoukkueelle ja käytän työssäni Functional Movement Screen-mittaria (FMS) urheilijoiden lihastasapainon määrittämiseen. FMS on testipatteristo, joka on kehitetty Yhdysvalloissa. Se on tarkoitettu liikkumisessa tarkoitettujen liikemallien tarkasteluun ja arviointiin. Testistössä on yhteensä 10 testiliikettä, joiden avulla havainnoidaan liikkuvuutta, liikkeen hallintaa ja -laatua. Testit pisteyttämällä saadaan tuloksia, joita voidaan soveltaa urheilijan vammojen ennaltaehkäisyssä.

Testit suoritetaan edustuksen pelaajille kevään ja alkukesän 2016 aikana. Testiin osallistuminen on vapaaehtoista ja toivonkin, että mahdollisimman moni osallistuu tutkimukseen. Mittaukseen osallistuminen edellyttää suostumuslomakkeen täyttämisen ja se palautetaan testin yhteydessä. Alle 18-vuotiailta vaaditaan huoltajan allekirjoitus. Opinnäytetyön ohjaajina toimivat fysioterapian lehtorit Maija Kangasperko (ft, TtM) ja Mari Törne (ft, TtM). Jos teillä ilmenee kysyttävää, niin vastaan mielelläni tutkimukseen liittyviin kysymyksiin.

Terveisin,

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[ ] Olen täysi-ikäinen ja suostun osallistumaan Satakunnan ammattikorkeakoulun fysioterapiaopiskelijan opinnäytetyön tutkimukseen keväällä 2016.

Allekirjoitus ja nimenselvennys:

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[ ] Huollettavani ________________________________ on alle 18-vuotias ja saa luvan osallistua Satakunnan ammattikorkeakoulun fysioterapiaopiskelijan opinnäytetyön tutkimukseen keväällä 2016.

Allekirjoitus ja nimenselvennys:

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APPENDIX 2

Functional Movement Screen
Kysely- ja pisteytyskaavake

Nimi:		PVM:	Syntymäaika:
Osoite:			
Kaupunki:		Sähköposti:	
Yritys/seura:		Ammatti:	
Pituus:	Paino:	Ikä:	Sukupuoli:
Päälaji:		Pelipaikka:	
Kätisyys/jalkaisuus:		Aikaisempi testitulos:	
Aikaisemmat vammat:			
Ajankohta:		Kuinka kauan vamma kesti?	

Testi:		**Alustava:**	**Lopullinen:**	**Kommentit:**
1. Kyykky				
2. Aita-askel	V			
	O			
3. Askelkyykky	V			
	O			
4. Olkapään liikkuvuus	V			
	O			
Impingementtitesti	V			
	O			
5. Suoran jalan nosto	V			
	O			
6. Punnerrus				
Ekstensiotesti				
7. Kiertotasapaino	V			
	O			
Fleksiotesti				
Yhteensä				