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**Ankle injury prevention guide for  
Kajaanin Haka 03/04 Team**

Bachelor of sports  
and leisure manage-  
ment

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## ABSTRACT

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**Title of the Publication:** Ankle injury prevention guide for Kajaanin haka 03/04 team

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The purpose of this bachelor's thesis is to provide functional and specified manual of ankle injury prevention for Kajaanin Haka youth team coaches. It provides basic information about the most common injuries in youth football. This thesis is done in collaboration with local football club Kajaanin Haka. Exercises in the manual aims injury prevention and making better football-playing athlete.

Football is fast paced and very physically demanding game. Physical demands varies between the playing position and playing style of the players. This effects the nature of the injuries occurring during the match. Factors that causes injuries are divided into two groups, intrinsic and extrinsic factors. Youth football players suffers similar injuries as adult players even though the game is different in both levels.

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## 1 INTRODUCTION

Football or soccer is by far the most played and the most popular sport around the world. Majority of the players are children (Faude. O, Rosler. R, Junge. A. 2013.) Latest estimation of the Fifa (International Federation of football association) showed that there are more than 265 million people playing football globally. This is close to 4% of the worlds' population (Kuntz, 2007.) Finland has more than 140 000 licensed players, 110 000 of this were juniors (under 18 years old) and the amount of players is predicted to grow every year with few percent. This makes it the most played game in Finland (Palloliitto, 2016.)

Football has various health benefits such as increased aerobic power, fat loss and prevention of life-style diseases (Krustrup et.al. 2010). Risk to get injured in football is high, due to its fast pace and hard collisions between the players. Some injuries can be very severe and long lasting but most of the injuries are mild. Most of the accidents that occurs in Finland happens during sporting (Parkkari. et.al. 2004) and majority of these accidents occur to children (Peterson. et.al. 1998b).

To be able to prevent injuries it is crucial to find out the most common injuries and the risk factors the game offers. Football is full of various situations where injury can happen. There are self-caused injuries and injuries caused by other factors.

The reasons for the injuries are often misunderstood especially in youth football. It is common to blame bad luck and other players or even the pitch when injury occurs. In many cases, the reason is a sum of various physical weaknesses and wrong choices made in the field. Some of the injuries are possible to avoid and control with proper preventive training and teaching the players correct techniques, for example running technique. This thesis will help the coaches to teach correct preventive training to avoid ankle injuries and at the same time players

## 1.1 The purpose of the thesis

The purpose of this thesis is to provide functional and specified manual of ankle injury prevention for Kajaanin Haka youth team coaches. Also, it provides basic information about the most common injuries in youth football. This thesis aims to find reliable sources and various exercises for the club to use. This thesis is done in collaboration with local football club Kajaanin Haka. Exercises, which are presented in the manual aims injury prevention and making better football-playing athlete. This manual provides information about athletic development as well.

This thesis concentrates only in prevention not reconditioning even though some of the exercises are suitable for the use in a reconditioning program. The final product is exercise bank more than a specific program for injury prevention. Another purpose of this thesis was to put the exercises in practice and get players opinions about the exercises. Test group was Kajaanin Haka 03/04 team.

After choosing, the topic of thesis next thing is to create the research questions, which acts as a foundation for the thesis and the project. Questions must be specified in order to limit the subject into smaller piece. The most important research question for this particular thesis was concerning the guide. Specifying the guide to fit the needs of the team and the club was the main idea for this thesis and requirement from the club.

How to make specified guide/program for preventing ankle injuries for the team?

What are the main reasons to cause ankle injuries?

How to find exercises that fits for the need of the team?

→ What are the preventive exercises?

## 2 KAJAANIN HAKA

Kajaanin Haka is a local football club in Kajaani. Club was established in 1953 and it has been very active since. Men's first team competes in a Finnish third division and the second team in a fourth division. The state of youth football in Haka is in a high level and they are eager to improve it every year. Nowadays they have junior teams for five different age groups varying from 8-17 years old. Kids under 11 years of age have their own "little league". They have created very successful little league for the whole region of Kainuu. This innovation has raised the amount of kids playing football in Kainuu. Haka wants to provide opportunities for every village inside a Kainuu region to play football. There is also "premier league" for 12-15 years old kids who are coming from the smaller villages and are representing their own village. Since the distances are very long in Kainuu region it is crucial to have programs like this. Kajaanin Haka also has an academy for players who are in army or in higher education, this academy provides a morning practices for the players and it is part of the second men's team, which plays in a fourth division.

Hakas' main principles are to provide good quality football coaching and developing the football culture of whole Kajaani region. Their new objective is to make better football playing athletes. This means new approach to coaching and player development. They want to have players in the men's' first team who have gone through the whole player path of Haka. This is important part of the continuity of the teams and club, also it ensures that the players want stay in Kajaani and play for them. The player path starts from the little league. There one can go through all the junior teams and then around 15 years of age the most talented players can already start practicing with the second or first team.

This thesis is done in collaboration with the club but the specified guide will be directed to 03/04 Haka team. This team consist of 15-17 boys, aged 14-15. Team practices four to five times a week, which includes physique training and sport specific training. During the winter, they played in futsal league in northern Finland.

### 3 FOOTBALL INJURIES AND PHYSICAL DEMANDS

Football is the most popular game in the world and it is played in every country (Reilly & Williams). Football is physically very demanding sport and the physical strain on body is high. It consists of fast direction changes from high speed, jumping, acceleration, deceleration and tackles. Player's physical capacity must be high in order to play 90 minutes (Williams, 2013). In football, two teams are trying to score more than the other does. Both teams have 11 players on the pitch and playing time is two times 45 minutes (Wong & Hong, 2005).

Many studies regarding football injuries has different definitions for a football injury. Often used definition is that football injury is injury, which has occurred in a match, or in training session, it requires medical attention from doctor or physiotherapist and it stops player to participate in the next training or match (Wong & Hong, 2005, 475). These researches can be interpret in many ways, this causes errors, and generalization of these results is not possible. Teams and players practice differently, some teams practice 5 days a week when other only twice a week, this means that other players have much more time to healing time. In many cases if the injury is light players might play especially if the match is important (Junge & Dvorak 2000.)

Football is very injury risk sport and greater number of the injuries are lower limb injuries, primarily in ankle and knees but also hip, groin, and thigh injuries are common. The amount of concussions occurring in football is often underestimated (Dvorak & Junge, 2000; Wong & Hong 2005, 475.) Another often-appearing injury is hamstring strain (Woods, et.al, 2004). Hawkins and his colleagues (Hawkins, Hulse, Wilkinson, Hodson & Gibson 2001, 44–45) studied male professional player injuries and they came into conclusion that 37% of all injuries are muscle tears or strains, 19% is ligament tears or sprains and 13% is contusions.

### 3.1 Ankle injuries

Ankle is very vulnerable for injuries. It is close to the ball throughout the game and this is why it often is injured. The risk to be injured is highest in dribbling, shooting and tackling (Tucker, 1997.) Ankle joint is carrying the weight of the whole body and due to this; the joint is under a great stress. (Orava, et al, 2006).

Ninety percent of all ankle injuries are sprains and they often occur in the lateral ligaments (Volpi, 2006). Lateral ligament injury mechanism is an inversion when feet is in a plantarflexion (Tucker, 1997). Ankle ligament injuries are divided into 3 groups from mild sprain to full tear of the ligament (Orava, et.al, 2006).

#### 3.1.1 Ankle Ligament Injuries

When player sprains their ankle, the lateral ligaments are the ones to suffer sprains or tears. Ninety five percent of all ligament sprains occurs in an outside side of the ankle (Hertel, 2002.) Lateral side inversion sprain occurs usually in a ground contact of running or bad landing from a jump with foot in a plantarflexion, which causes an inversion (Baxter, Schon & Porter, 2007). Poor ankle and foot control causes frequent sprains (Pasanen, 2009).

In most cases, tearing happens in posterior talofibular ligament (FTA ligament). In addition, Calcaneofibular ligament (FC ligament) is very vulnerable for sprains. Both of these ligaments can sprain or tear simultaneously. This often happens when the foot undergoes excessive inversion (Hertel, 2002.)

Torn of medial ligaments of the ankle require hard contact and is often caused by extrinsic factors (Pasanen, 2009.) It is harder to treat than posterior ligament injury and often demands surgery. Excessive eversion is caused by extrinsic factors such as uneven field or hard tackle. After serious ligament injury, ankle can become very loose even with proper treatment and reconditioning (Orava, 2006.)

### 3.1.2 Ankle Joint injuries

Joints on lateral side of the ankle have higher risk to suffer damage than the ones on the medial side. The most common joints to suffer an injury are peroneus longus and peroneus brevis. Usually joint is torn; this can happen in a takeoff, a hard contact to the joint or simultaneously with a sprain. In some cases, these joints can break and surgery is needed to repair the joint. (Orava, 2006.)

Another joint that can suffer injury is tibiocalcaneal. It is very strong joint and it is situated on the medial side of the ankle. It attaches to the side of the navicular bone and youth players might have a painful extra bone (tibiale externum) in that attachment point. This bone can rub against the joint and cause inflammation and pain. It rarely breaks but sometimes it might mildly tear. (Orava, 2006.)

### 3.2 Intrinsic factors

Sports causes millions of injuries yearly. The risk factors, which are leading to injuries, are divided in two groups; Intrinsic factors (person related) and extrinsic factors (environment related). (Murphy, et.al, 2003.)

Intrinsic factors has two groups, physical and psychological abilities. Physical abilities include sex, age, injury history, poor rehabilitation, aerobic and anaerobic fitness, body size, flexibility, muscle imbalance, postural stability, reaction time and anatomical alignment. Important psychological abilities are motivation and resistance to stress. (Murphy, et.al 2003; Parkkari, J. et.al. 2003.)

Previous injuries, inadequate rehabilitation and too early return to practices and games are the biggest reasons for injuries (Murphy, et.al 2003; Hägglund, et.al, 2006.) Hägglund (2006) founded correlation between injury history and suffering new injury. Players with more injuries in the past were more likely to be injured again.

Older players (25+ years) have higher risk to be injured than young players do (<17 years). Backous (1988) studied junior football players aged 6-17 and came into conclusion that after age of 14 risk to get injured doubles, reasons leading to this are increased pace of the game and physical abilities growth (Backous, et.al. 1988.) Many studies prove, that women athletes have a much higher risk to injure their knee or more specifically ACL joint (Murphy, et.al 2003).

Lack of flexibility is one major reason for hamstring and quadriceps injuries (Witrouw, Danneels, Asselman, D'have, & Cambier, 2003). Witrouw et.al (2003) showed in their study that there are no significant differences between the numbers of non-dominant and dominant leg injuries.

### 3.3 Extrinsic factors

Playing surface, shoe type, use of ankle tape or brace, level of competition and skill level are extrinsic factors. Players cannot affect to these risk factors by themselves, they need to be able to adapt to these. (Murphy, D.F., Connolly, D.A.J., Beynnon, B.D. 2003).

Highest risk to be injured is during competition (Murphy, et.al 2003). Nielsen and Yde studied 123 Danish male football players competing at different levels. They found that 60.5% of all injuries occurred in a game situation and the players' competition level affected injury incidence and the pattern of injury (Nielsen, & Yde, 1989.)

Various studies have analyzed the relation between skill level and injury. Findings proves that players with a lower skill level have higher risk to be injured. In youth football, the lower level players have a twofold increased incidence of all injuries compared to players with higher skill level (Murphy, D.F. et.al 2003.) Chorniak (et

al 2000) studied risk factors related to severe injury in 398 male football players. In low skill level, player incidence of severe injury was doubled compared to high skill level player. (Chomiak, Junge, Peterson, & Dvorak, 2000.)

Playing surface increases the incidence of injury. Artificial turf causes significantly more injuries than normal grass or gravel (Arnason, et.al. 1996).

### 3.4 Physical demands of football

According to (Mclaren, & Morton) recreational and elite level player consumes 5-17 kcal/min during game. Players run 5,5 km – 11 km per game depending their playing position. Position has major effect on the kilometres travelled during the game and intensity of the movements. Midfielders will run the most due to the nature of the game and the tactics of the game. 58%-70% of the game consist of walking or jogging corresponding to 7km. The rest 30% consist of moderate speed and high speed running and sprinting. Intensity of the game drops towards the end, especially in recreational football where physical condition is not in the same level. Average oxygen intake during the game is close to 70% of the maximal and heartbeat is around 85% of the maximal rate (Bangsbo, Magni & Krstrup, 1991.) Fatigue from the first half is the biggest reason for this. Running with ball is only 1,5%-2,4% of the total distance travelled (Di Salvo, et.al, 2007, 2–4).

Player performs 150-200 intense actions including sprints and physical battles with the opponent. Depletion of glycogen in some muscle fibres may be the reason for the fatigue towards the end of the game (Bangsbo, Magni & Krstrup, 1991.) Players perform 1000-1400 short timed actions that includes 10-20 sprints, 15 tackles, 10 headers, and 30 passes. High intensity running happens every 70 seconds (Stolen et. al).

### 3.5 Physical demands of youth football

Physiological differences between youth and adult player effects to the total distance covered, amount of high intensity actions performed and the frequency of the high intensity actions (Rumpf, 2015.)

Average distance covered by youth player (14-17 years) during 90- minute game is 4435-8098 meters. Twelve percent of this was high intensity running corresponding to 374-2062 meters. (Rebelo, Brito, Seabra, Oliveira & Krstrup, 2014). (Rebelo, et.al, 2014) came in a conclusion that towards the end players get fatigued and running speed decreases also heart rate of the players is high, close to 85% of the maximal heart rate. In younger children, these results are different due to smaller field and less players participating in the game (Capranica, Tessitore, Guidetti, & Figura, 2001.)

Youth players have notably lower maximal oxygen intake (VO<sub>2</sub> max) than adult players but their running economy is at the same level. On average it is proved to be <60 mL/kg/min. (Stole et.al.)

Playing position determines the physical demands and has major effect on the total distance covered. Likewise, in adult football midfielders covers more ground compared to other positions and strikers/wingers performs high intensity actions the most (Rumpf, 2015.)

## 4 ANATOMY OF THE ANKLE

Ankle has two functional parts, lower and upper ankle joint. Function of the lower limbs depends on these joints. The principles of kinetic chain base on the function of the joints. Understanding the medical components of the ankle will have tremendous effect on creating manual for injury preventive training. (Ahonen, et.al. 1998).

### 4.1 Bones of the Ankle

Ankle consist of 26 bones and it is made of joints and bones that joint each other. (Ahonen, et.al. 1998).The bones in the ankle form a metatarsus arch, which has divided into two supportive arches, Medial and lateral. Medial consist of talus, navicular, cuneiform, metatarsals and phalanges. Calcaneus and cuboid forms a lateral supportive arch (Hervonen, 2004.)

The biggest and the hindmost bone is calcaneus, it forms a back fulcrum of the ankle. Calcaneus joints with talus and cuboideum. Talus joints to naviculare and it joints with three cuneiform bones. These bones joints with metarsal bones. Ankle and wrist has a similar bone structure. Ankle has to carry the whole body weight and it has built to endure that. With arch build, the weight has divided evenly between the metatarsus and the heel (Ahonen, et.al. 1998; Kapandji, 1995).



Figure 1. Bones of the foot

## 4.2 Joints of the Ankle

### 4.2.1 Talocrural (TC) Joint

TC joint, also known as the ankle joint. It is formed between upper side of talus and lower part of tibia and fibula. Talus is wider from front than back and this forms a convex in the lower part of the joint. Joint forms two arches, Medial and Lateral, which has deeper crease. Upper surface of the joint connects with tibia and makes it concave. This surface is opposite to talus, wider from back than front.

The heads of tibia and fibula, also known as Lateral and medial malleoli joint to medial and lateral side of talus. Lateral malleolus (head of fibula) is bigger and located lower than medial malleolus (head of tibia). Big part of the stability of TC-joint comes from lateral malleolus. TC- joint is a hinge joint that moves ankle to dorsiflexion and plantarflexion (Ahonen, et.al. 1998; Kapandji, 1995.)

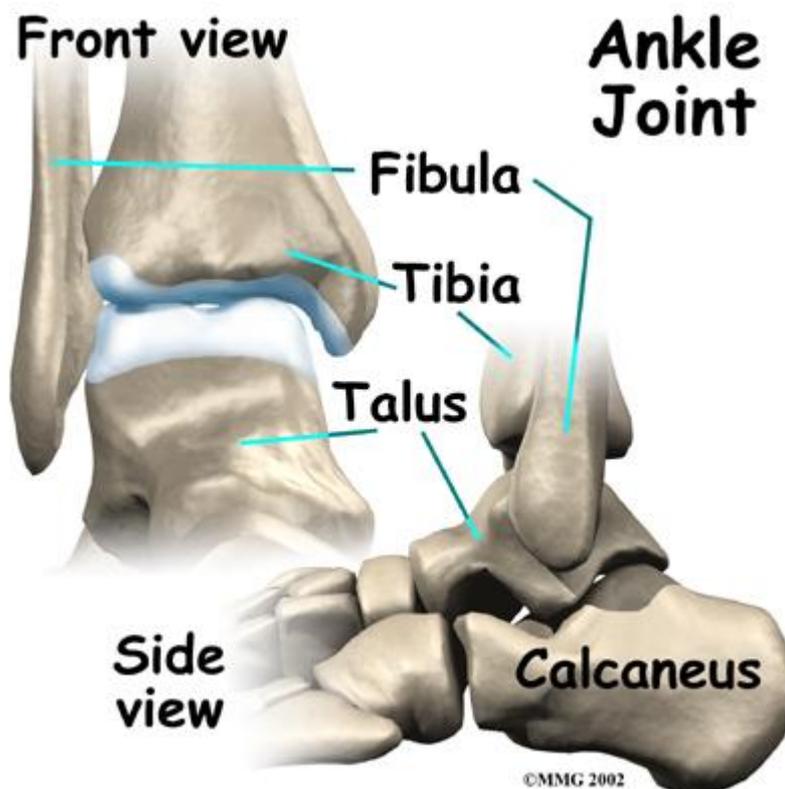


Figure 2. Joints of the ankle

#### 4.2.2 Subtalar (STJ) Joint

Lower ankle joint (subtalar joint) forms in between calcaneus and talus. Underside joint surfaces of talus joints into upper side of calcaneus. There is two point of articulation between the bones, posterior and anterior. Concave surface of talus and convex surface of calcaneus forms a posterior talocalcaneal articulation. The convex surface of talus joints into concave surface of calcaneus. This is called anterior talocalcaneal articulation.

Subtalar joint is unstable most of the time because the articulation points are not perfectly lined; this requires much work from surrounding ligaments and muscles. Stable position for the joint is when standing on flat ground, weight evenly divided between both feet's. Movements in subtalar joint are supination and pronation (Ahonen, et.al. 1998; Kapandji, 1995.)

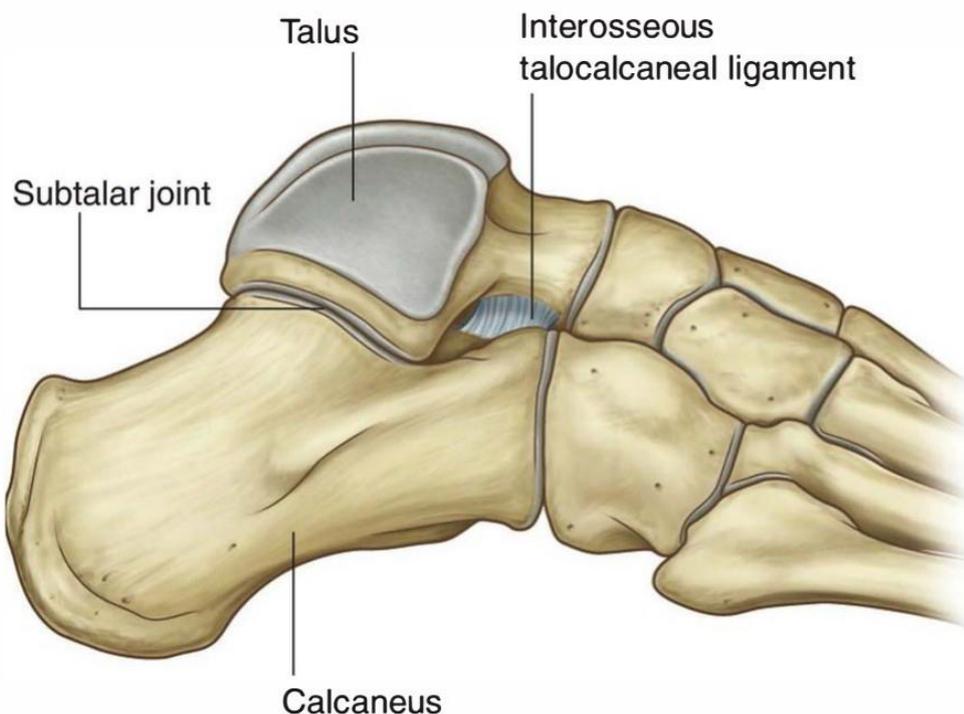


Figure 3. Joints of the ankle

### 4.3 Ligaments of the ankle

In the lower ankle joint (subtalar joint) Talus and Calcaneus is connected to each other with short and strong ligaments. Walking, jumping and running causes heavy stress on the ligaments in order to sustain the stress it crucial to have strong and healthy ligaments. Interosseous talocalcanean ligament is the most important ligament between these two bones (Kapandji, 1995.)

The Deltoid ligament is very strong ligament; it attaches the medial malleolus to the tarsal bones. Its wide base spreads out and attaches to talus, navicular and calcaneus. It consist of four smaller parts: tibionavicular, anterior and posterior tibiotalar and tibiocalcanean ligaments. The main job of these ligaments is to prevent anterior displacement of the leg bones and strengthen the ankle joint. Additionally they help to maintain the medial longitudinal arch (Moore, 1992.)

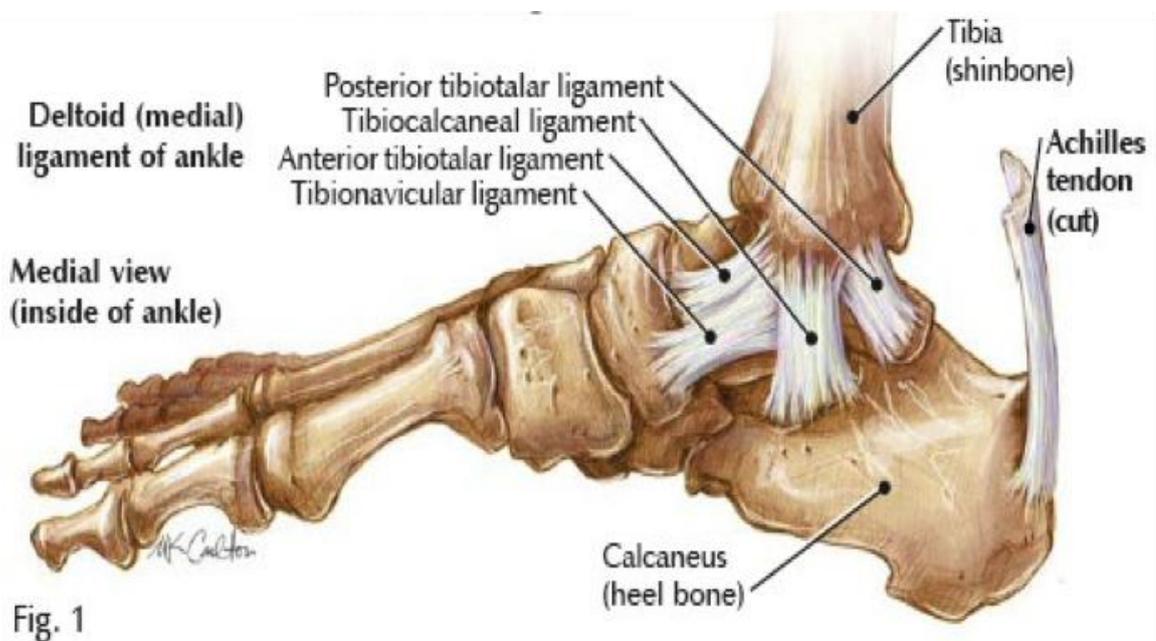


Figure 4. Ligaments of the ankle.

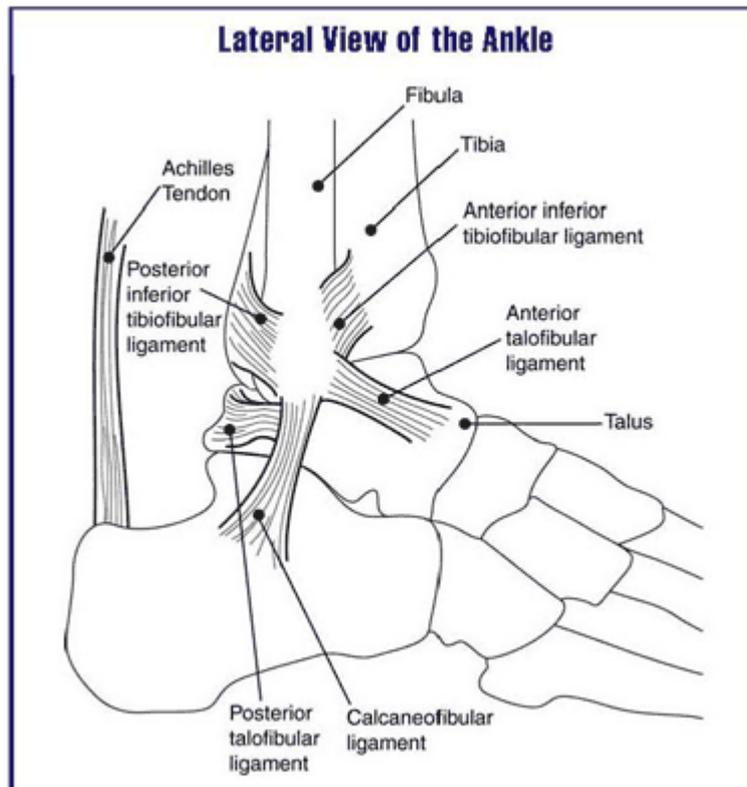


Figure 5. Ligaments of the ankle

There are three ligaments on the lateral side of the ankle, which attach the lateral malleolus to the talus and calcaneus. Lateral ligaments are weaker than deltoid ligaments. It consist of three separate ligaments: anterior and posterior, talofibular ligaments and calcaneofibular ligament. These ligaments resist inversion of the ankle joint. (Moore, 1992.)

#### 4.4 Muscles of the Ankle

The muscles in the lower leg causes the movement of the ankle. Tendons of these muscles goes through the ankle and attaches into the foot. Three important muscle groups for the ankle and foot movement are anterior, posterior and lateral muscles (Moore, 1992; Ahonen, et.al. 1998; Kapandji, 1995.)

Anterior muscles includes tibialis anterior, extensor digitorum longus and extensor hallucis longus and fibularis tertius. Tibialis anterior dorsiflexes the ankle and inverts the foot. Extensor muscles are responsible of dorsiflexion of the ankle and extending the toes. Eversion of the foot and dorsiflexion of the ankle are the main job of fibularis tertius. (Moore, 1992; Ahonen, et.al. 1998; Kapandji, 1995.)

Posterior muscle group has two groups: superficial and deep layers. Both muscle groups' plantarflexes the ankle but deep muscles also flexes the toes. Superficial muscle group includes gastrocnemius, soleus and plantaris. Deep muscle group consist of flexor hallucis longus, flexor digitorum longus and tibialis posterior. (Moore, 1992; Ahonen, et.al. 1998; Kapandji, 1995.)

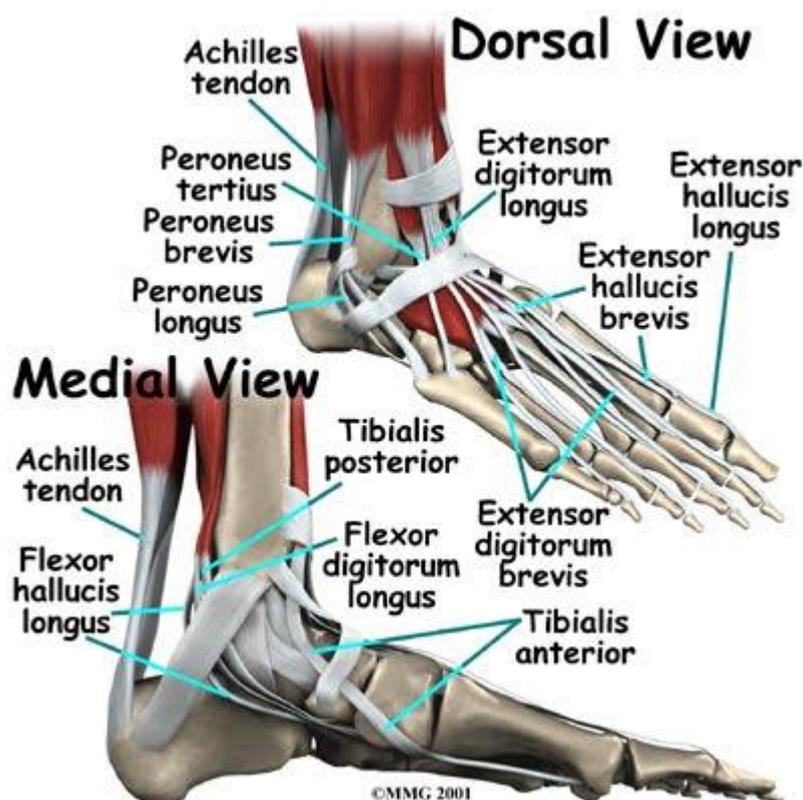


Figure 6. Muscles of the foot

Muscles also protect the ankle joint from injuries. Especially extensor digitorum longus, peroneus brevis and tibialis anterior have a crucial role in preventing ankle injuries that occur in plantarflexion

Table 1. Muscles effecting ankle and foot movement (Hervonen, 2004. 248-255).

Tibialis anterior	dorsiflexion, supination
Extensor hallucis longus	dorsiflexion, supination
Extensor digitorum longus	dorsiflexion, pronation
Peroneus longus	plantarflexion
Peroneus brevis	plantarflexion
Triceps surae	plantarflexion
Plantaris	plantarflexion
Flexor digitorum longus	plantarflexion, supination, adduction
Tibialis posterior	plantarflexion, supination, adduction
Flexor hallucis longus	plantarflexion, supination

Tibialis anterior and extensor muscles belong to the front (extensor) group of muscles, whose main function is dorsiflexion of the foot, but they have other functions as well. The lateral (peroneus) group includes peroneus longus and brevis. The function of these muscles is plantarflexion and they support the arch. The posterior (flexion) group consists of six muscles: Triceps surae, plantaris, flexor muscles, tibialis posterior and popliteus. The main function of these muscles is plantarflexion of the foot (Hervonen, 2004. 248-255).

## 5 ANKLE INJURY PREVENTION

In this thesis the injury preventive training is based on medical and performance point of view. Some of the movements that will be showed in the final product are ankle specific and some are more overall. Other movements enhance players' performance on the field and works as injury prevention training as well. The final product will be combination of both of these methods.

### 5.1 Ankle injury prevention

(Tropp, et.al.1985) Compared two different methods for ankle injury prevention on players with previous ankle injuries. They used coordination training on balance board to improve functional stability and orthosis during training. These methods was proved to reduce injuries in players with previous ankle related injuries (Tropp, Askling & Gillquist, 1985.)

Another study by (Mohammadi, 2007) had 80 male soccer players from Iran 1<sup>st</sup> division teams. Players were divided into four groups: group 1 had proprioceptive training program, group 2 had strength training based program, group 3 used orthosis and group 4 was the control group. Mohammadi's research came in a conclusion that only proprioceptive training had significant results in preventing ankle injuries for players with previous ankle injuries (Mohammadi, 2007.)

(Dvorak, et.al. 2002) studied the effects of injury prevention program focusing on education and supervision of players and coaches in male youth amateur teams. They had 14 teams, which they divided into two groups of seven teams. The other group had injury preventive exercises while the other continued training and playing as usual. In the intervention group the incidence of injury per 1000 hours of football were 6,7 injuries and in the other group it was 8,5 injuries. This means 21% less injuries in the intervention group. The prevention program had major effect in overuse injuries, mild injuries and injuries occurred during training. With preventive program, the amount of injuries reduces but this requires educating

coaches and players and these interventions should be included in everyday training (Dvorak, et.al. 2002.)

## 5.2 Athletic development

Athletic development is very effective injury prevention method and its' been used also in reconditioning. It aims to prevent injuries more generally and it develops player's physical condition and athletic abilities. Injury prevention specialist Bill Knowles presents a theory called; performance based injury prevention model. This includes athletic development and reconditioning. Purpose of athletic development is to improve performance and prevent injury by developing athletes that are adaptable to the demands of their sport. (Knowles, 2016; Gambetta)

## 6 PRODUCT DEVELOPMENT PROCESS

This guide is based on Social and healthcare product development model. Social and healthcare product has unique qualities compared to other fields. Purpose of social and healthcare product is improving clients' health, wellness and control of life. Product always includes interaction between the customer and professional from that specific field. In this way, the effectiveness of the product is maximized (Jämsä & Manninen, 2000; Rouse, 2016.)

Product development has five different stages; identifying the problem, idea analysis, outlining the product, prototyping and finishing. First step is identifying the problem or design criteria. This step includes brainstorming and analyzing the information available. Idea analysis consist of closer evaluation of the product. Outlining the product will start with analyzing which factors and point of views are controlling the planning and producing the product. Planning is based on the customer analysis and profile. Prototyping involves creating a prototype based on the information gathered. Last phase is the finalizing the product and putting it into test (Jämsä & Manninen, 2000; Rouse, 2016.)

### 6.1 Identifying the problem

In this first step of product development process, everything starts with brainstorming and collecting information about the products, which already exists. Different statistics of the product such as need, expenses and mistakes helps to identifying the problem. The purpose of problem-based approach is to improve an already existing product or service when the quality of the product will not fulfill its purpose. It is crucial to find out the customers who are affected by the problem and how common the problem is. In social and healthcare business the needs for improvements are similar regardless the place or the company. These improvements are caused by different health needs of people and new information related to healthcare (Jämsä & Manninen, 2000; Claessens, 2015.)

Guide creation process started with identifying the problem. The main problem since the beginning was, how to create functional guide which includes effective and useful information. All the information was gathered by the time guide creation process started. Other problems existed such as how to find a purpose for the guide.

## 6.2 Idea analysis

After the need of the product or the need of improvement is decided, idea analysis starts. This phase concentrates finding solutions to the problems, which are local or organizational. Idea analysis could be very short phase in product development if the project aims upgrading an old product. Applying innovative and creative approach to the problem works very well when finding the answers. In addition, brainstorming is effective way of working. The most important question to be asked is “What kind of product helps to solve the problem and meets the purpose?” (Jämsä & Manninen, 2000.)

Different ideas of the final product came up during the time spent with the team and during the conversations with the team coach. First it was meant to be more a guide for good injury prevention and work as a tool for the coaches. Later on he came up with the idea that it would be a guide full of a different exercises that the coaches can use in the trainings. The coach suggested that it would be better if it would be an exercise bank for the players to support their independent training. Based on that suggestion the final product started to form.

## 6.3 Outlining the product

Drafting the product or service is based on forming a customer profile and customer analysis. Profiling and analyzing provides information about the health and

well-being needs and expectations of the customer. In social and healthcare, the information comes to the customer through professionals for example coaches or physiotherapists. It is crucial to take into account the needs of the customers and the people who provides this information to the customers (Jämsä & Manninen, 2000.)

The aim of the final product was to match the needs of the commissioning party.

#### 6.4 Prototyping

Transmitting the information is the main purpose in many social and healthcare products or services. The essential content of the product rests on facts and the information is provided in a clear and accurately to the customer. Empathizing in the role of customer helps when creating a material for the use of customer. Brochures and manuals are most common ways to transmit information. Choosing the content for the printed publications depends on the purpose and the customers. Style of the manual should be formal, easy to read, understandable and useful. Choosing correct font and concentrating on the language. Visually attractive product is effective and user friendly (Jämsä & Manninen, 2000.)

#### 6.5 Finalizing the product

Getting feedback and asking it from different people is crucial in order to make good and working product or service. Finalizing the product starts after analyzing the feedback and possible other versions of the product. Paying attention into small details and improving the product as good as possible. This phase includes planning the distribution of the product (Jämsä & Manninen, 2000.)

## 6.6 Product planning process

In the beginning, I had a conversation with the commissioning party about the subject of the thesis and the product. Based on this conversation I decided the topic of the thesis and started planning the content of the guide/service. The main idea was to create a specific guide for the team that I was using as a test group. Commissioning party also wanted it to be suitable for other teams as well. After deciding the topic, this project started to proceed very fast.

We decided that I would do a guide that is possible to print out and hand out for players, coaches and parents. This way everyone can look into it and use it more effectively.

The content of the productization process is based on facts and these facts are explained clearly and understandable in the product. Choosing the correct subject matter depends on the client or customer (Jämsä & Manninen, 2000.) This particular guide was directed to the coaches and players; this meant that the language and content used in the guide must be suitable for them.

Commissioning party gave me a freedom to choose the content. The test group helped me to decide the movements and exercises for the guide. Final product is a guide that any team member can apply into their training.

## 7 RESEARCH METHODOLOGY

This bachelor's thesis is done by using qualitative research method. Material collecting process for this thesis can be divided into two parts, observation and research. Research process started before observation period, this led into more trustful and accurate conclusions. Thorough research of this particular subject gave strong foundation for the observation period. The observations based on the authors' own experiences and knowledge. Research plan was open since the beginning and the final product intertwined together after every piece of information was gathered.

Qualitative research focuses in small amount of cases and thorough analysis of those is essential. Subjective approach to the project is natural for this research method and for this thesis. In a qualitative research, the role of the author is more lenient. This leads into more flexible planning and executing the research. Great amount of scientific research consist of pure common sense and previous experiences of the researcher, which applies to this thesis quite heavily. Hypothesis is not compulsory in qualitative research; this means that researcher does not have certain advance assumptions of the research target or the research results (Eskola & Suoranta, 1996. 13-15; Kananen, 2015, 53-57; Flick, 1998. 2-5.)

### 7.1 Content of the guide

The guide was created by using social and healthcare productization model and qualitative research. Observation based on previous experiences and research. Testing of the players was not possible due to lack of time.

Content for the guide started forming during the thesis process and putting the research-based information in a practice started in the beginning. First step was to choose the right movements for this age group and finding the weaknesses and strengths. Guide will include different skill levels for most of the movements and this way it is suitable for other age groups as well. Pictures and clear explanations of the movements will help coaches and players to perform the movements in a

safe way. Information for the guide was gathered from various online articles, youtube videos and books. Every exercise presented on the guide is based on earlier research and observations.

## 7.2 Observation plan

The main problem throughout the thesis process was creating a reliable option for testing since there was lack of time for proper testing. Observation and some small tests was the only way to find a real need and purpose for the project. These observations started on February 2018 and ended on April 2018. The purpose of the observation plan was to gather information of the player's physical condition and physical abilities. Observations were done systematically and it was continuous. Thorough research of ankle injury prevention training and own experiences worked as a base for the ability to make reliable observations.

The actual recording of the results of the observations was done after every month of training. This included the notices made during the practice session such as improvements, abilities to perform movements and motivation.

<b>February</b>	<b>March</b>	<b>April</b>
2.2.18. First practice session with the team. Observation started.	2.3.18. Observation concentrates more on players' motivational side.	2.4.18. Last month of observation started.
12.2.18. Flexibility and balance tests	19.3.18 Same balance and flexibility tests. Clear improvements in ankle flexibility.	16.4.18 Similar tests again. Most of the group were able to perform harder versions of each movement.

26.2.18. First month of training behind. Improvements made in motivation and in sense of rhythm	30.3.18. Development in balance can be seen in part of the team.	30.4.2018. Final assessment of the team done. All the players were able to improve their ankle control and balance.
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### 7.3 The process of the thesis

Research process for this thesis started before the topic was chosen and any writing was done. Previous knowledge of the subject helped when I was choosing the topic. The topic and the content for the thesis was selected because of my background in football and the conversation I had with the CEO of Kajaanin Haka football club. Personal experiences in ankle injuries was one major factor when choosing the topic.

The first idea was to do a support tool for the coaches, which they can implement into the training sessions. I started the research process and the writing process based on this idea but after I had few conversations with the coach of the team that I was using as a test group. I decided to do ankle injury prevention guide for the players which they can use for their independent training. This decision helped me to find the aim and the purpose of thesis. Focus was to find reliable information and to create a functional guide for the players. The biggest research problems I had was that how to find the exercises that fits the needs of team and how to separate the reliable information from the unreliable. These two were the main problems but there were other such as how to create a functional guide. The meaning of this project is to educate myself and everybody else who will use the end product or read this thesis.

The content and the material for this thesis was acquired mainly using online articles and books. Books from the school library was used and videos from different

internet sites. Analyzing the material was the hardest part because finding reliable information is not simple. Comparing different sources and comparing old information to the new information was one way to discover reliable sources.

#### 7.4 Guide creation process

The production process of this guide follows the traditional product development phases. This process aims to move straightforwardly from phase to phase. First step was to identify the purpose and the aim of the guide while assessing the needs of the commissioning party. Research for the guide started based on these information. Observation of the team was the key element in this phase of the process while thorough research gave a strong foundation for the observations. Analyzing the observations and the information of the player's physical condition helped to finalize the idea analysis. Commissioning party's agreement of the content of the guide was needed before implementation phase.

Implementation phase included taking pictures of the movements and creating the content of the guide. Suitable movements for the guide was chosen during the research and observation process. Every movement was pictured (starting point and ending point) with the author working as a model. Before adding any pictures into the guide, the cover page and introduction were written. The text in the guide was written in Finnish since the customers are Finnish. Pictures were put first into the page and then detailed instructions of the movement was written underneath the pictures. The instructions were written in a way that the target customers can easily understand it and train safely. In this phase of the process systematic observation of the team were crucial. Observation ensures the fact that the guide will be effective and match the needs of the team.

Final step before distribution was analyzing the outcome of the production process. The purpose of this final step is to find errors and make improvements if needed. Assessment was done by the coach of the team and the CEO of Kajaanin Haka. After few corrections it was ready to be handed out to the players and other teams as well.

## 8 RESULTS

Current fitness level of the team is on average level. Differences between the players are easily noticeable and every player has their own strengths and weaknesses. There are five categories included into this current physical state of the team, motivation, athleticism, ankle injury history, ankle strength and physical condition. Each of these categories effects on planning a specific injury prevention manual for the team. These categories are based on systematic observation and coaching of Haka 03/04 team. This test period was 3 months.

### 8.1 Outlining the product

The final product of this thesis is based on the need of the team. There are five main categories which works as a base for the guide, athleticism, injury history, ankle strength/condition, physical condition and motivation. Each category effects on planning ankle injury prevention guide. These are essential information when creating a specific injury prevention guide.

Drafting the product starts with the customer analysis and analyzing the information. (Jämsä & Manninen, 2000). These five categories was found during the customer analysis and this information provided the need for the guide. Customer analysis or customer profile gave strong foundation for the guide and creating the guide based on that information was easy. The tests and questionnaires were done for the players and coach were crucial part of the team analysis

### 8.2 Prototyping

The first prototype of the guide included exercises which were based on these five main categories. The main key to provide useful guide is detailed but simple training instructions. Structure of the guide was very organized and exercises were in sensible order.

### 8.3 Athleticism

Athleticism is very wide concept and it consist of various physical skills and abilities. The state of athleticism in this team is very good with some individuals but some individuals have struggles with some basic skills. The most athletic players uses their physical abilities in high level and they create solutions to the problems they are facing in practice and game situations. Most of the players have average level of athleticism and in a group like this the good ones easily stand out. The observations of general athleticism based on the trainings and tests. Tests was done based on John Cone's testing system (Cone, J. 2012). Tests included one leg star excursion balance test (SEBT), one leg hop test, agility test and lower/upper body mobility tests.

In SEBT test, player stands on leg in the center of an 8-pointed star. Performance is measured by the reach of the other leg in every direction. Hands has to be on the hips. Four practice trials were given. Results were divided into two categories, 0cm<60cm and 60cm< (Cone, J. 2012.) 10 players participated to the tests.

<b>Direction</b>	<b>0cm&lt;60cm</b>	<b>60&lt;</b>
<b>Anterior</b>		10
<b>Anterolateral</b>		10
<b>Medial</b>		10
<b>Posteromedial</b>		10
<b>Posterior</b>		10
<b>Posterolateral</b>	1	9
<b>Lateral</b>	2	8

<b>Anterolateral</b>	3	7
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The triple hop for horizontal distance measured the reactive power of the lower limbs (Cone, J. 2012.) Performance is measured from the heel of the landing foot from the third jump.

<b>Triple hop test</b>	<b>0&lt;5m</b>	<b>5m or more</b>
	4/10 players	6/10 players

Sprint test (The 505 test) with turn measured the agility of the players (Cone, J. 2012.) Test included 15 meter sprint with one unilateral cut. The results were divided into two categories 2,7seconds or more and under 2,7seconds.

<b>The 505 test</b>	<b>2,7sec or more</b>	<b>under 2,7sec</b>
	5/10players	5/10players

Upper and lower body mobility test included deep squad, shoulder mobility, in-line lunge and active straight leg raise.

#### 8.4 Ankle Injury history

Injury history in this team is rather clear and they have not suffered severe injuries in recent years. They have been able to avoid ankle injuries, only few sprains and strains occurred during last season. Coach of the team was interviewed and the information was gathered based on his answer.

Question	Answer
<b>How many severe/mild ankle injuries have occurred during last two seasons?</b>	<b>Players have been able to avoid severe ankle injuries. Only 4-6 ankle sprains that have caused the player to miss 2 weeks of the season. Under 4 contusions have occurred.</b>

### 8.5 Ankle strength

Ankle strength and flexibility has been under observation since starting with this group. They have shown great flexibility in the ankle and only couple of players have felt stiffness in their ankles. Since the beginning, they were able to perform most of the exercises given to them. Level of the exercises has grown progressively during the test period. Ankle strength testing have included various exercises for example; ankle flexibility and balance exercises. These tests was done in the beginning of the testing period. Balance tests included basic one leg exercises which were performed in different ways. Flexibility test included deep squat. Players were assessed based on their performance, if they were not able to execute the movement they got "B" and if they were able to execute movement they got "A". There were 10 participants. Test was done with using these four movements:

1. One leg stand for 30seconds
2. One leg stand with high knee for 30 seconds
3. Lunge balance test for 30 seconds
4. Deep squat

Results:

<b>Movements</b>	<b>Category A</b>	<b>Category B</b>
One leg stand	10 players	0 players
One leg stand with high knee	10 players	0 players
Lunge balance	10 players	0 players
Deep squat	7 players	3 players

The purpose of these tests was to get information about their ankle mobility, strength and flexibility. Deep squat was the only test where some of the players struggled and they were not able to perform the movement.

#### 8.6 Physical condition

Team is in good physical condition, some individuals have better fitness and physical abilities. This is normal in this age group; the differences can be very significant. Running fitness and stamina they have in high level. They have had practices year-round and these have included conditioning, sport specific training and physique training. Improvements must be made in home training, as this is important for individual development. They have four to five times a week practice and some of the players are participating additional sport specific training sessions during the week. They have a one hour physique training session per week and six hours of football training per week. This can be seen in their high level of fitness. Players are encouraged to practice in their own time. The assessment of the physical condition is based on their weekly amount of training and authors' observation.

### 8.7 Motivation

Motivation effects in injury prevention many ways. Player must be motivated to perform the exercises and be ready to sacrifice time for it. Motivation to improve and develop themselves and their skills effects as well.

Level of motivation varies between the individuals. They have different reasons to participate the practices and games. Few players are aiming to play in higher level and those players are more interest in developing their football skills and athletic abilities. Friends are the biggest motivation for all of them and being part of a group.

Motivation was tested with questionnaire. 10 players took part in the questionnaire

The amount of independent training per week?

Main reasons for participating training sessions?

The amount of independent training per week?	0<2h	2<4h	4<6h	6h or more
Answers:	0/10 players	4/10players	4/10players	2/10players

Main reasons for participating training sessions?	Friends	Improving sport specific skills	Staying in good shape	Improving athletic abilities	other, what?
Answers:	10/10 players	10/10 players	8/10 players	6/10 players	Desire to play in high level.

					<p>Desire to play for the first team.</p> <p>Dream to be a professional player.</p>
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### 8.8 The final form of the guide

Based on the test results, the final version of the guide was formed. The guide answers the following questions, why and how to do injury preventive training. It includes overall training instructions, purpose of the training and detailed instructions for each movement. Almost every exercise is tested with the players and they should have the knowledge and skills to perform them correctly. The guide is very simple and easy to read, this way players can easily use it and they do not have to study anything. This guide is made for the players and to support their independent training. Every part of the five main categories are included in the guide, some is less visible, some more. General athleticism is less visible but it was important information when creating the guide and it gave good overall picture of the team.

## 9 DISCUSSION

Football is the biggest sport in the world and it has millions of registered players around the world. The fact that everybody can play it raises the popularity of the sport. Even though football is big sport, there are not much information about the injury prevention. Injury preventive training should be part of everyday training for football players. This kind of training can include everything from athletic training to specified injury prevention training. In many cases, the importance of it is often forgotten.

The main purpose of this thesis was to create a practical and specified guide of ankle injury preventive training for Kajaanin Haka 03/04 team. The aim of the guide was to provide research based and reliable information about the injury preventive training. The guide will help the players to reduce the amount of injuries and educating them about this subject. Coaches can easily apply the information from this guide to the training sessions. Other teams in this club can also use the information.

During this thesis process I faced various problems regarding material research and guide creation process. I manage to overcome these problems rather easily. Fulfilling the needs of the team and the commissioning party was the hardest part. Without my internship period with the team I would have not to be able to provide reliable information and useful product for them.

Finding information was rather easy since there are numerous studies done regarding injury preventive training. Separating reliable information from unreliable was one big problem during this process. In addition, there should be more studies specifically for ankle injuries in youth football. Many study was done years ago, there could be a need for updating some information. Various researches concentrated more rehabilitation than prevention. Rehabilitative exercises can be used in preventive training but they are not necessarily as effective as prevention specific exercises. Source criticism was crucial in order to find the best and reliable sources. Reading through various articles, books and researches gained my knowledge and awareness of this topic.

My previous experiences of ankle injuries and injuries overall worked as a stable base for this process. During my football playing years, I have suffered many ankle related injuries and neglected the rehabilitation and prevention training. This woke up my interest towards this topic and this was very effective for my own health as well it is for others.

### 9.1 Reliability

The reliability of this thesis is based on two main factors, systematic research and use of information related to the topic. By using new information the reliability of this thesis was improved. The evaluation of the team is showed clearly and the test results are in charts. There are huge amount of information about ankle injuries and the preventive training, so it was possible to use the latest information as much as possible. Every exercise in the guide is picked carefully and there has been evidence that it works. The tests was chosen on evidence based information and research.

### 9.2 Thesis evaluation

The thesis process was simple and only few problems occurred. Research process was rather fast and easy since there are large amount of reliable information available. Proper research made creating the guide easy. The guide itself was quite successful and the commissioning party liked it. In the end, it actually had more information and movements than in the original plans. The information in the guide is adjusted in the level of the target group. It will be very helpful for the players if they decide to use it.

## 10 LIST OF REFERENCES

- Ahonen, J., & Ahonen, J. (1998). *Alaraajojen rakenne, toiminta ja kävelykoulu*. Lohja: VK-Kustannus. Retrieved from <https://kamk.finna.fi/Record/kajakki.11180>
- Allan Buhl Nielsen Johannes Yde. (1989). Epidemiology and traumatology of injuries in soccer. *The American Journal of Sports Medicine*, 17(6), 803-807. 10.1177/036354658901700614 Retrieved from <http://ajs.sagepub.com/content/17/6/803.abstract>
- Arnason, A., Gudmundsson, A., Dahl, H. A., & Jóhannsson, E. (1996). Soccer injuries in iceland. *Scandinavian Journal of Medicine & Science in Sports*, 6(1), 40-45. 10.1111/j.1600-0838.1996.tb00069.x Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/8680943>
- Arnason, A., Sigurdsson, S. B., Gudmundsson, A., Holme, I., Engebretsen, L., & Bahr, R. (2004). Physical fitness, injuries, and team performance in soccer. *Medicine and Science in Sports and Exercise*, 36(2), 278-285. 10.1249/01.MSS.0000113478.92945.CA Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/14767251>
- Astrid Junge, Dieter RÄ¶sch, Lars Peterson, Toni Graf-Baumann, & Jiri Dvorak. (2002). Prevention of soccer injuries: A prospective intervention study in youth amateur players. *The American Journal of Sports Medicine*, 30(5), 652-659. 10.1177/03635465020300050401 Retrieved from <http://ajs.sagepub.com/content/30/5/652.abstract>

- Astrid Junge, & Jiri Dvorak. (2000). Influence of definition and data collection on the incidence of injuries in football. *The American Journal of Sports Medicine*, 28(suppl 5), 46. 10.1177/28.suppl\_5.S-40 Retrieved from [http://ajs.sagepub.com/content/28/suppl\\_5/S-40.abstract](http://ajs.sagepub.com/content/28/suppl_5/S-40.abstract)
- Backous, D. D., Friedl, K. E., Smith, N. J., Parr, T. J., & Carpine, W. D. (1988). Soccer injuries and their relation to physical maturity. *American Journal of Diseases of Children*, 142(8), 839-842. 10.1001/archpedi.1988.02150080045019 Retrieved from <http://dx.doi.org/10.1001/archpedi.1988.02150080045019>
- Bangsbo, J., Norregaard, L., & Thorso, F. (1991). Activity profile of competition soccer. *Canadian Journal of Sport Sciences*, 16(2), 110. Retrieved from <https://search.proquest.com/docview/205841012>
- Barengo, N. C., Meneses-Echávez, J. F., Ramírez-Vélez, R., Cohen, D. D., Tovar, G., & Bautista, J. E. C. (2014). The impact of the FIFA 11+ training program on injury prevention in football players: A systematic review. *International Journal of Environmental Research and Public Health*, 11(11), 11986-12000. 10.3390/ijerph111111986 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/25415209>
- Capranica, L., Tessitore, A., Guidetti, L., & Figura, F. (2001). Heart rate and match analysis in pre-pubescent soccer players. *Journal of Sports Sciences*, 19(6), 379-384. 10.1080/026404101300149339 Retrieved from <http://www.tandfonline.com/doi/abs/10.1080/026404101300149339>
- Castagna, C., D'Ottavio, S., & Abt, G. (2003). Activity profile of young soccer players during actual match play. *Journal of Strength and Conditioning Research*

h, 17(4), 775-780. 10.1519/00124278-200311000-00024 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/14636107>

Chomiak, J., Junge, A., Peterson, L., & Dvorak, J. (2000). Severe injuries in football players. influencing factors. *The American Journal of Sports Medicine*, 28(5 Suppl), 68. 10.1177/28.suppl\_5.S-58 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11032109>

Claessens, M. (2015). The new product development process (NPD) – obtain new products. Retrieved from <https://marketing-insider.eu/new-product-development-process/>

Cone John. (2012). Soccer-specific performance testing of fitness and athleticism: The development of a comprehensive player profile. *Strength and Conditioning Journal*, 34(5), 11. Retrieved from <https://search.proquest.com/docview/1082324933>

Dvorak, J., & Junge, A. (2000). Football injuries and physical symptoms. A review of the literature. *The American Journal of Sports Medicine*, 28(5 Suppl), S3. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11032101>

Eskola, J., & Suoranta, J. (1996). *Johdatus laadulliseen tutkimukseen*. Rovaniemi: Lapin korkeakoulu. Retrieved from <https://kamk.finna.fi/Record/kajakki.6648>

Faude, O., Rößler, R., & Junge, A. (2013). Football injuries in children and adolescent players: Are there clues for prevention? *Sports Medicine*, 43(9), 819-8

37. 10.1007/s40279-013-0061-x Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/23723046>

Flick, U. (1998). *An introduction to qualitative research*. London: SAGE. Retrieved from <https://kamk.finna.fi/Record/kajakki.15393>

Fuller, C., Ekstrand, J., Junge, A., Andersen, T., Bahr, R., Dvorak, J., . . . Meeuwisse, W. (2006). Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Clinical Journal of Sport Medicine*, 16(2), 97-106. 10.1097/00042752-200603000-00003 Retrieved from <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=n&CSC=Y&PAGE=fulltext&D=ovft&AN=00042752-200603000-00003>

Giles, K., Penfold, L., & Giorgi, A. (2005). A guide to developing physical qualities in young athletes; Retrieved from [https://www.movementdynamics.com/uploads/newsletters/A\\_Guide\\_to\\_Developing\\_Physical\\_Qualities\\_in\\_Young\\_Athletes.pdf](https://www.movementdynamics.com/uploads/newsletters/A_Guide_to_Developing_Physical_Qualities_in_Young_Athletes.pdf)

Häggglund, M., Waldén, M., & Ekstrand, J. (2006). Previous injury as a risk factor for injury in elite football: A prospective study over two consecutive seasons. *British Journal of Sports Medicine*, 40(9), 767-772. 10.1136/bjsm.2006.026609 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16855067>

Hawkins, R. D., Hulse, M. A., Wilkinson, C., Hodson, A., & Gibson, M. (2001). The association football medical research programme: An audit of injuries in professional football. *British Journal of Sports Medicine*, 35(1), 43-47. 10.1136/bjsm.35.1.43 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11157461>

- Hertel, J. (2002). Functional anatomy, pathomechanics, and pathophysiology of lateral ankle instability. *Journal of Athletic Training*, 37(4), 364-375. Retrieved from <https://search.proquest.com/docview/206647721>
- Hervonen, A. (2004a). *Tuki- ja liikuntaelimityn anatomia* (7. p. ed.). Tampere: Lääketieteellinen oppimateriaalikeskustamo. Retrieved from <https://kamk.finna.fi/Record/kajakki.31745>
- Hervonen, A. (2004b). *Tuki- ja liikuntaelimityn anatomia* (7. p. ed.). Tampere: Lääketieteellinen oppimateriaalikeskustamo. Retrieved from <https://kamk.finna.fi/Record/kajakki.31745>
- Iaia, F. M., Rampinini, E., & Bangsbo, J. (2009). High-intensity training in football. *International Journal of Sports Physiology and Performance*, 4(3), 291. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/19953818>
- Jämsä, K., & Manninen, E. (2000). *Osaamisen tuotteistaminen sosiaali- ja terveysalalla*. Helsinki: Tammi. Retrieved from <https://kamk.finna.fi/Record/kajakki.20751>
- Joyce, D., & Lewindon, D. (2015). *Sports injury prevention and rehabilitation*. London: Routledge Ltd.10.4324/9780203066485 Retrieved from <http://www.tandfebooks.com/isbn/9780203066485>
- Kananen, J. (2015). *Online research for preparing your thesis : A guide for conducting qualitative and quantitative research online*. Jyväskylä: JAMK University of Applied Sciences. Retrieved from <https://kamk.finna.fi/Record/kajakki.49754>

- Kapandji, I. A. (1997). *Kinesiologia 2 : Alaraajojen nivelten toiminta : Lonkkanivel , polvinivel, nilkkanivel, jalan nivelet, jalkaholvi*. Laukaa: Medirehab. Retrieved from <https://kamk.finna.fi/Record/kajakki.10392>
- Kirkendall, D. T., Kirkendall, D. T., & Dorrance, A. (2007). *The complete guide to soccer fitness and injury prevention : A handbook for players, parents, and coaches*. Chapel Hill: The University of North Carolina Press.10.5149/9780807882757\_kirkendall Retrieved from [http://northcarolina.universitypressscholarship.com/view/10.5149/9780807882757\\_kirkendall/upso-9780807831823](http://northcarolina.universitypressscholarship.com/view/10.5149/9780807882757_kirkendall/upso-9780807831823)
- Krustrup, P., Aagaard, P., Nybo, L., Petersen, J., Mohr, M., & Bangsbo, J. (2010) . Recreational football as a health promoting activity: A topical review. *Scandinavian Journal of Medicine & Science in Sports, 20 Suppl 1(s1)*, 1. 10.1111/j.1600-0838.2010.01108.x Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/20210908>
- Kuntz, M. (2007). 265 million playing football. Retrieved from [https://www.fifa.com/mm/document/fifafacts/bcoffsurv/emaga\\_9384\\_10704.pdf](https://www.fifa.com/mm/document/fifafacts/bcoffsurv/emaga_9384_10704.pdf)
- Mohammadi, F. (2007). Comparison of three preventive methods to reduce the recurrence of ankle inversion sprains in male soccer players.35(6), 922-926. Retrieved from <http://journals.sagepub.com/doi/abs/10.1177/0363546507299259?journalCode=ajs&articleCitationDownloadContainer>
- Moore, K., Schwartz, P., Kozié, J., Irwin, D., & Calder, J. (1992). *Clinically oriented anatomy. third edition* Lippincott Williams & Wilkins.

- Murphy, D. F., Connolly, D. A. J., & Beynon, B. D. (2003). Risk factors for lower extremity injury: A review of the literature. *British Journal of Sports Medicine*, 37(1), 13-29. 10.1136/bjism.37.1.13 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/12547739>
- Orava, S., Heikkilä, J., Hämäläinen, H., Huotari, K., & Heinonen, O. (2006). *Jalkapallovammat. suomen jalkapalloliitto*.
- Parkkari, J., Kannus, P., Kujala, U., Palvanen, M., & Järvinen, M. (2003). Liikunta vammat ja niiden ehkäisy. *suomen lääkäri-lehti*. 1(58), 71-76.
- Rampinini, E., Coutts, A., Castagna, C., Sassi, R., & Impellizzeri, F. (2007). Variation in top level soccer match performance. *Int J Sports Med*, 28(12), 1018-1024. 10.1055/s-2007-965158 Retrieved from <http://www.thieme-connect.de/DOI/DOI?10.1055/s-2007-965158>
- Rebelo, A., Brito, J., Seabra, A., Oliveira, J., & Krstrup, P. (2014). Physical match performance of youth football players in relation to physical capacity. *European Journal of Sport Science*, 14 Suppl 1(sup1), S156. 10.1080/17461391.2012.664171 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/24444199>
- Reilly, T. (2003). *Science and soccer* (2. ed., 1. publ. ed.). London [u.a.]: Routledge.
- Rouse, M. (2016). Product development (new product development, or NPD). Retrieved from <http://searchcio.techtarget.com/definition/product-development-or-new-product-development-NPD>

- Rumpf, M. (2015). Injury prevention in football. Retrieved from <https://www.footballscience.net/special-topics/injury-prevention/>
- Suomen palloliiton vuosikertomus 2016. (2016). Retrieved from [https://www.palloliitto.fi/sites/default/files/Palloliitto/spl\\_vuosikertomus\\_2016.pdf](https://www.palloliitto.fi/sites/default/files/Palloliitto/spl_vuosikertomus_2016.pdf)
- Witvrouw, E., Danneels, L., Asselman, P., D'Have, T., & Cambier, D. (2003). Muscle flexibility as a risk factor for developing muscle injuries in male professional soccer players. *The American Journal of Sports Medicine*, 31(1), 41-46. 10.1177/03635465030310011801 Retrieved from <http://journals.sagepub.com/doi/full/10.1177/03635465030310011801>
- Wong, P., & Hong, Y. (2005). Soccer injury in the lower extremities. *British Journal of Sports Medicine*, 39(8), 473-482. 10.1136/bjism.2004.015511 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16046325>
- Woods, C., Hawkins, R. D., Maltby, S., Hulse, M., Thomas, A., & Hodson, A. (2004). The football association medical research programme: An audit of injuries in professional football--analysis of hamstring injuries. *British Journal of Sports Medicine*, 38(1), 36-41. 10.1136/bjism.2002.002352 Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/14751943>

