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KNEE PROBLEMS AMONG IAIDO PRACTITIONERS

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The purpose of this thesis was to study the incidence of knee problems among iaido practitioners. The study was made in co-operation with the Finnish iaido federation. The amount of scientific studies made about the subject is very limited and therefore inspired the study. The data for the study was collected by an epidemiological survey, which was visible as an e-form to all of the practitioners practising iaido in Finland. The survey was available for two weeks in November 2011. When the e-form closed, 81 had answered to the questionnaire, approximately 160 practitioners received the information about the survey.

Data analysis was performed with the Tixel 9 statistical software which hides the mathematics behind the analysis. According to the results, 53% of the practitioners have knee problems. The incidence of knee problems increases with age and those who have practised iaido less than five years have the most knee problems. The study also revealed that certain techniques, such as sitting positions and techniques performed with knees touching the floor are connected to knee problems. Still, some have found iaido relieving their knee problems. However, it remains unclear how many suffer from knee problems only due to iaido. It needs further research what is the effect of gender, other sports, other martial art practices and if there are differences in training habits.

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1 INTRODUCTION

The most common place of injury among athletes is the knee (Mero et al. 2012, 231-232). However, knee problems are also common among general aging population (Käypä Hoito 2012). The knee is a weight bearing joint between two long bones which makes it vulnerable to injury (Hall 2007, 249). Common knee joint pathologies are osteoarthritis, rheumatoid arthritis and acute joint trauma (Kisner & Colby 2007, 693-694). Many factors affect on a person acquiring knee problems such as gender, age, physical condition and earlier injuries (Peltokallio 2003, 14). The most commonly injured structures are the menisci, collateral ligaments and the ACL (Kisner & Colby 2007, 722).

Iaido is a Japanese martial art and it is practised alone by practising techniques with a samurai sword. The techniques are done from a various different positions. It is believed that iaido is kinder to the body and aggravating the knees less than for example karate, judo or other martial arts. (Ronin Jiu-Jitsu & Kobudo 2006.) However, some of the injuries associated with iaido include cut wounds, lateral epicondylitis, tendonitis and bursitis of the knee (Clausen 1998 & 2011).

This bachelor's thesis is an epidemiological study of the frequency of knee problems among Finnish iaido practitioners. The study covers the connection between the years of practise, grade of the practitioner and techniques and knee problems. The study has an overview of the anatomy of the knee joint, biomechanics, knee injuries and injuries in iaido. The reason to implement this study was that there are no previous made studies specifically about knee problems among iaido practitioners. The outcome of the study clarifies the connection between iaido practise and knee problems but leaves unresolved questions for future studies.

2 IAIDO

Iaido is a Japanese martial art which is not as familiar as for example judo or karate to many people. Iaido differs from these other budo arts in one very important way. It is practiced by using a katana, which is a samurai sword, performing the techniques alone. In simple words, iaido means the art of drawing the sword from its sheath. The practice itself consists of series of techniques or sword forms (kata). (Musô Shinden Ryû association of Finland 2011.) The kata are repetitively trained in order to fully understand the true nature of the art (Ronin Jiu-jitsu & Kobudo 2006). Iaido practitioner dresses in a jacket, Gi, and loose pants, Hakama (Pori Kendo club 2012). Overall, iaido is regarded to be a defensive art (Musô Shinden Ryû association of Finland 2011). Iaido is practiced with a Japanese sword (katana), practice sword (iai-to) or a wooden sword (bokken) (Finnish Musô Jikiden Eishin Ryû 2007). A grade system is used in iaido. The lowest grade in all iaido schools practiced in Finland is 6. kyu and the highest is 10. dan. However, one can only graduate until 8. dan. In some Japanese schools the grading starts from dan grades. The amount of techniques increases when the grade is higher. (Hellstén, personal communication on 30.10.2012.)

Hayashizaki Jinsuke Minamoto no Shigenobu, who was a samurai, is considered to be the founder to most of the still existing iaido styles. He was born in 1546; specific year of death is unknown, but sometime during 1615-1624. At that time, many swordsmen started to develop themselves spiritually, physically and intellectually through drawing the sword from the sheath. Iaido was born due to this new idea. The art was then known as iaijutsu. (Musô Shinden Ryû association of Finland 2011.) Iaido is an umbrella term used for semi-related or unrelated traditional streams of instruction known as koryū. “Iaido” as a term was first used by Nakayama Hakudô, the founder of Musô Shinden Ryû, in 1932. (Thibedeau 2010.) Nowadays, the most common schools that are practised, Musô Shinden Ryû and Musô Jikiden Eishin Ryû, are directly conducted from the school of Hayashizaki Jinsuke Shigenobu (Pori Kendo club 2012).

2.1 Philosophy

The term iaido doesn't describe the main activity of the art. The rough translation of the two characters, iai, in iaido is "being constantly prepared, meet the opposition immediately" and do meaning "path". This means that one must always be prepared and handle problems swiftly. In practise this is visible in increased awareness of one's surroundings and studying the techniques for handling different combative scenarios. (Thibedeau 2010.) The purpose in iaido is to overcome the imaginary enemy without even drawing the sword from its sheath. In other words, the opponent is conquered spiritually. According to some resources, some of the techniques in iaido, now passed down over, have been secret techniques related to Zen practice and enlightenment. (Goodman 2010, 227.) However, the mindset is also to practice methods of sword techniques from the outset of a hostile encounter with a potential enemy but the kata are not meant to be considered as complete methods for handling a certain scenario. They are a framework used to develop in handling the sword and fundamental skills of iaido. (Thibedeau 2010.)

For a true iaidoka (iaido practitioner), the sword is a part of the person himself and the only opponent to conquer is one's own self. That is why iaido cannot be considered as a sport. Constant and relentless training helps the practitioner to find his place in the universe. (Finnish Iaido Federation 2011.) A reason for some people to practice iaido is to sharpen concentration and improve one's capacity to focus the mind (Ronin Jiu-Jitsu & Kobudo 2006). Iaidokas learn to be calm in challenging situations, maintain mental focus and promote peaceful relation with others (Thibedeau 2010).

2.2 Iaido in Finland

Toshikazu Ichimura sensei (teacher) brought iaido and also aikido to Finland in the beginning of the seventies. In 1986 the Finnish Iaido federation was founded to gather the information about iaido in Finland to one place. (Finnish Iaido Federation 2011.) During the same year, Gakudo Takada, who has had a huge influence in Finnish iaido, visited the Nordic countries for the first time. At that time, Musô Shinden

Ryû was the leading iaido school in Finland. Nowadays, Zen Nippon Kendo Renmei (ZNKR) which is organised by the kendo association is the most popular style. In ZNKR there are twelve kata which have been collected and modified from the techniques of older schools. (Finnish Iaido Federation 2011: Österman, 2009, 124.) Other styles practiced in iaido association are for example Musô Jikiden Eishin Ryû, Hontai Yoshin Ryû –iaijutsu and Suiô Ryû –iaikenpo (Österman, 2009, 124.)

2.3 Techniques

Even though iaido is not considered to be a sport, it has many beneficial factors in human well-being besides the spiritual side; it enhances fitness, speed, agility and precision (Goodman, 2010, 229). Still, the techniques are practised slowly. Too swift movements can meld important elements together and act against the stated goals of training. Fast movements are easier to execute but then self-protection and effectiveness will be lost. Speed indeed has its own role in iaido but only when it is used correctly and when it is correct to use. Also the purpose is not to memorize the kata like dance choreography; the important thing is to demonstrate a complete understanding what it is trying to accomplish. (Thibedeau 2010.)

Even though there are several different schools in iaido, the following four components form always the kata: drawing the sword from the sheath (nukitsuke), the cutting techniques (kiritsuke), shaking the blood from the blade (chiburi) and returning the sword to its sheath (noto) (Finn, 1982, 31). Iaido techniques vary greatly and they are done from different starting positions: crouching, sitting, recumbent, standing or walking position. For example, in one branch of Musô Jikiden Eishin ryû school the first seven kata are started from a standing position, the next eleven kata are started from a kneeling, seiza, position and the third series containing ten kata are started from a different sitting position, tatehiza, which is half-kneeling. Each attack direction is inspected in day light and in darkness: left, right, front, behind. External obstacles can be part of the practised technique. Sometimes the space is very narrow or low. Some techniques are practised against other iai opponent and forms against enemies who try to stop you from drawing your sword either from behind or front. (Finnish Musô Jikiden Eishin Ryû association 2007.)

There are some slight variations in the techniques of iaido schools which result in different movement patterns in the body. For example, in ZNKR the position of the feet is slightly laterally turned and therefore differs from the other schools. Also Musô Shinden Ryû and Musô Jikiden Eishin Ryû schools use vertical strikes, as in some old Japanese schools use diagonal strikes which cause more rotation to the trunk. Still, in general the techniques in ZNKR resemble Musô Shinden Ryû and Eishin Ryû because they originally derive from these schools. The techniques in Eishin Ryû differ slightly due to different weight shifts in some techniques compared to for example Musô Shinden Ryû. In Musô Shinden Ryû, the centre of gravity is low and each movement begins from that low centre of gravity. (Hellstén, personal communication 30.10.2012.)

The standing techniques are thought to be more demanding because in standing, one has more moving parts and therefore the practitioner needs to have more control to perform the movements correctly. The first practiced kata in Musô Shinden Ryû are done from a sitting position but in an old Japanese koryû school Mugai Ryû, the first practiced techniques are done in standing in order to make the joints more mobile and prepare the practitioner for the sitting techniques. These are done for the first 2-3 months and then the practitioner moves on to practice sitting techniques. The sitting positions seiza and tatehiza (Figure 1.) are recognized to be demanding and it takes some time for the practitioner to get used to these positions. After two years, however, the practitioner shouldn't have huge problems when sitting in seiza. It is harder to feel comfortable in tatehiza, where the other leg is flexed on the side. This position also requires more flexibility. Still, there are numerous individual factors contributing on how these positions feel. (Hellstén, personal communication 30.10.2012.)

Figure 1. Seiza kneeling position and tatehiza half-kneeling position (The Disarmy Wiki, 2012: Sei Sho Kan, 2005.)

3 STRUCTURAL ANATOMY OF THE KNEE

The knee joint, also known as tibiofemoral joint, is a modified hinge joint which is the most complex and largest joint of the human body (Figure 1.). Actually the joint is composed of three joints in a single joint cavity: the first tibiofemoral joint is located laterally, between the lateral condyle of the femur, lateral condyle of the tibia which is weight-bearing and lateral meniscus, the second tibiofemoral joint is located medially, between the medial condyle of the femur, medial condyle of the tibia and medial meniscus and the intermediate patellofemoral joint, which is located between the patella and the patellar surface of the femur. (Tortora & Derrickson, 2009, 290.)

The distal aspect of the femur has two cartilage coated condylar surfaces; both are convex, asymmetrical and saddle-shaped. An intercondylar fossa separates these condyles. These surfaces correspond to similar articular surfaces of the tibial condyles. The tibial surface is in contrast to femoral condyles concave and shallower than the femoral counterpart. Also the tibial surfaces are asymmetrical because there is a difference in curvature. (Cailliet, 1992, 1-2.) The medial femoral condyle is lower than the lateral which causes more loading on the site which means that the medial side is more prone to knee arthrosis than the lateral side (Ahonen,Sandstöm & Laukkanen, 1998, 293). In a typical synovial joint, there are two opposing articular surfaces and the joint is enclosed within a capsule that contains synovial fluid, which is secreted as a lubricant by synovium (Cailliet, 1992, 3.)

The movements of the knee joint include flexion, extension and slight rotation; lateral rotation is possible only in flexed position (Tortora ym. 2009, 290). The whole range of movement extends from slight overextension to 160° flexion. In flexion, the lateral and medial collateral ligaments loosen which allows even extensive rotation and abduction-adduction movement. This is possible because the movement axis shifts when the knee goes to flexion. In other words, the femoral condyles slide forward in the tibial condyles. The rotation and abduction-adduction movement does not occur in a healthy lock-extended knee. (Ahonen et al. 1998, 294-295.)

Two menisci are located on the periphery of the tibiofemoral joint (Figure 2.). They are curved, fibrocartilaginous tissue, connected to each other by the transverse ligament of the knee and the joint capsule. The main functions of the menisci are to assist in distributing the pressure in the femur and tibia evenly in weight bearing and balance the intra-articular pressure caused by muscular action. (Cailliet, 1992, 9; Tortora, 2009, 290.) They also compensate the irregularity of the bone shapes and circulate synovial fluid. The medial meniscus is C-shaped and the lateral meniscus is almost a complete O-shape. (Tortora, 2009, 290.)

Several bursaes, 11 or more, are located in the knee joint. They are small sacs of synovial fluid. The function of the bursaes is to permit friction-free action and diminish attrition and inflammation of the surrounding moving tissue. Bursaes can be inflamed and cysts form in the area. The correct term for this irritation is bursitis. (Cailliet, 1992, 45, 47.)

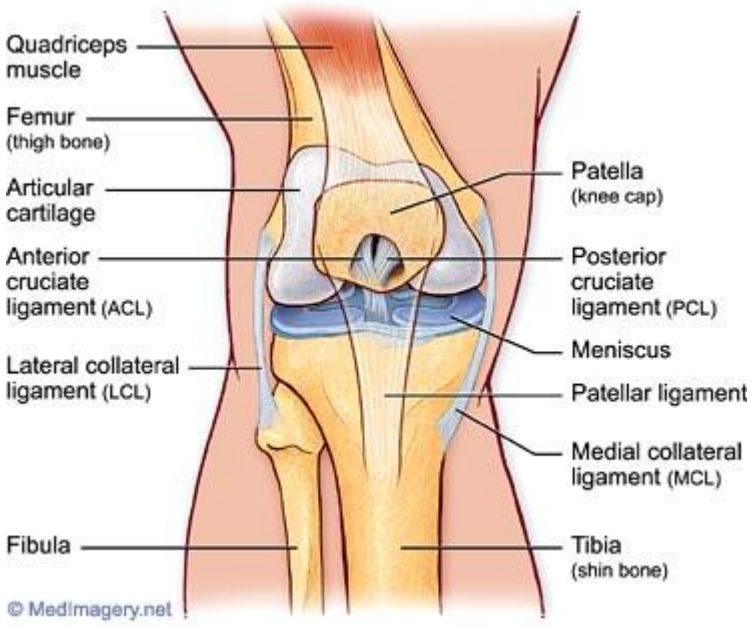

Figure 2. The anatomical structure of the knee joint; anterior view, knee in flexion, l.dx. (Sports Medicine UK.)

3.1 Ligaments

Ligaments are categorized as connective tissue. Tendons and ligaments are similar in structure and function except the arrangement of the component collagen fibers in ligaments is more irregular than in tendons and ligaments have more elastin fibers within the collagen fibers compared to tendons. Ligaments of the knee include cruciate ligaments and collateral ligaments. Cruciate ligaments are more important from functional point of view; damage to these ligaments contributes to a significant impairment and disability. The two cruciate ligaments are: the anterior cruciate ligament (ACL) and the posterior cruciate ligament (PCL) (Figure 3.). (Cailliet, 1992, 16.) The cruciate ligaments connect the tibia and the femur inside the joint capsule (Tortora & Derrickson, 2009, 290). The ACL attaches the anterior surface of the tibia and the posterior part of the femoral condyle. It limits hyperextension of the knee by preventing the anterior sliding of the tibia on the femur. The ACL is stretched or torn in most, 70%, of the serious knee injuries. (Cailliet, 1992, 16; Tortora & Derrickson, 2009, 290.) The PCL attaches the posterior intercondylar area of the tibia and the lateral surface of the medial condyle. The function of the PCL is mainly to prevent the posterior sliding of the tibia when the knee is flexed, this function is important especially when walking down stairs. (Tortora & Derrickson, 2009, 290.)

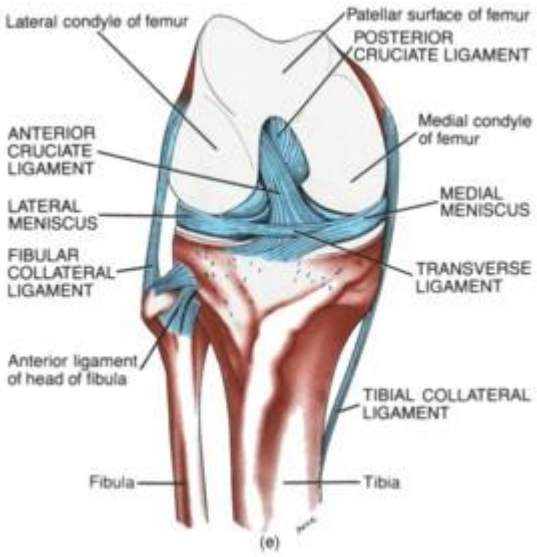

Figure 3. The ligaments in the knee joint, posterior view. (The Stretching Institute.)

The collateral ligaments' role is to stabilize the joint by guiding and restricting joint motion (Caillet, 1992, 20). The medial collateral ligament extends from the medial condyle of the femur to the medial condyle of the tibia. This ligament prevents the tibia from rotating to abduction compared to the femur. Tendons of muscles sartorius, gracilis and semitendinosus cross the ligament and support the whole medial aspect of the joint. The lateral collateral ligament extends from the lateral condyle of the femur to the lateral side of the head of the fibula. This ligament prevents the fibula from rotating to adduction compared to the femur and it strengthens the lateral aspect of the knee joint. The tendon of the biceps femoris muscle covers this ligament and the tendon of the popliteal muscle is deep to the ligament. (Ahonen et al. 1998, 295; Tortora & Derrickson, 2009, 290.)

The patellar ligament extends from the patella to the tibial tuberosity. It is a continuation of the tendon of insertion of the quadriceps femoris muscle, the role of this ligament is to strengthen the anterior surface of the joint. Oblique popliteal ligament and arcutate popliteal ligament strengthen the posterior surface of the joint. (Tortora & Derrickson, 2009, 290.)

3.2 Muscles supporting the knee joint

Muscles supporting the knee joint are categorized in the anterior extensor, posterior flexor, medial adductor and lateral abductor groups. The adductors and abductors are also stabilizers and rotators. (Cailliet, 1992, 26.) The muscle mainly responsible for knee extension is m. quadriceps femoris. It comprises the rectus femoris, vastus lateralis, vastus medialis and vastus intermedius. It also directs the movements of the patella because the tendon of rectus femoris is inserted in the patella and all the muscles converge on a ligament that attaches to the tibial tuberosity. Each of the muscles in this group can extend the knee individually except the oblique fibers of the vastus medialis, it keeps the patella centered against lateral pull. (Ahonen et al. 1998, 301-302; Cailliet, 1992, 27-29.) M. gluteus maximus has an effect on extension during the pre swing in walking (Ahonen et al. 1998, 302).

There are several muscles is the posterior flexor group but only m. biceps femoris brevis and m. popliteus are effecting purely on the flexion of the knee. Other flexor muscles affect on other joints at the same time. These muscles are m. semimembranosus, m. semitendinosus, which are together with biceps femoris brevis and longus the hamstring muscle group, m. sartorius, m. gracilis, and m. gastrocnemius. (Ahonen et al. 1998, 304-305; Hervonen, 2004, 224, 236.) M. popliteus strengthens the joint posteriorly, m. gastrocnemius acts to flex the knee when it is not weight-bearing (Cailliet, 1992, 42; Hervonen, 2004, 238). The tensor fascia latae is considered to be a knee extensor but its function is mainly abduction and stabilization of the hip (Cailliet, 1992, 37). The strong iliotibial band strengthens the lateral collateral ligament which the tensor fascia latae tightens. M. sartorius, m. semitendinosus, m. gracilis assist the medial collateral ligament by contracting. As said, the collateral ligaments are supported by the thick tendons of the muscles. (Kapandji, 1997, 116.)

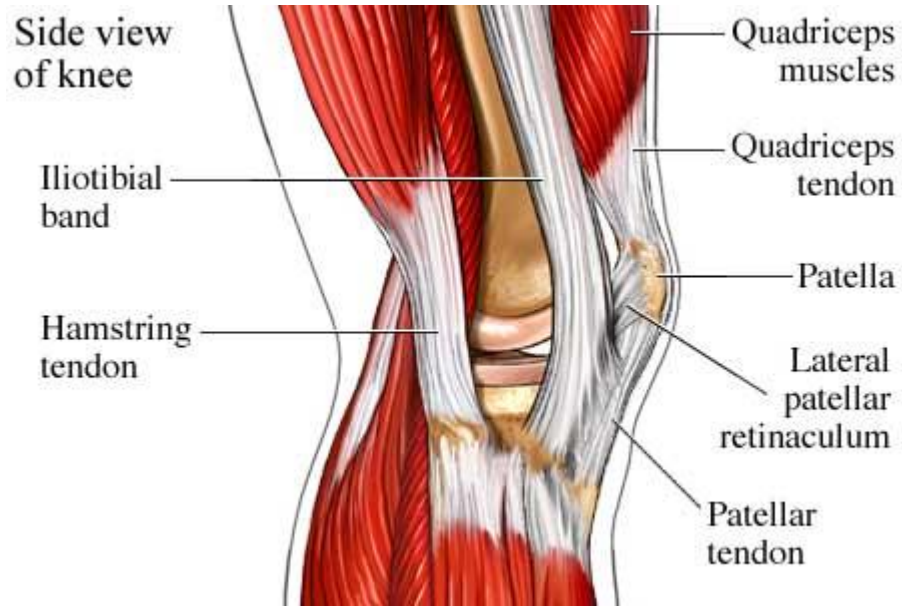

Figure 4. The muscles and tendons supporting the knee joint. (Revolution Health.)

4 KNEE BIOMECHANICS

In the human body, muscle's moment arm, the shortest distance between a force's line of action and an axis of rotation, with respect to a joint center is the vertical distance between the muscle's line of action and the joint center. The moment of arms of the muscles crossing a joint, change as the joint moves through a range of motion. For all muscles, the moment of arm is largest when the angle of pull on the bone is close to 90°. Due to the torque being the product of moment arm and muscle force, each change in the moment arm directly affect the joint torque that a muscle generates. If a muscle generates constant joint torque during exercise, it produces more force when its moment of arm decreases. (Hall, 2007, 424.) The concept of torque is important when studying human movement because torque produces movement of the body segments (Hall, 2007, 427).

Even though the tibiofemoral joint appears to function as a plain hinge joint rotating about a fixed point on a rotating axis, the exact mechanism of knee movement is completely different. Actually, the joint is a complex joint structure due to its intrinsic ligamentous structures, anatomically exceptional articular surfaces, the presence of menisci and the alignment of the muscular tendons. Movements of the knee joint, flexion and extension, are a combination of simultaneous gliding motion and rotation about a sagittal axis of the femoral condyles. To add more, this all is combined with concurrent rotation about a vertical axis. The tibia rotates about its own vertical axis internally during flexion and externally during extension. (Cailliet, 1992, 49.) After 20° of flexion, the medial and lateral collateral ligaments become relaxed allowing both gliding and axial rotation. When flexion increases, the degree of possible rotation increases and it is maximum at full flexion. The cruciate ligaments limit rotation of the tibia on the femur. Both cruciate ligaments control the knee motion through mechanics and proprioception. Factors affecting on the dynamic stability of the knee are the load imposed on it and the resulting reaction of the muscles about the joint. (Cailliet, 1992, 50-51, 53.)

The potential for torque development at the knee joint is large due to the joint is positioned between the body's two longest bony levers (the tibia and the femur). In addition, the knee is a major weight-bearing joint. During daily activities, the tibiofemoral joint is loaded in compression and shear. Tension development in the muscles and weight bearing contribute to these forces. When the knee is fully extended, compression dominates. This compressive force at the tibiofemoral joint has been informed to be slightly more than three times the body weight during the stance phase of gait and approximately four times the body weight during stair climbing. The medial tibial plateau bears most of the load during stance when the knee is in extension and the lateral tibial condyle bears smaller loads during the swing phase. This is because the medial tibial condyle is significantly bigger than the lateral one with approximately 60% larger surface area. The medial condyle also has a thicker articular cartilage which protects the joint from wear. The menisci assist with force absorption at the knee, bearing 45% of the total load and help protect the articulating bone surfaces from wear. Weight bearing produced shear component of joint force increases when the knee is flexed to minimum of 90°. The ligaments and other supportive structures crossing the knee must resist the shear. These structures can stretch and even rupture in extreme stress and activities such as deep knee bend. (Hall, 2007, 246-247.)

Compared to the tibiofemoral joint, the compressive force at the patellofemoral joint is smaller, one and a half during normal gait and three times body weight during stair climbing. During weight bearing, patellofemoral compression increases with knee flexion due to high quadriceps tension required to prevent the knee from buckling against gravity and the increasing compressive component of force acting at the joint. The squat produces patellofemoral joint reaction a force equivalent of 7,6 times body weight and increases with the depth of the squat. (Hall, 2007, 247.)

The mechanisms supporting the knee joint are different and depend on the position of the joint. When the knee is slightly flexed, body's gravity focuses behind the flexion and extension axis of the knee joint. This results in the tendency of the knee joint to flex unless the quadriceps prevents it. In a normal stance, the quadriceps is vital in order to maintain the position. If the knee joint is hyper extended, the ligaments behind the knee prevent it from extra bending. That is why an upright position can be maintained without the activation of the quadriceps. When the knee joint is hyper

extended, the axis of the femur runs obliquely backwards sloping downwards. The active force can be divided into vertical force vector, which represents the body mass and force vector, which points horizontally backwards and increases hyper extension. The more force is directed backwards, the greater is the force vector and the more the farthest back ligaments stretch. If the knee hyper extends too much, the ligaments will over stretch. This creates a vicious cycle aka causes the knee's hyper extension to increase more. (Kapandji 1997, 118.)

The force affecting the upper part of tibia is not vertical because the axis of femur is directed sloping downwards medially. The force can be divided into vertical force vector and transverse vector which is directed horizontally in the middle. This part attempts to cause knock-knees, the physiological valgus of the knees and increase space between the medial condyles. However, the MCL prevents it. The knee joint is exposed to considerable sideward forces, especially during walking and running. These forces are directed to the bony structures. When the body is in a certain position, the knee joint is unstable and tilts inwards. This increases the physiological valgus of the knee inwards and opens the inner joint gap. If the torque is strong, the MCL can sprain or tear. A serious sprain injury of the ligaments affects on the stability of the knee joint. When the LCL has been torn, the knee joint is incapable of resisting strong forces directed to the lateral side during walking and running. The collateral ligaments are not the only stabilizing structures; muscles forming active "ligaments" help the collateral ligaments. These muscles include tensor fascia latae, quadriceps, gracilis, sartorius, semitendinosus and iliotibial tract. The meaning of these muscles is important in securing the stability of the knee joint. (Kapandji 1997, 114-115.)

Based on the Anatomy Trains concept, regardless of the function of individual muscles, they always affect on the network of fascial continuity which extends the whole human body anatomically and functionally. The term "fascia" means the connective tissues surrounding muscle tissue, "myo". These terms are combined into myofascia because they are inseparably connected together. Meridians are part of this myofascial continuity and they are separated in several force vector lines across the body. The lines disseminate load and movement. (Myers 2012, 1, 4-5.) The knee is part of several lines: the superficial anterior line, which for example takes part in knee ex-

tension, the superficial posterior line, which supports the body in an upright position, the deep frontal line, which for example stabilizes each segment of the lower limb and the lateral line, which balances the anterior and posterior parts of the body (Myers 2012, 73, 97, 115, 179).

5 KNEE INJURIES

Factors such as the location between the long bones of the lower extremity, weight bearing and locomotion functions make the knee vulnerable to injury (Hall 2007, 249). There are several reasons to acquire a knee injury (exertion and basic illnesses) and most people have knee pain at some point in their life (Niinimäki 2008). Common joint pathologies are osteoarthritis, rheumatoid arthritis and acute joint trauma. Osteoarthritis (OA) is the most common disease affecting weight bearing joints. OA leads to pain, joint limitation and muscle weakness. One-third of people over the age of 65 have evidence of OA. Overweight, joint trauma, developmental deformities, abnormal tibial rotation and weakness in the quadriceps are OA risk factors. Rheumatoid arthritis usually starts from the joints in the hands and feet but with progression, the knees are involved. The range of motion decreases and the joints become swollen and warm. After knee surgery, the joint is vulnerable to post immobilization hypomobility. The motion becomes restricted due to the contractures developed in the capsule, muscles and soft tissue. (Kisner & Colby 2007, 693-694.) For majority of the people, joint attrition is painless and inclides in the normal aging process. With joint degeneration, menisci degeneration is common. When the joint attrition is severe, a knee replacement surgery is considered. (Niinimäki 2008.) Osteoarthritis is the most common joint disease in the world. According to the Finnish Health 2000 research the incidence of knee osteoarthritis is minimal among people less than 45 years of age (male 0,3%, women 0,4%) but already in male age group 55-64 the incidence is 9,1%. In the age group 75-84, the incidence of OA among men is 15,6% and women 32,1%. (Käypä hoito 2012.) When studying knee pain, the age-adjusted prevalence (over the age of 18) during the past month was 18,1% among men and 21% among women (Arokoski, Manninen, Kröger, Heliövaara, Nykyri & Impivaara 2007). The statistics of the social insurance institution of Finland reveal that all in all

4967 (men 2584, women 2383) people started to receive daily allowance for knee and/or shin fractures and 7355 (men 4348, women 3007) for joint and ligament dislocations in the knee area in 2011. All in all, in 2011, 249 761 received daily allowance for knee and/or shin fractures and 283 987 for joint and ligament dislocations in the knee area. (Kela statistics of health insurances 2011 2012, 140-145.)

Most commonly injured structures are the menisci, collateral ligaments and the ACL. Ligament injuries mostly occur in individuals between 20 to 40 years of age in sports but can also occur in individuals of all ages. From ligament injuries, the ACL is most commonly injured. However, usually more than one ligament is injured in a sudden trauma. The ACL can be injured from a blow to the lateral side of the knee, by forceful hyperextension of the knee or when the tibia rotates externally on the planted foot. This mechanism accounts for 78% of all ACL injuries. The PCL is usually injured by a blow to the anterior part of tibia when the knee is flexed. Injuries to the MCL can be partial or incomplete and can occur when valgus force is placed across the knee. The LCL injuries result from a traumatic varus force across the knee but these injuries are quite rare. (Kisner & Colby 2007, 722.) The medial meniscus is usually injured by internal rotation of femur when the foot is fixed on the ground; external rotation does the same to the lateral meniscus. Meniscal tears might cause acute locking of the knee and when the injury is acute, the person might have difficulties bearing the weight equally on both legs. (Kisner & Colby 2007, 737.)

Amongst young and working aged population, injuries without trauma are commonly a result from overuse. These can be presented as inflammation of the bursae, bursitis or pain in the tendons, tendonitis. Chondramalacia is a common reason for knee pain amongst young women. Chondramalacia is the softening and splitting of the cartilage under the patella. With the pain, crepitation is usually part of the condition when the knee is flexed and extended. (Niinimäki 2008.) A study made by Wilk and Reinold reveals that patellofemoral (PTF) disorders are some of the most common pathologic conditions of the orthopedic community, even 25% of the general population suffers from patellofemoral pain at some point of their life (Wilk & Reinold 2001, 325-336). The cause of patellofemoral pain might include direct trauma, overuse, degeneration or anatomical variations leading to faulty patellar tracking. Impairments caused by PTF include for example weakness of the VMO, pronated foot, pain in retropatellar

region, patellar crepitation, swelling or locking and weakness in the hip abductor musculature. (Kisner & Colby 2007, 712.)

The amount of injuries depends on the sport. In sports that include contact (ice hockey, soccer, basketball, wrestling, boxing etc.) the occurrence of injuries is larger than in individual sports (track and field, tennis, swimming etc.). In sports, most injuries occur in soccer and especially American football and when included winter sports, alpine sports have high rate of injuries as well. Stress injuries are most common in individual sports: of all injuries approximately 35% women and 20% men. (Peltokallio 2003, 20: Mero, Uusitalo & Hiilloskorpi 2012, 231-232.) Stress injuries' affect is substantial when concerning sports but minimal in the ability to work. The most common injuries in contact sports are serious injuries such as tearing of a ligament etc. (Peltokallio 2003, 20.)

In general, the majority of sudden sports injuries are bruises, soft tissue sprains and tears. The injuries often occur as a consequence of a sudden trauma. The most common place of injury amongst athletes is the knee, 28% of all the injuries. Ankle, foot, heel and shin area follow. (Mero et al. 2012, 231-232.) The risk of injury during sports is on average slightly higher amongst men than women but the risk of having a serious knee injury is 3-7 times higher amongst women. The reason is suspected to be the difference of bones in the pelvis and lower limbs, joints, muscles and women's looser ligaments. (Mero et al. 2012, 229.) The risk factors for having an injury are: age and gender, weight and height, earlier injuries, physical condition, anatomical inaccuracies, muscle mass, mobility of the joints, structure of the skeletal system, muscle tightness, psychical condition, and inadequate gear, neglecting warm-up, excess training, overloading and bad technique. (Peltokallio 2003, 14: Edwards, Farrow & Hardy, 2010, 7).

In martial arts, such as boxing, judo, karate, fencing and jujutsu, the risk of injury is high because of the even aggressive contact with the opponent. When considering the knee, the twisting movements strain the knees and can cause ligament injuries and cartilage damage. (Edwards et al. 2010, 30.) For example in judo and karate, the most common injuries are twisting injuries of the knees (Mero et al. 2012, 230). A study made in 2006 reveals that amongst kendo practitioners in Finland, the share of

lower limb injuries of all the injuries was 56,2%, which is clearly the largest part. However, from which knee injuries (sprain or dislocation) were only three cases. Most of the injuries were cuts (713 cases), 20 cases were fractures, 50 cases of muscle sprains, 51 cases of joint dislocations. There were also reported nine cases of Achilles tendon injuries. (Paala 2006, 31.) Paala's study also reveals that a study made by Spôtsu anzen kyokai in 1999, the amount of sprains in lower limbs was 19,6%; majority of those sprains were in the ankle but a great deal was also in the knee, foot and shin. Considerable amount of the knee injuries were ligament and menisci injuries. (Paala 2006, 15.)

On the other hand, one form of martial arts, have been studied to improve knee problems. A study made by Xu, Hong, Li and Chan, showed that regular tai chi practice improved knee and ankle proprioception in elderly people. (Xu, Hong & Li, 2004, 50.) Several studies have been made about the connection of knee osteoarthritis and tai chi. For example, Wang et al. discovered that tai chi reduces pain and improves physical condition for people with knee osteoarthritis. (Wang, Schmid, Hibberd, Kalish, Roubenoff, Rones & McAlindon 2009, 1545-1553.) Lee & Lee had the same discovery about tai chi being effective in decreasing pain and stiffness, improving balance and knee joint motion (Lee & Lee 2008, 11-8).

Aikido is a martial art including a lot of static and dynamic kneeling on the mat and some of the techniques include factors that might expose one to acquire a knee injury: pressure on the joint due to hyperflexion/ compression and torquing the joint during pivoting/turning. Hyperflexion and compression may damage the menisci, the patella and create general wear and tear. Activities in aikido including hyperflexion and compression are kneeling to bow in/out of training, warm-ups involving kneeling then lying back, and seated technique. Torquing injuries are especially harmful for tendons, ligaments and the menisci. People with poor body mechanics might end up with knee torquing, especially beginners are prone to let their knee turn inward as they turn or drop their centers or move their upper and lower body separately when they turn. The risk grows if the practitioner continues the false technique and it will set into muscle memory. Still, most people train without incurring serious knee damage even though aikido poses all the risks to the knees. It is also possible to start practice aikido with damaged knees but in that case the practitioner must be aware of

his own limits and inform the instructor about the condition. (Rosen 2003.) A study made by The Aikido and Knee injury project revealed that 51% of those who have had knee injuries are under 35 year-olds and the highest rate of injury has been amongst those who have trained 1-5 years (43%) (Rosen 2002).

6 INJURIES IN IAIDO

Regardless of the age, iaido can practically be practiced by anyone with a good general health since it is kinder to your body than karate, judo and most of the other Japanese martial arts (Ronin Jiu-jitsu & Kobudo 2006). When considering sports injuries in iaido, the most common injuries are cut wounds in the hand or a pierced left hand. Another common problem is lateral epicondylitis, also known as tennis elbow. Iaidoka also has the risk to trip over the hakama and the fall can cause various injuries. (Clausen 1998.) However, it is much more common to acquire a chronic injury rather than an acute injury due to the repetitive motions of kata practice. For example, some iaidokas suffer from chronic wrist injuries such as carpal tunnel syndrome. (Clausen 2011.)

The knee is a vulnerable place for an iaidoka due to constant deep squats and finish with a shock almost directly on the tendons. Sitting positions such as seiza and tatehiza create ideal conditions for tendonitis. Bursitis of the knee is quite common among iaidokas as the bursae of the knees are irritated by repeated blows as when one kneels without proper control. (Clausen 2011.) Still, in general, martial arts such as kendo and iaido might have a lower rate of injury than most martial arts. Iaido is subject to the range of soreness and strains to be expected in any sport. (Clausen 1998.) As said, iaido suits for people seeking less strenuous practices but it’s not for the weak-kneed with all the kneeling, squatting and springing (Choose your weapon: Exotic martial arts 2009, 2). The important factor in iaido practice and injury rates is if the iaidoka is using knee pads or not. In iaido, the knees are constantly in contact with the floor and this may lead to irritation in the sheath around tibia. This irritation is also known as shin splints. This is why most top Sensei will not allow their students to practice without knee pads. If practice on a hard floor is constant and knee-

pads are not in use, the career will presumably be quite short. Iaidokas who don't use knee pads might also develop Osgood-Schlatter's disease, which is a slight tearing of tibia in the area where the patellar tendon joins the tibia. (Clausen 2011.) The use of knee pads is not compulsory. However a clear majority use knee pads but there are some cases who have found that practicing iaido without knee pads suits them better and some might also have a higher pain threshold. One cannot rank the schools in iaido according to the knee injury rate. (Hellstén, personal communication on 30.10.2012.)

7 THE AIM OF THE THESIS

The aim of the study is to find out the prevalence of knee problems among iaido practitioners in Finland, the connection of knee injuries and iaido when also considering the years of practice, the grade of the practitioner and different techniques.

The main questions are:

1) How common are knee problems among iaido practitioners in Finland?
2) What is the connection between knee problems and the years of practice?
3) What is the connection between knee problems and the grade of the practitioner?
4) What is the connection between knee problems and different techniques?

8 RESEARCH IMPLEMENTATION

The process began in August 2011 by deciding the subject for my study. The subject changed slightly from the original plan towards a more simplistic and narrower area. The study was planned to be epidemiologic and quantitative to get exact answers. An agreement with the Finnish iaido federation was signed on September 2011. (Appendix 1)

8.1 Study method

A good base is built on a study when the researcher has made certain choices. These choices include setting the problem, making scientific philosophic choices (how do I understand the studied object?), choosing the method and theoretical understanding. There are three traditional study strategies from where to chose the method for the study: experimental study (measuring the effect of one variable to another), survey study (quantitative study which collects standardized data from a population) and a case study (detailed, intensive data from a single case or from a small population). (Hirsjärvi, Remes & Sajavaara 2004, 115, 125.) In a survey study, the subjects form the sample. The data collected from a survey study is handled quantitatively. The form used to collect the data is necessary to pilot to verify aspects and possibly re-phrase the questions. The survey may be sent to the subjects via mail or it can be open in the internet. Usually the subjects are reminded twice about the survey to get the reply percent high. The problem might be the dropout rate: the bigger the sample, the bigger the dropout. If the sample is very specific, the dropout percent is usually smaller. The benefits of a survey study is that it enables the collection from a large population, it is effective, the data is easily handled and analyzed and the researcher doesn't need to develop new analyzing methods. The weaknesses include that the interpretation may be difficult, the data is superficial and the studies are theoretically modest. The reliability of the population may also be questioned. (Hirsjärvi et al. 2004, 182-185, 193.)

The essential components of a quantitative study are conclusions from previous studies, previous theories, presenting hypotheses, defining concepts, planning and collecting data which is based on quantitative and numeric values, choosing subjects for the study (a sample is taken from a defined population), placing the data into a statistically processed form and making conclusions based on the statistic analysis of the data by using tables, charts and testing the significance of the results. However, hypotheses are only used when there is a valid explanation. Usually the explanations are found from the theory or previous studies. If there are no validation, placing hypotheses is usually avoided. The size of the sample is dependent on the accuracy of the results; the bigger the sample, the more accurate result. Also, the size of the result is basically dependent on the goals of the research, how accurate results is wanted,

how many variables are meant to be studied simultaneously and how homogeneous the population is when considering the studied subject. When the analysis is ready, the results still need to be interpreted. Interpretation is speculation and clarification of the meanings that were emerged from the analysis. (Hirsjärvi et al. 2004, 131, 149, 169, 213.)

8.2 Piloting the questionnaire

The questionnaire (Appendix 2) was piloted to assess if the planned questions were comprehensive enough to answer all the areas that were to be studied and if the questionnaire included unnecessary questions. The piloting happened on October 20th 2011. The subjects were the iaido practitioners of the Tampere club. At the time of the piloting 7 people were present. The pilot questionnaire included 21 questions and three questions to give feedback about the questionnaire: eight questions were background information (age, gender, years of practise, other hobbies, grade etc.), eight questions were about knee problems, three questions about the treatment of the knee problems and two questions about if iaido has helped the subjects' knee problems. There were 16 multiple choice questions and five questions were left open. The covering letter included an introduction, explained the aim of the questionnaire and relevant information about the handling of the data. The purpose of the questionnaire was also explained before the forms were given. The questionnaire was in Finnish. Piloting the questionnaire had a good effect on how to improve it even though the changes weren't huge. Question 1.8 was changed slightly to include all forms of exercise and question 4.1 needed more options, not only "yes" and "no". Also, a question about school and association was added due to the feedback. The co-operation with the Finnish iaido federation and the name of my teacher were added to the covering letter. One of the subjects had problems understanding the question due to Finnish not being the mother language. This lead to a question if a mere Finnish version is enough, if there is more people practising iaido whose mother language is not Finnish. However, after discussing with the vice president of the iaido federation, the questionnaire was done only in Finnish.

8.3 Study group

The final questionnaire for the data collection was decided to be delivered to the subjects as an e-form as it requires less paperwork, the subjects can answer whenever and wherever they want during the time it is available and the data can be directly transferred to a computer programme. As an e-form, the questionnaire can be open to the public as long as the creator wants to. The vice president of the Finnish iaido federation assisted me on passing the information about the questionnaire to the subjects. The link to the questionnaire was sent via email to all Finnish clubs where iaido is practised, neither depending on the school nor association. Only exception was that the Tampere club didn't receive the final version because it was part of the pilot study. The exact amount of people receiving the e-form web site remains unclear as the information was not directly sent to the subjects and there is not a clear record of how many people were practising iaido at the time but an estimation of 160 persons received the questionnaire. The questionnaire was open for the subjects from November 4th until November 21st and the subjects were reminded once about the questionnaire. Overall, 81 subjects answered the questionnaire. Therefore, the answering percentage was approximately 50% which is good for an electrical survey study because the coverage is usually a significant problem. People do not read emails as often as traditional post and emails from unknown sources might end up in spam file. Also, nowadays the answering percentage in a survey study is usually less than 50%. (Ruskoaho, Vänskä, Heikkilä, Hyppölä, Halila, Kujala, Virjo & Mattila 2010, 281: Vehkalahti 2008, 44.)

8.4 Research process

When the exact subject for my study was decided, literature research for references for the theory part started immediately. Planning the questionnaire started at the same time. Soon after piloting the questionnaire, the final version of the questionnaire was ready and opened to the public. After the data collection, literature review and research continued and writing the theory part of the thesis started. Writing the theory part and literature research continued throughout spring and summer of 2012 and the

data analysis started on October 2012. Table 1 describes the whole process of the research.

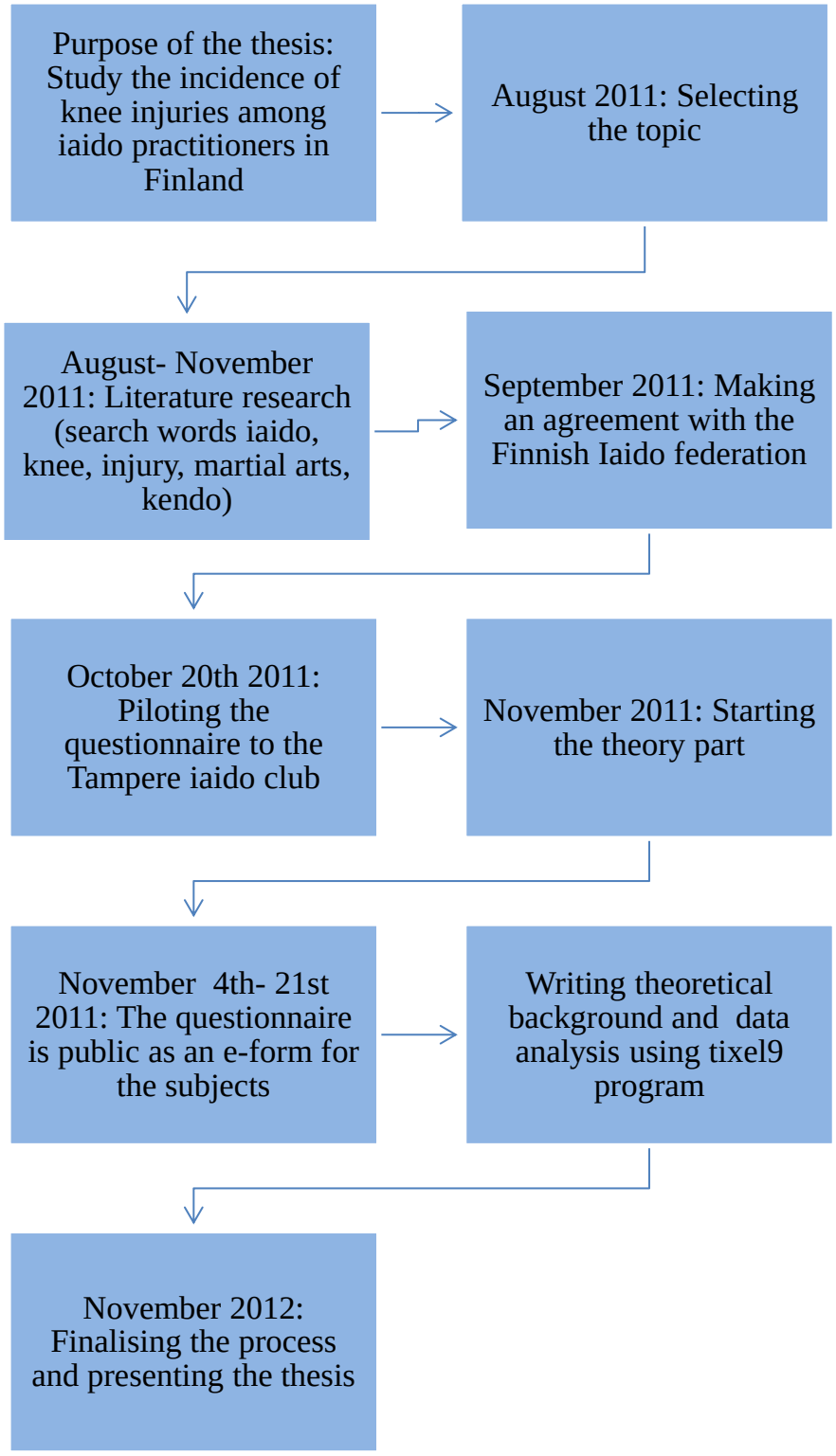

Table 1. Research process

8.5 Analysis

When all the data was collected, it was directly transferred to an excel table. The features of the e-form made this possible. To make the data analysis easier, a computer program was used which calculates automatically and hides these mathematic calculations. Program used was the tixel 9 software provided by SAMK. Majority of the results were converted into numeric values in order to analyze them properly. However, open questions were left as they were. The matrix included a lot of data but only the data significant to this study was used.

9 RESULTS

All in all, 81 persons answered the questionnaire, 17 of which were women and 64 were men. Majority of the subjects were in the age group 26-35 (30%). The other age groups were under 25 year olds (22%), 36-45 (26%), 46-55 (19%), 56-65 (2%) and only one person was in the group 66-75. Average age for the respondents was 36,2. Majority of the subjects have been practicing iaido less than 5 years. The average of iaido practice years was 7,9. (Table 1.) The tables for some results are shown in Appendix 3.

Iaido years	*Freq.*	*%*
≤ 5	44	54
6 - 10	16	20
11 - 15	10	12
16 - 20	5	6
21 - 25	3	4
26 - 30	2	2
31 - 35	1	1
Total	81	100

Age	*Freq.*	*%*	*Cum. freq.*	*Cum-%*
≤ 25	18	22	18	22
26 - 35	24	30	42	52
36 - 45	21	26	63	78
46 - 55	15	19	78	96
56 - 65	2	2	80	99
66 - 75	1	1	81	100
Total	81	100	81	100

Table 1. The subjects' iaido years and age groups.

The questionnaire revealed that 44% (36 persons) practice other budo arts besides iaido from which the most common ones are karate (8 persons), kendo (8 persons) and jodo (6 persons). Also, 8 persons practice two or more budo arts besides iaido. From the respondents, 43% (35 persons) have changed from another budo art to iaido, the most common were karate (11), aikido (10) and kendo (9). Majority, 75%, of the subjects have other hobbies besides iaido, these include for example gym training, running, walking, cycling and yoga.

Musô Shinden Ryû is the most popular school with 36% (29) of the respondents practicing it. Second is ZNKR iaido with 20% (16), then Musô Jikiden Eishin Ryû follows closely with 19% (15) and Suio Ryû iai kenpo is practiced by 17% (14) of the subjects. Interestingly, 9% (7) answered only iaido. Table 2. shows the distribution of the schools.

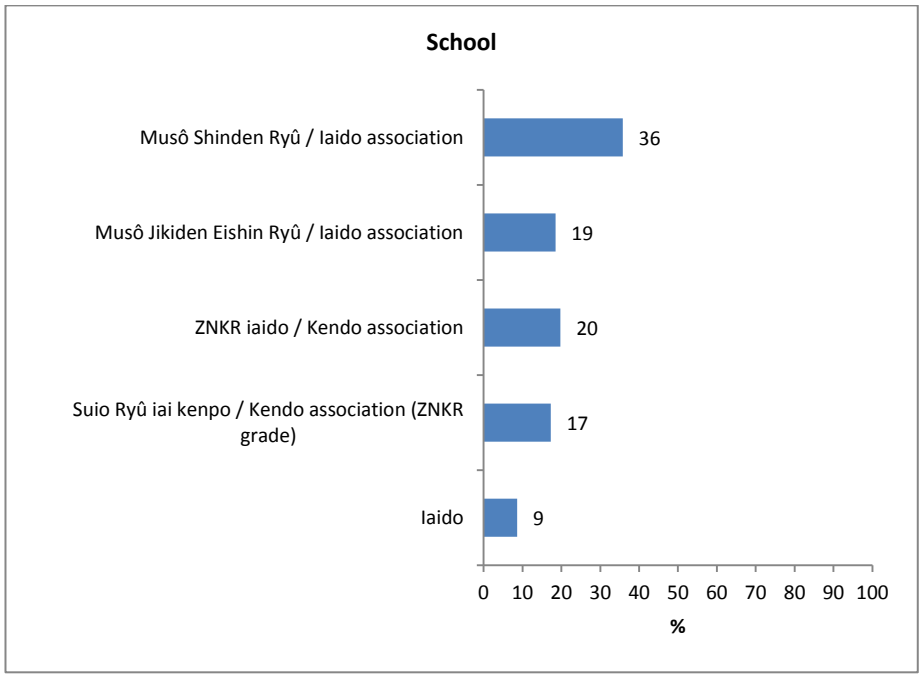

Table 2. Iaido schools and associations

9.1 The frequency of knee problems

Of the respondents, 30% (24) reported that they had knee problems before they started iaido. From those 24 persons, 21 still have knee problems. All in all, 53% (43 per-

sons) reported having knee problems at the moment. From those, 9 subjects reported that there is a direct connection between their knee problems and iaido. There are 20 persons who have had treatment for their knee problems and 9 have had surgery for the knees. (Table 3. Appendix 3) Self-help methods are familiar to 29 persons such as pain killers, ice pack, knee support, stretching and muscle strength exercising. The questionnaire reveals that 61% of those who practice other budo arts besides iaido now have knee problems. (Table 4. Appendix 3)

According to the results, the incidence of knee problems increases with age. Only 33% of the group under the age of 25 report having knee problems, half of the group 26-35 have knee problems and majorities of the groups 36-45 and 46-55 experience knee problems (57% and 73%). (Table 5. Appendix 3) From those 43 subjects who experience knee problems, 19% (8) answered to experience pain daily, 31% (13) weekly, 33% (14) monthly and 17% (7) less frequently than once a month. One hadn't answered to this question. The question about pain was implemented by asking the subjects to place the amount of pain in scale from one to ten, 10 being maximum and 1 indicating very little pain. The average answer was 4,8 from 35 respondents and six subjects reported several numbers, for example 6-7 or 2-7 depending on the exertion. All in all, 40 subjects answered that there is pain in the knee area. The most common place of pain was the front part of the knee with 87% majority. (Table 6. Appendix 3)

The questionnaire revealed that 22% have found iaido relieving their knee problems, 22% say iaido has not helped their knee problems and 16% say there has not been any change. Majority, 33%, practices iaido more often than twice a week, 22% twice a week, 27% 1-2 times a week, 7% 1-2 times in 2 weeks and 5% practice 1-2 times a month and 5% less than 1-2 times a month. (Table 7. Appendix 3) Those who report suffering from the problem in the beginning of the practice session but it goes away with warm-up are 12 persons, 16 say that the problem comes up at the end of the practice and 15 say the problem is disturbing only during exertion throughout the exertion. The amount of practice compared to knee problems was studied (Table 8.). According to the questionnaire, all of those who practice less than 1-2 times a month have knee problems (4). Also the majority who practice 1-2 times a month (75%) and 1-2 times in 2 weeks (67%) have knee problems. However, bigger part of the group

that practices more often than 2 times a week experience knee problems (56%). The probability value of these results is not significant and the correlation is low.

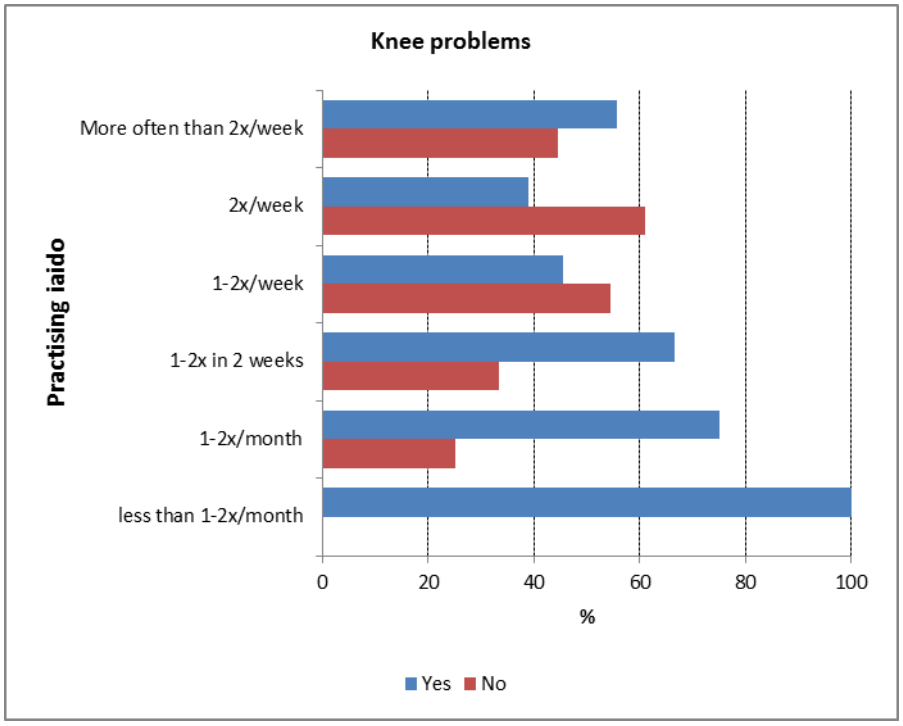

Table 8. Amount of practice compared to knee problems.

9.2 The connection between knee problems and years of practice

According to the results, those who have practiced iaido less than five years have the most knee problems when considering the size of the group (Table 9.). All of the subjects who have practiced iaido 26-35 years have knee problems but there are only three subjects in those categories. Majority of the groups 5-10 (63%) and 21-25 (67%) do not have knee problems. The probability value of these results is not significant and the correlation is low.

%	*≤5*	*5-10*	*11–15*	*16 - 20*	*21 - 25*	*26 - 30*	*31 - 35*	*Total*
Yes	52	38	60	80	33	100	100	53
No	48	63	40	20	67	0	0	47
Total	100	100	100	100	100	100	100	100
N	44	16	10	5	3	2	1	81

Table 9. The effect of iaido years to the incidence of knee problems.

9.3 The connection between knee problems and the grade of the practitioner

Only 4% of the people who answered are the lowest grade which is 6. kyu and 2% are the currently highest held grade in Finland of 6. dan. The biggest group is the people having 1. kyu grade. The distribution of the grades is presented in Table 10.

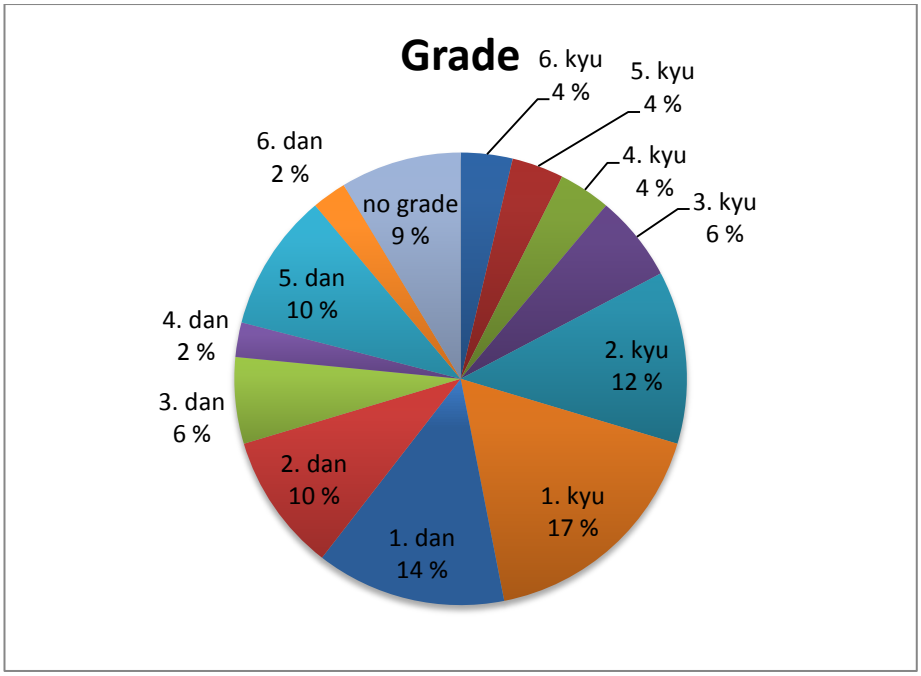

Table 10. Grades of the practitioners.

According to the results, nearly all of the grade categories had more ‘Yes’ answers than ‘No’ answers when asking about experiencing knee problems (Table 11.). Subjects having grades 3.kyu, 1.kyu, 1.dan and the ones who didn’t report their grade had more ‘No’ answers. All of the subjects who have 4.dan grade reported to have knee problems. However, there are only two subjects in that category. High values of ‘Yes’ answers are also visible in grades 3.dan (80%) and 2.kyu (80%). From the biggest group of practitioners, 1.kyu, 71% reported not having knee problems. Also, a clear majority of the 1.dan grades, which is the second biggest group, do not have knee problems (82%). The probability value of these results is not significant (0,11) and the correlation is moderate (0,43).

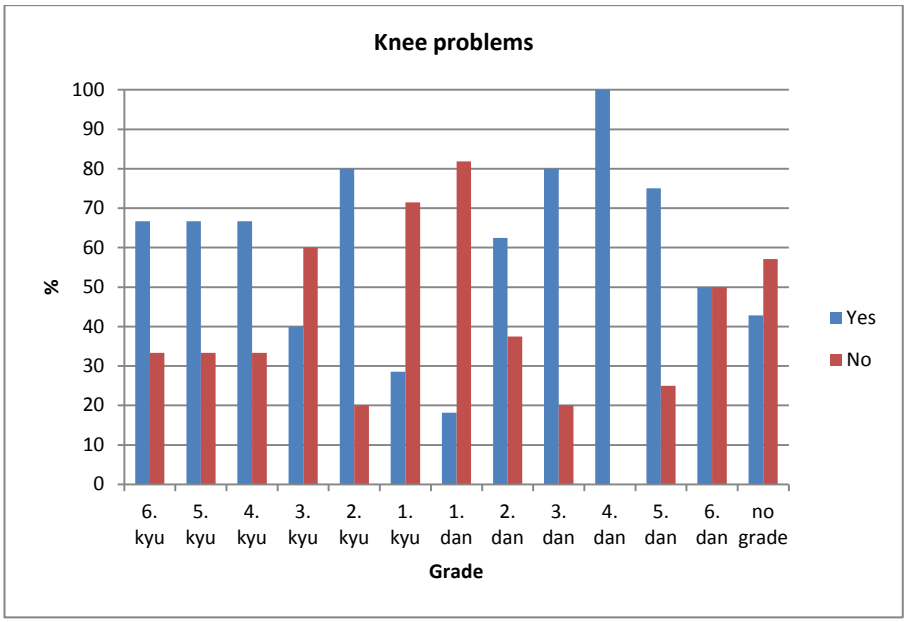

Table 11. The effect of the grade to the incidence of knee problems.

9.4 The connection between knee problems and techniques

Certain iaido techniques aggravate the problem according to 74% (31 persons) of the ones who have knee problems at the moment. Tatehiza and seiza positions are reported to be demanding positions for the knees by 14 respondents. Overall, techniques performed on the floor with knees touching the floor are mentioned by 17 people to be aggravating the knees. Also respondents mentioned squatting movements, sudden twists and certain knee angles to be provoking the problem.

All of the subjects practicing Suiô Ryû iai kenpo reported that certain techniques aggravate knee problems (Table 12.). Majority of the practitioners from other schools also reported similar results. The least 'Yes' answers gave the Musô Shinden Ryû practitioners (54%). When considering the grade of the practitioner and the connection between knee problems and techniques, all of the ones having grades 6.kyu, 3.kyu, 1.dan, 4.dan, 5.dan, 6.dan and the ones who didn't report their grade, informed that certain techniques and knee problems have a connection (17 from 42 persons). The probability value of these results is not significant and the correlation is low.

%	*Musô Shinden Ryû*	*Musô Jikiden Eishin Ryû*	*ZNKR iaido*	*Suiô Ryû iai kenpo*	*Iaido*	*Total*
Yes	54	75	75	100	83	74
No	46	25	25	0	17	26
Total	100	100	100	100	100	100
N	13	8	8	7	6	42

Table 12. The effect of certain techniques to the incidence of knee problems when considering the school.

10 CONCLUSIONS

According to this study, majority of the iaido practitioners who answered to the questionnaire have knee problems. However, it is ascertain whether iaido has been the only cause for the subjects' problems. The frequency of knee problems increases with age. Those who practice iaido less frequently experience more knee problems compared to those who practice at least once a week. Those who have practiced iaido less than five years have more knee problems when compared to those who have practiced iaido longer. Two-thirds of those subjects having grade 4.kyu or below have knee pain and 80% of those with grade 2.kyu have knee problems. Certain techniques, such as sitting positions seiza and tatehiza, have a connection with knee problems. The results have similarities with the general population due to the connection with increasing amount of knee problems and age.

11 DISCUSSION

Deciding the subject for my study was in fact quite easy. However, the idea for the study slightly changed right in the beginning as the study would have been too wide and more complex to complete. One of the most challenging parts of the study was to find relevant information and studies made about knee problems and iaido. This

came to my awareness right in the beginning of the project when the vice president of the Finnish iaido federation told me that there is a lot of information generally about iaido but he couldn't say what kind of studies have been made about the incidence of knee problems. After months and months of searching I came to a conclusion that the information is very limited and I mostly relied on the studies made about other martial arts such as kendo and aikido. Kendo presents similar movements as iaido and aikido at times. Still, relying mainly only on those martial arts decreased the specificity and validity of my study and I couldn't reflect my results to previously made studies. On the bright side, at the end of writing the theory part I found more specific information related to iaido and I had also personal reference from the vice president of the Finnish iaido federation, Pasi Hellstén. In addition, it was challenging to find and write information about an art, which was almost completely strange to me. As said, the internet and the books contain plenty of information about iaido, its different schools and therefore different techniques and its long history. At times, just iaido's philosophy felt overwhelming but still intriguing. Luckily, I had outside help to compact the information to a much shorter version and to find the relevant parts of the art.

I am pleased that I chose a subject that interested me and seemed clear to carry through. Before starting the process, I had received the impression that iaido is a sport with a great amount of knee injuries. Therefore, the idea was to approach the subject from a perspective that assumes that knee problems are common and study the reasons for this fact more thoroughly. Nevertheless, in the beginning of the communication about my study with Hellstén, his opinion was that iaido is in fact a martial art with quite low rate of knee injuries and many people have changed from other martial art to iaido due to knee problems. This changed the setting for the study and I decided to include a part which reveals the respondents opinions and experiences about iaido's benefits. Still, according to Clausen (2011), iaidokas are vulnerable for knee injuries but he also mentions that the injury rate is lower than in other martial arts.

Overall, I am happy with the questionnaire and the results it gave to the study but the final version was made and opened to the public before the precise study questions were decided which decreases the validity of the study and is one consideration of

improvement. If the study questions were decided earlier, the questionnaire would have included more in detail questions about the wanted areas. Still, regardless of this set back, I am confident the questionnaire served the study well. The final questionnaire included a part where the subjects could comment and give feedback and there were some good points about the questions. For example the questionnaire could have included clearer definitions of some words such as ‘exertion’. Question 2.4 was left unclear for some people and the spaces to write were too short. Also one subject wondered why the questionnaire didn’t include questions about what is the surface where the practices are held and the use of knee pads. Having answers about how many use knee pads and what is the connection between knee problems and the use of knee pads would have given interesting results especially when considering that some iaidokas prefer practising without knee pads according to Hellstén. A new study could be made about the use of knee pads and the surface due to this knowledge that sitting positions and techniques done from a kneeling position are aggravating the knee problems most.

The purpose was to deliver the information about the questionnaire to as many iaido practitioners as possible. The information was not sent directly to each person, it was sent to all of the instructors of the iaido clubs and it is unknown how many practitioners were in the clubs at the moment. Therefore it is impossible to say exactly how many received the questionnaire. Still, an estimation of 160 persons received the link to the e-form. This means that roughly 50% answered and the reliability of the study is quite good when considering that the surveys were sent electronically. Nevertheless, I was positively surprised about the amount of received questionnaires. It can only be speculated why the rest of the iaidokas didn’t answer; some might have forgotten, some weren’t willing and some might have thought that the questionnaire didn’t concern them.

There was almost a year’s gap before the data analysis began which means that the subjects might have now different experiences about their knee problems and therefore the results might be different if they answered the questionnaire later. The data analysis phase was interesting but at the same time exhausting. It was difficult to pick the data relevant to the study and compare it to the other factors. The extent of the data gave the possibility for endless ways of analysis. Some of the data was con-

tradictory and some data needed to be changed in order to analyze it correctly. During the analysis process I noticed that some of the data was incorrect and some information was lacking. For example, one had reported to have 7. kyu grade which doesn't exist in iaido and some had only answered to practice iaido when the school and association were asked. Also some of the answers included other body parts besides the knee such as the foot. In these minor cases I took the charge to change the answer. One fact which might have also affected the results especially in question 2.2 is that some practitioners answered to practice more than one school and hadn't marked the grade for each school and also which Finnish association their school belongs to. These might cause some bias to the study but the modifications were essential for the analysis. The comments from the subjects also varied greatly; some said iaido has really helped after other martial arts and some said that iaido is worsening the knee problems. One even commented "In the end, iaido destroys the knees but it's worth it". It is uncertain if the persons practicing iaido less frequently than 1-2 times a month (Table 2.) practice so infrequently because of knee problems or the knee problems are caused because the practice is so infrequent (lack of flexibility, muscle weakness etc.).

The aim of this study was to find out the incidence of knee problems among Finnish iaido practitioners. Knee problems are common among the normal population as it is in sports. However, among normal population, the knee problems are more common among the older population and the most common problem is osteoarthritis and one-third of people over the age 65 have signs of OA (Käypä Hoito 2012: Kisner & Colby 2007, 693-694). Therefore, it is difficult to compare the results from this study to the normal population due to the study concerning mainly younger population and this study didn't focus on the type of knee problem. According to the study made by Arokoski, Manninen, Kröger, Heliövaara, Nykyri and Impivaara (2007) for the Health 2000 survey, 18,1% of men and 21% of women over 18 years of age have experienced knee pain. Compared to those results, people practicing iaido have more knee problems than the general population. All in all, 53% reported to have knee problems. Most suffer from the problem at the end of exertion (46%) and during the exertion throughout the exertion (43%). Majority suffers from the problem monthly (33%). However, the amount of pain is not extreme with the average of 4,8 in a 1-10 scale.

Many of the subjects who experienced knee problems reported that when the knee is in extreme flexion (seiza and tatehiza), the knee problem is aggravated. According to Hellstén, these positions usually are difficult especially for those who have not practiced iaido that long and it takes even years to get used to these positions. Therefore it is no wonder that 52% of the subjects who have practiced iaido less than five years have knee problems. Thus, it may be speculated that the cause for majority of knee problems is in fact due to the practitioners being unused to positions which demand high flexibility. Furthermore, techniques performed on the floor with knees touching the floor are difficult for 54% of those who see the connection between different techniques and knee problems. Also, many practitioners commented that their knee problems decreased with practice as the flexibility and muscle strength increased. Interestingly, the subjects who have moved to practice iaido from other budo art have less knee problems than those who do not have prior budo experience (43% vs. 61%). This fact might also indicate that those who have had practice from other budo art have better control and muscle strength in lower extremities than the one's without any budo background.

The fact that practitioners with less than 5 years of experience have more knee problems affects also in the connection between the grade of the practitioner and knee problems. From the three minor grades, 6.kyu, 5.kyu and 4.kyu, 67% answered to have knee problems. Then from grade 3.kyu, 40% have knee problems but again 80% from the practitioners with 2.kyu have knee problems. The results show that the incidence of knee problems increases with age which supports the previous made studies by the Health 2000 Survey about the risk of osteoarthritis increasing with age.

Almost one-fourth reported that iaido has been relieving their knee problems. Those who have found iaido's positive effects on knees comment that iaido doesn't twist the knees in a way that other budo arts do, such as taido and karate, iaido is gentler on the knees, iaido has strengthened the muscles supporting the knee joint and many practitioner has learned to be careful in certain movements which include especially techniques performed on the floor on knees. Few have also changed from one school to another to avoid some positions and techniques. Some also admit that it has not

been only iaido that has helped. The conclusion from the comments was that iaido helps gradually when the movements become familiar and when flexibility and muscle strength increase.

This study leaves many unresolved questions and gives possibilities for future research. Now the epidemiological study part has been made and this gives the possibility to compare iaido to other similar martial arts in other studies. As the results showed, those who practice seldom and those who have practiced less than five years have more knee problems. This fact gives reasons to wonder about the level of the instructors and the features the instructors possess. Does the instructor consider that the newcomer might not have the muscle strength and flexibility required to practice certain katas? In general, it could be studied what is the knowledge and skills of the instructors and what type of instructor training they go through. In this study the aim was not to focus on the specific types of knee injuries as it was to study how many of the Finnish iaidokas experience knee problems. Therefore, a continuing study about this subject could include more specifically the character of the injuries, prevention and treatment of different knee conditions. A question about how the gender of the practitioner affects in the incidence of knee problems is as well one point of view that could be studied more thoroughly. This study also doesn't answer to the questions about training habits in more detail such as warm-up or as previously mentioned the use of knee pads or the surface where the practices are held. Generally, in my opinion there could be more research done about iaido's influence on physical, mental and psychological health.

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SATAKUNNAN AMMATTIKORKEAKOULU
SATAKUNTA UNIVERSITY OF APPLIED SCIENCES

OP07B

SAMK / Agreement on the Preparation of a Thesis

Author of thesis: Erika Vidqvist	Student number: 0901605	Group in which studies were started: PH09p

Degree programme: Physiotherapy

Name of supervising teacher, email address, telephone number and address:
Esa Bärlund (esa.barlund@samk.fi), Maija Kangasperko (maija.kangasperko@samk.fi)

Client, name of contact person, email address, telephone number and address:
Finnish Iaido Federation, Pasi Hellstén (pasi.hellsten@gmail.com)

Title of thesis: Knee problems amongst iaido practitioners

Scheduled progress of thesis: Graduation: November 2012

More detailed information is provided in the approved research project plan attached to the agreement.

Insurances. If the thesis is prepared entirely or partly during the student's paid employment, the client shall draw up an appropriate written employment contract. The employer shall take out the statutory insurance policies because the insurance policies taken out by Satakunta University of Applied Sciences do not cover the author of a thesis prepared during paid employment.

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Publication of results and confidentiality. The thesis shall be public in its entirety. If the thesis includes business secrets or other confidential information referred to in the Openness Act, the confidentiality requirements shall be taken into consideration when preparing the thesis report. When necessary, the confidential information shall be kept in the background material. The thesis, or parts thereof, can also be published on the Internet upon separate agreement. The parties involved in the thesis (student, client and supervising teacher) undertake not to disclose any confidential information or documents brought up during the thesis process or in preceding or following negotiations and not to make use of any confidential information expressed by another party without separate permission.

Any disputes over the agreement shall be primarily resolved by mutual consent between the parties. If no agreement can be reached in negotiations, the disputes shall be resolved at the Satakunta District Court.

This agreement was prepared in identical copies, one for each party.

Satakunta University of Applied Sciences is entitled to use the cooperation project as a reference to the University's working life contacts, including SAMK's cooperation database in which searches can be made on the Internet. For each thesis, the following information is indicated: title, organisation and contact person in the organisation. Furthermore, the project may be used for the attainment of objectives se on vocational higher education e.g. in the form of teaching material or method, provided that the confidentiality of the information included on the project is not jeopardised.

Date: 22.9.2011 Pori

Signature of the client's representative, title and clarification of name: Pasi Hellsten SIL, Ryhmänjohtaja	Signature of Director of Education / Dean and clarification of name: Anne Sankari -lab

Signature of the auhor: Erika Vidqvist

Person in charge: Anne Sankari	Last revised: 24.3.2011

samk ? KYSELY

Polviongelmat iaidon harjoittajien keskuudessa

Lomake on ajastettu: julkisuus alkaa 4.11.2011 9.50 ja päättyy 21.11.2011 12.00

seliteteksti

Hei!

Olen kolmannen vuoden fysioterapeuttiopiskelija Satakunnan ammattikorkeakoulusta ja teen opinnäytetyötäni polviongelmien ilmaantuvuudesta iaidon harjoittajien parissa. Tutkin asiaa lähettämällä kaikille Suomen seuroille kyselylomakkeen koskien iaidoa ja polviongelmien/-kipujen ilmaantuvuutta ja mahdollista aiheuttajaa. Teen opinnäytetyöni yhteistyössä Suomen iaidoliiton kanssa.

Kyselyn tekeminen kestää noin 5 minuuttia, vastaaminen on täysin vapaaehtoista. Kyselylomake on anonyymi ja käsittelen tiedot luottamuksellisesti. Tietoja käytetään vain kyseiseen tutkimukseen. Kyselylomakkeen lopussa on kommenttilaatikko, johon saa vapaasti kommentoida kyselyä.

Kiitos vastauksista!

Erika Vidqvist

Opinnäytetyötäni ohjaa Maija Kangasperko (maija.kangasperko@samk.fi)

1. Taustatiedot

1.1 Sukupuoli
- Mies
- Nainen

1.2 Kuinka vanha olet? (vuotta)

1.3 Kuinka kauan olet harrastanut iaidoa?

1.4 Vyöarvo

1.5 Koulukunta ja liitto (kendo/iaido)

1.6 Kuinka usein harjoittelet?
- Useammin kuin kaksi kertaa viikossa
- Kaksi kertaa viikossa
- 1-2 kertaa viikossa
- 1-2 kertaa kahdessa viikossa
- 1-2 kertaa kuukaudessa
- Harvemmin kuin 1-2 kertaa kuukaudessa

	En	Kyllä	Jos kyllä, mitä?
1.7 Harrastatko muita budolajeja iaidon lisäksi?			

	En	Kyllä	Jos kyllä, mistä?
1.8 Oletko siirtynyt iaidoon toisesta budolajista?			

	En	Kyllä	Jos kyllä, mitä?
1.9 Harrastatko muuta liikuntaa?			

2. Polviongelmat

	Ei	Kyllä	Jos kyllä, millaisia?
2.1 Oliko sinulla ennen iaidoa polviongelmia?			

2.2 Onko sinulla tällä hetkellä polviongelmia?
- Ei (siirry kohtaan 4)
- Kyllä

Jos kyllä, kuvaile vaivaa

2.3 Koska ja miten vaiva on alkanut?

2.4 Jos polvessa/polvissa on kipua, missä alueella kipu on pahin? Valitse kaikki sopivat vaihtoehdot
- [ ] Etuosassa
- [ ] Takaosassa
- [ ] Oikealla sivulla
- [ ] Vasemmalla sivulla

Muualla, missä?

2.5 Asteikolla 1-10, kuinka voimakasta kipu on? 0= ei kipua, 10= pahin mahdollinen kipu

2.6 Kuinka usein polviongelmat häiritsevät?
- Päivittäin
- Viikoittain
- Kuukausittain
- Harvemmin kuin kerran kuukaudessa

2.7 Missä yhteydessä vaiva häiritsee? Valitse kaikki sopivat vaihtoehdot
- [ ] Vain rasituksessa koko rasituksen ajan
- [ ] Rasituksen alussa, mutta vaiva häviää lämmittelyn myötä
- [ ] Vaiva häiritsee rasituksen loppupuolella
- [ ] Päivittäinen jatkuva vaiva, myös levossa
- [ ] Öisin, vaiva häiritsee nukkumista

Muussa yhteydessä, missä?

	Ei	Kyllä	Jos kyllä, missä?
2.8 Ilmeneekö vaiva tietyssä/tietyissä tekniikoissa tai asennoissa?			

3. Hoito

	En	Kyllä, polvi/polvet on leikattu	Kyllä, mutta en ole ollut leikkauksessa	Kumpi polvi on leikattu koska?
3.1 Oletko ollut hoidettavana polviongelmien takia?				

	Lääkäri	Fysioterapeutti	Muu
3.2 Polviani on hoitanut			

	En	Kyllä	Jos kyllä, mitä? (kipulääke, jääpakkaus ym.)
3.3 Oletko käyttänyt polviin itsehoitomenetelmiä?			

4. Polviongelmien parantuminen

4.1 Ovatko polviongelmat helpottuneet iaidoharjoitusuran aikana?
- Ei, koska minulla ei ole polviongelmia
- Ei muutosta
- Ei
- Kyllä

4.2 Jos kyllä, millä tavalla? Oletko tehnyt muita harjoitteita polviongelmien korjaamiseksi? Vai onko pelkkä iaidon harjoittaminen auttanut?

5. Kyselylomake

	Kyllä	Ei	Jos ei, miksi?
5.1 Oliko kyselylomake selvä?	○	○	

	Kyllä	Ei	Jos ei, miksi?
5.2 Oliko vastaaminen helppoa?	○	○	

Kommentteja

Tietojen lähetys

Tallenna

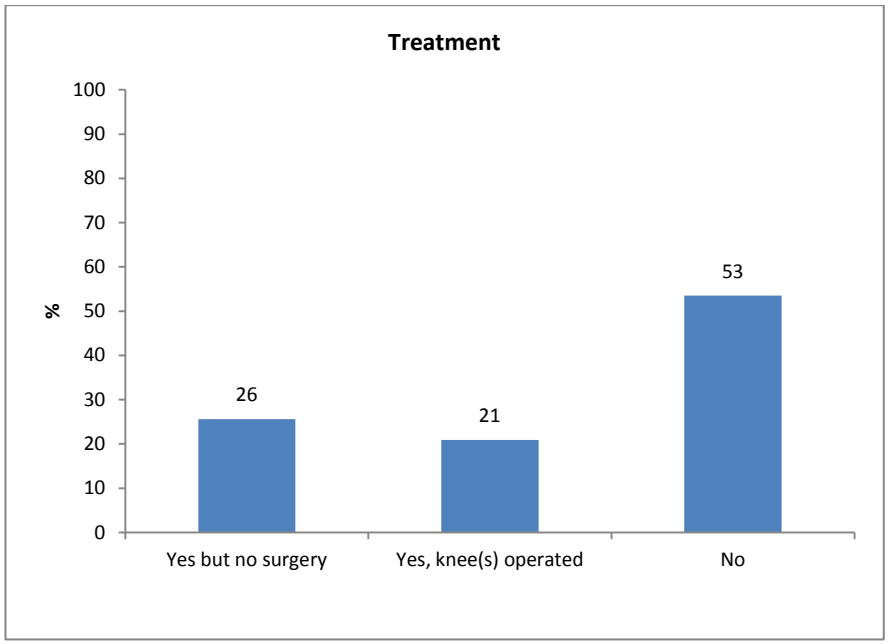

Table 3. Treatment for knee problems.

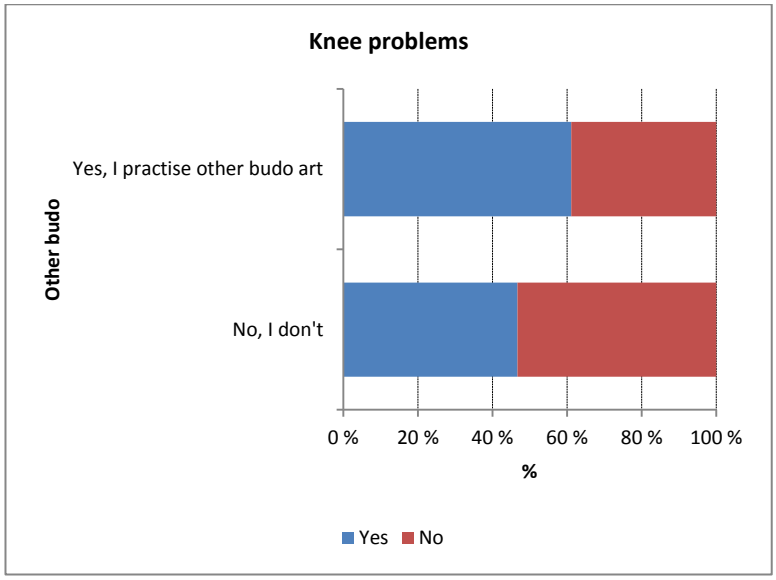

Table 4. The effect of other budo practice to knee problems. Probability value of the result is not significant and the correlation is low.

%	*≤ 25*	*26 - 35*	*36 - 45*	*46 - 55*	*56 - 65*	*66 - 75*	*Total*
Yes	33	50	57	73	50	100	53
No	67	50	43	27	50	0	47
Yht.	100	100	100	100	100	100	100
N	18	24	21	15	2	1	81

Table 5. The effect of age to the incidence of knee problems. The probability value of the result is not significant and the correlation is low.

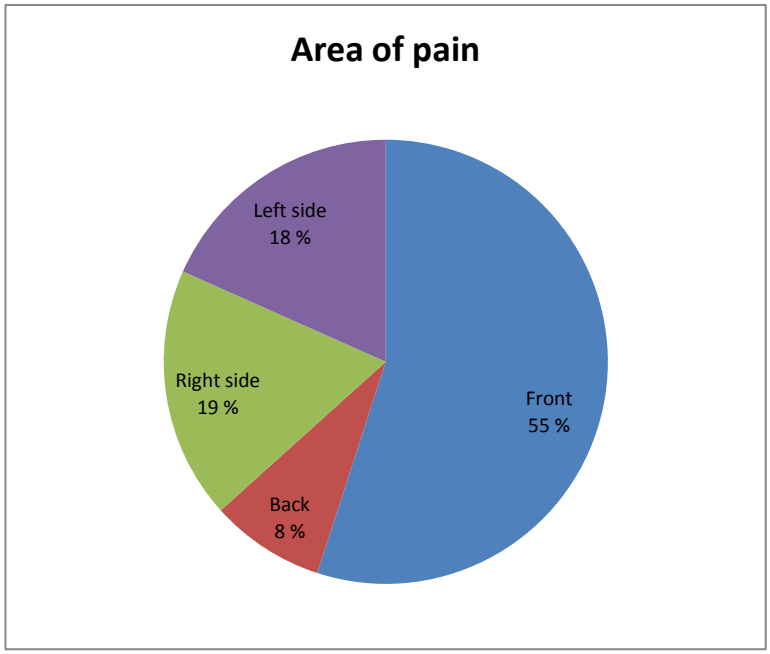

Table 6. Area of pain in the knee.

Frequency	*Freq.*	*%*	*Cum. freq.*	*Cum-%*
More often than 2x/week	27	33	27	33
2x/week	18	22	45	56
1-2x/week	22	27	67	83
1-2x in 2 weeks	6	7	73	90
1-2x/month	4	5	77	95
Less than 1-2x/month	4	5	81	100
Total	81	100	81	100

Table 7. The frequency of iaido practice.