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THE INCIDENCE OF SHOULDER PROBLEMS AMONG FEMALE BASEBALL PLAYERS PLAYING IN SUPERPESIS

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OLKAPÄÄVAIVOJEN YLEISYYS NAISTEN SUPERPESIKSEN PELAAJIEN KESKUUDESSA

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Tutkimuksen tarkoitus oli selvittää olkapäävaivojen yleisyys Naisten Superpesiksen pelaajien keskuudessa. Olkapäävaivojen yleisyys yleisen populaation keskuudessa sekä tilastollisten tietojen puute pesäpalloilijoiden olkapäävaivojen yleisyydestä toimivat innoittajina tähän tutkimukseen. Tutkimusmateriaali kerättiin kyselylomakkeella, joka lähetettiin Naisten Superpesiksen pelaajille tammikuussa 2008. Kaudella 2008 Superpesistä pelasi yhteensä 11 joukkuetta; 132 pelaajaa, joista 48 vastasi kyselyyn.

Tulosten analysointi alkoi kesäkuussa 2008 Tixel taulukkolaskenta ohjelman avulla. Tulosten mukaan 62% vastanneista olivat kokeneet olkapäävaivoja. Kaikilla heistä vaiva esiintyi kipuna. Olkapäävaivojen yleisyyden lisäksi tutkimus tarkasteli pelivuosien ja iän vaikutusta olkapäävaivoihin. Tulosten mukaan vaivat lisääntyivät selvästi pelivuosien, mutta myös iän lisääntyessä. Tutkimuksessa oli myös otettu huomioon pelipaikan vaikutus olkapäävaivojen esiintyvyyteen. Tulokset kertoivat, että lukkarit ja kopparit todennäköisimmin kärsivät olkapäävaivoista.

Tulosten mukaan pesäpalloilijoiden olkapäävaivat ovat yleisiä, myös tavalliseen populaatioon verrattuna. Yhtenä todennäköisenä syynä olkapäävaivoihin voidaan pitää yliolan liikettä palloa heittäessä. Tutkimus herätti monia kysymyksiä koskien mm. pelipaikan todellista vaikutusta, sukupuolen, harjoittelutavan vaikutusta olkapääongelmiin. Miten ehkäistä olkapääongelmia on yksi suurin kysymys jonka tutkimus toi esille. Näihin kysymyksiin vastaaminen vaatii lisätutkimuksia.

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Key words: shoulder, pain, shoulder joint, baseball players

The purpose of this study was to find out the incidence of shoulder problems among female baseball players playing in Superpesis. The frequency of shoulder pain among standard population and lack of statistical information of the prevalence of shoulder problems among baseball players gave an idea to implement this study. The study data was collected by an epidemiological survey, which was sent to the female baseball players playing in Superpesis on January 2008. Out of 132 players 48 answered the questionnaire.

The data analysis started on June 2008 with the help of Tixel statistical software package. According to the results 62% of the players that answered the questionnaire do have problems with their shoulder joint. All of them report the problem being pain. Secondly the study considered the effect of the playing years and age on the shoulder pain. The result revealed that the incidences of shoulder problems grow as the age and the playing years increase. Thirdly the effect of playing positions to shoulder problems was considered. The study suggests that the back fielders and the pitchers have the highest risk of having shoulder problems.

According to the results, the incidence of shoulder problems among female baseball players is high, also when compared to standard population. The study also suggests that throwing motion could be one of the main reasons for the shoulder pain. The study arose many questions concerning the effect of playing position, sex and training habits to the incidence of shoulder problems. How to prevent these problems is one of the largest questions this study has brought out. These questions would require further research to find out the answers.

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1 INTRODUCTION

Shoulder problems are common, not only among overhead athletes, like throwers, swimmers, weight lifters and tennis players, but also among standard population. According to Niinikoski & Rinta- Mänty (2007, 1) right after neck- and back pain, shoulder problems are the most common reason people seeing a doctor. In the Netherlands shoulder problems are the second largest musculoskeletal problem. Only low back pain is more common. (Geraets, Goossens, Bruijn, Köke, de Bie, Pelt, van den Heuvel & van der Heijden, 2004, 33.) Shoulder problems are also common among people who have a spinal cord injury. According to Sollman (2006) overloading of the shoulder joint causes even 71% of people with spinal cord injury to suffer from shoulder pain. Due to its frequency shoulder pain and lesions have nowadays received a lot of attention from researchers world wide. In the study of Viikari-Juntura, Nykyri and Takala (2007, 23) the lifetime prevalence of shoulder pain was 46,8%; 20,6% had suffered from the pain during the preceding month.

This bachelor's thesis is an epidemiologic study of the incidence of shoulder problems among Finnish female baseball players, who play in Superpesis in Finland. The study covers the connection between the age and playing years and the shoulder problems among the players. It also discusses of the connection between playing position and shoulder problems. The study has a brief presentation of the biomechanics of throwing and three common shoulder lesions. The reason that this particular topic was chosen was my familiarity and interest in this sport and shoulder pain. Any statistical information of the incidence of the shoulder problems among these players could not be found. The outcome of this study gives new ideas for further research of this problem among overhead athletes.

2 ANATOMY OF THE SHOULDER

The shoulder joint is known as humeroscapular or glenohumeral joint (Figure 1.). They refer to humerus (arm bone) and scapula (shoulder blade). The head of humerus is rounded and it articulates with the glenoid cavity of the scapula. (Tortora & Derrickson, 2006, 233-235) The shoulder joint is a synovial ball-and-socket joint, which enables three degrees of freedom. This means that the shoulder joint is able to perform motion in three different planes; flexion-extension, abduction-adduction and internal and external rotation. (Enoka, 1994, 129.) All of the synovial joints have synovial cavity between two bone ends, which is filled with synovial fluid. Articular capsule (connective tissue surrounding the joint), synovial membrane, articular cartilage and the geometry of the bones hold the articulating bones close together. (Enoka, 1994, 128; Tortora & Derrickson, 2006, 261-262.) Articular cartilage is dense white connective tissue, formed mainly of water. The main aim of the cartilage is to reduce the friction between the bones. (Enoka, 1994, 128; Tortora & Derrickson, 2006, 261-262.)

Synovial joints have ligaments surrounding it. Together with glenoid labrum (Figure 1.) the ligaments serve as static stabilizers of the shoulder. The ligaments fuse with the articular capsule enabling the large movements of the shoulder and the proper functioning of the muscles. (Enoka, 1994, 129; Halén, 1995.) In shoulder the ligaments are called coracohumeral ligament, glenohumeral ligaments and transversehumeral ligament. These ligaments help to maintain the stability of the joint. There are also other ligaments that affect on the shoulder function; acromioclavicular ligament, coracoacromial ligament and coracoclavicular ligament. Glenoid labrum is surrounding the glenoid cavity making it larger and deeper, and also serves as attachment point to bicheps brachii tendon and glenoid ligaments. (Baker & Ayers; Tortora & Derrickson, 2006; 277.)

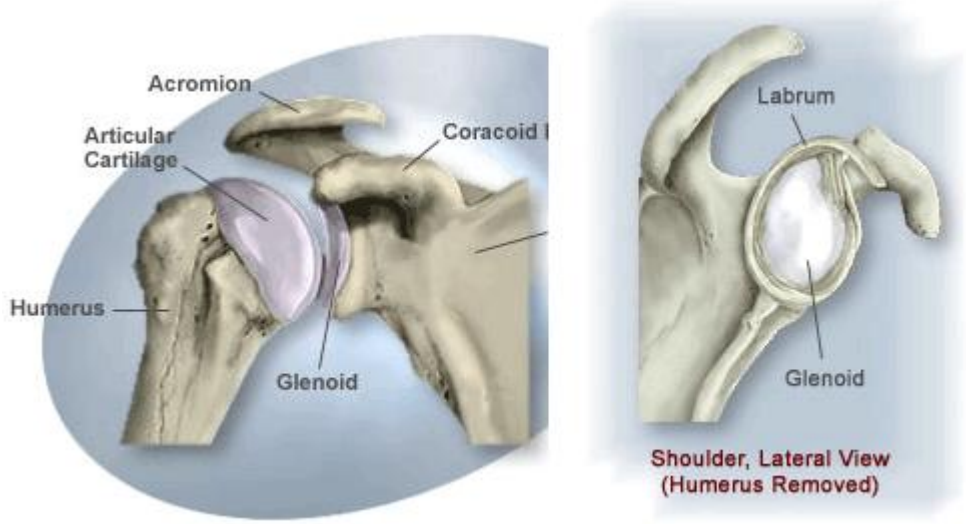


Figure 1. Shoulder joint, anterior and lateral view. (Go Orthopedics, Arthroscopic Surgery & Sports Medicine.)

In addition to the ligaments, the shoulder stability and strength originates from the dynamic stabilizers; the surrounding muscles. Closest to the joint are rotator cuff muscles (Figure 2.), which include subscapularis, supraspinatus, infraspinatus and teres minor. They form a circle of tendons around the shoulder joint. These muscles make the control of small shoulder movements possible, by holding the humeral head in the correct position. (Baker & Ayers, 2008; Halén, 2005; Tortora & Derrickson, 2006; 276, Virtapohja, 2008, 22.) The main motions produced by these muscles are medial and lateral rotation and abduction of the shoulder. (Tortora & Derrickson, 2006; 276.) The long head of biceps muscle is also said to be functionally part of the rotator cuff muscle group (Halén, 2005; Virtapohja, 2008, 22). Teres major muscle assists the internal rotation of shoulder (Tortora & Derrickson, 2006; 363). Rotator cuff tendons are easily affected due to the narrow space they have under the acromion (subacromial space). The superior part of the subacromial space consists of inferior surface of acromion, the coracoacromial ligament and the coracoid process. The inferior part is based on the greater tuberosity and superior part of the humeral head. Within the subacromial space are located the rotator cuff tendons, the tendon of the long head of biceps, the subacromial bursa and the superior capsule of the shoulder joint. (Lewis, Green & Dekel, 2001, 458.) In addition to the rotator cuff muscles also other muscles in the shoulder girdle are stabilizing the shoulder and the scapula. These muscles are

levator scapulae, serratus anterior, trapezius, rhomboids, and pectoralis minor. (Tortora & Derrickson, 2006; 362-363.)

Shoulder internal rotators:

- Pectoralis major
- Latissimus dorsi
- Anterior deltoid
- Subscapularis
- Teres major

Shoulder external rotators:

- Posterior deltoid
- Infraspinatus
- Teres minor
- supraspinatus

Scapula stabilizers:

- Trapezius
- Levator scapulae
- Rhomboid minor and major
- Serratus anterior
- Pectoralis minor

(Agur & Dalley, 2005, 496; Halén, 2005; Tortora & Derrickson, 2006, 360, 363)

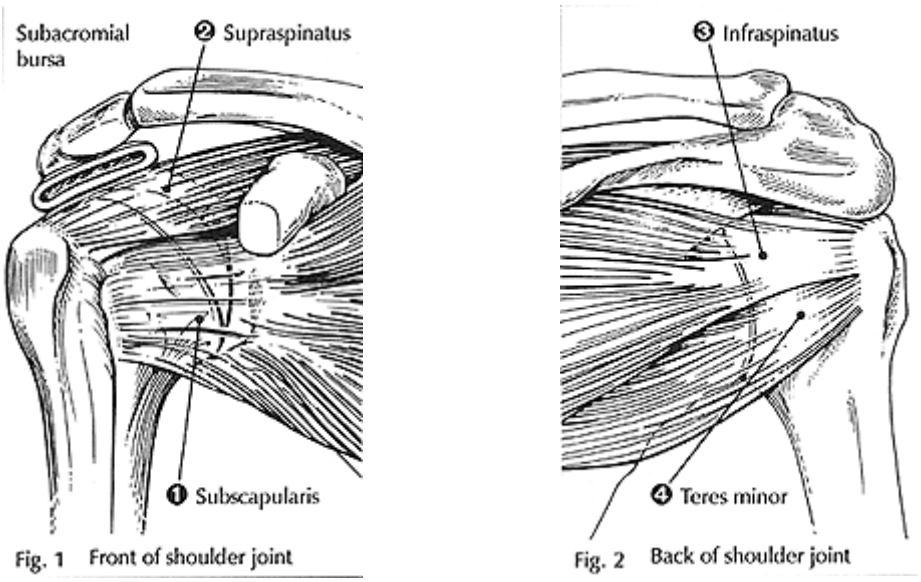


Figure 2. Rotator cuff muscles of the shoulder; anterior and posterior view. (Hughston Sports Medicine Foundation.)

3 BIOMECHANICS OF THROWING

Throwing a baseball is stressing different parts of the body in different phases (Figure 3.). It is kinetic energy transfer starting from legs, continuing to hips, spine, shoulder, elbow, and wrist (Altchek & Hobbs, 2000). The sequence of muscle activity varies as all athletes perform the throwing motion with their individual style (Cooper, 1997). Throwing motion consists of six different phases; wind-up, stride, arm cocking, arm acceleration, arm deceleration and follow-through. The throwing motion involves the whole body and is successful only if the timing, coordination and directions are correct. This chapter describes the throwing motion mostly on the shoulder point of view. (Zachazewski, Magee & Quillen, 1996, 334-335)

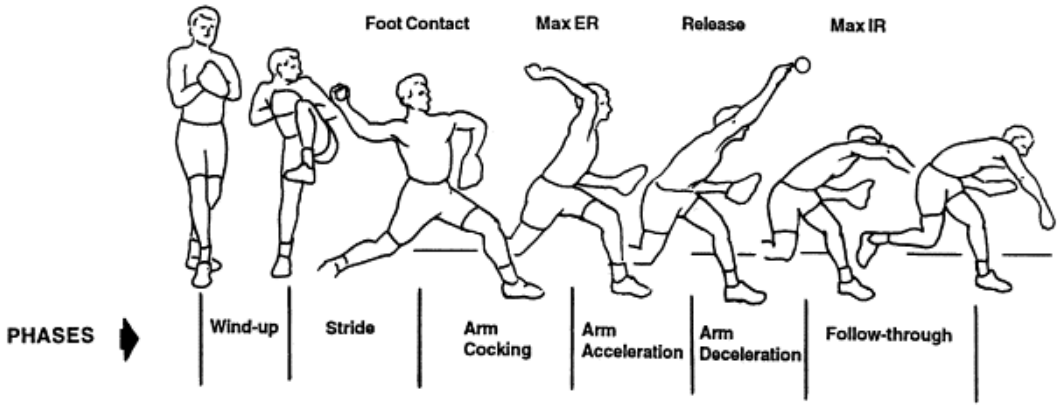


Figure 3. The six phases of throwing. (Fleisig, Barrentine, Zheng, Escamilla, & Andrews, 1999)

3.1 Wind-up

The wind-up phase helps the thrower to find a good starting position and also gives speed to the throw. In right handed throwers the left leg raises little during the wind- up phase. The arms are little flexed in front of the athlete as he or she

takes the ball out of the glove. (Zachazewski et al. 1996, 335.) This point is still a minimal stress to the shoulder joint (Curtis & Deshmukh, 2003). It is however essential that the scapulohumeral rhythm is proper and places the hand in optimal position for the throw (Cooper, 1997, 19).

3.2 Stride

The stride phase initiates right after the wind-up phase. During the stride phase the hip starts to rotate externally. The stride leg lands to the ground, but the weight is still on the supportive leg. The stride foot should point out to the direction of the throw. The position of the foot is very crucial in throwing motion. Wrong position can affect the lower body force contribution reductively. This forces the throwing arm to work much harder to produce adequate throw. During the stride phase also the hands separate and the shoulders abduct. The throwing arm starts to rotate externally. This movement acquires the strength of the deltoid and supraspinatus muscles. The supraspinatus muscle maintains the proper position of the humeral head in the glenoid fossa. Upper trapezius and serratus anterior muscles have also an important role in positioning the glenoid for the humeral head. The activation of the posterior deltoid, latissimus dorsi, teres major and minor and infraspinatus muscles make the horizontal abduction of the arm possible. Scapular retraction is performed by the rhomboid and middle trapezius muscles. (Zachazewski et al. 1996, 336-338.)

3.3 Arm cocking

In this phase the body starts to rotate towards the target. The weight shifts on the leading leg simultaneously with pelvic rotation. The trunk is hyper extended as it starts to rotate towards the target. Concurrently with the upper body rotation, the shoulder is in the maximum external rotation (165-180 degrees) and starts to adduct horizontally. This movement acquires the pectoralis major and anterior

deltoid muscle activity. The serratus anterior muscle is however the most active of the shoulder girdle muscles during the cocking phase; it stabilizes and protracts the scapula. Also other muscles in the shoulder girdle area (levator scapulae, trapezius, rhomboids, and pectoralis minor) are very active and together stabilize the scapula and maintain the correct position of the humeral head in the glenoid cavity. Cocking phase is very strenuous also for the inferior glenohumeral ligament and the inferior portion of the glenoid labrum. (Cooper, 1997, 20.) The throwing hand stays in the 80-100 degrees of abduction during the whole phase. Approximately 550 to 770 N force, which is ca. 80% of the body weight, is needed to resist shoulder distraction during the arm cocking phase. (Zachazewski et al. 1996, 338-341.)

3.4 Arm acceleration

This rapid phase starts from the maximum external rotation of the shoulder and ends at ball release. During this phase the elbow extends slightly anterior to the trunk and the shoulder internally rotates. Rotator cuff muscles, trapezius, serratus anterior, rhomboids and levator scapulae stabilize the scapula and control the humeral head, which are essential during this phase. The trunk starts to flex towards the target. (Zachazewski et al. 1996; 343-346.) The late cocking and acceleration phase make a high stress for the anterior ligamentous structures of the shoulder (Curtis & Deshmukh, 2003).

3.5 Arm deceleration

During this phase the trunk and hips continue flexing forward and the shoulder rotates internally until neutral position. The rotator cuff muscles contract eccentrically to slow down the motion of the arm (Curtis & Deshmukh, 2003). In addition to the teres minor muscle, which is the most active of the posterior shoulder muscles during deceleration phase, infraspinatus, supraspinatus, teres

major, latissimus dorsi and posterior deltoid muscles are crucial in preventing shoulder distraction and subluxation. The scapula stabilizers play an important role in this phase. (Zachazewski et al. 1996, 346.)

3.6 Follow- through

During follow-through phase the energy of the throwing arm starts to absorb to the other muscles of the body and makes the control of the throwing arm easier. The body is still flexing and the arm continues its way to horizontal adduction. The scapula stabilizers and the posterior shoulder muscles are still active in this phase. (Zachazewski et al. 1996, 347.) Also the posterior ligamentous tissues are under high stress during this phase (Curtis &Deshmukh, 2003).

4 COMMON INJURIES OF OVERHEAD ATHLETE

Stabilizing structures - the labrum, capsule and rotator cuff tendons - are under a high stress during throwing motion (Altchek & Hobbs, 2000). It has been studied that the muscle activity in the shoulder girdle area during the throwing motion differs among athletes with shoulder problems and those who have healthy shoulders. The different sequence of using the muscles can be compensating for instance laxity in the shoulder. Shoulder problem can occur if the right muscles do not support the scapula and shoulder joint when it is needed. (Cooper, 1997, 21-22.) Pain in different parts of the shoulder or different phases of the throw may reveal the location of the shoulder problem. According to Altchek & Hobbs (2000) if the pain is in the anterolateral portion of the deltoid muscle, the pain often indicates supraspinatus tendon injury. If the pain is in the posterior joint line, the problematic area is often either in posterior labrum or infraspinatus tendon area. Anterior joint line pain again may indicate subscapularis or biceps

tendon or capsulolabral injury. Pain during the cocking phase may indicate internal impingement and anterior capsulolabral injury (abduction, external rotation). Posterior capsulolabral injury or general capsular stretch often cause pain during the deceleration/ follow through phases. This chapter is discussing about three common shoulder problems of overhead athletes; impingement (including rotator cuff and capsular problems), instability and SLAP lesions.

4.1 Impingement of the shoulder

Subacromial impingement is common injury, not only among athletes, but also among other population. The cause of it has been controversial; previously it was suggested that it is only caused by the friction between acromion and rotator cuff tendons in the subacromial space. Nowadays many studies suggest that the aetiology can be multifactorial. Known reasons for subacromial impingement are: rotator cuff overuse or degenerative tendinopathy, instability (secondary impingement), restricted glenohumeral capsule, scapular instability, posture and mechanical or anatomical reasons. (Lewis, Green & Dekel, 2001; Nawoczenski, Ritter-Soronen, Wilson, Howe & Ludewig, 2006, 1605; Niek van Dijk, 2007, 11.)

Subacromial impingement syndrome due to rotator cuff overuse is common among athletes and may lead to secondary impingement. Continuous overhead motion may cause muscle fatigue which leads to micro trauma to the glenohumeral ligaments and rotator cuff tendons. This can cause inflammation and pain. Deficiency of rotator cuff muscle function can also lead to altered kinematics and superior translation of the humeral head during arm elevation, causing secondary impingement of the rotator cuff and biceps tendon under the acromion. (McClure et al, 2006, 1087; Nawoczenski, 2006, 1605; Zachazewski et al, 1996, 350; Lewis et al, 2001, 463.) Chronic inflammation and repetitive stress of the rotator cuff muscles can lead to weakening of the muscles, which increases the risk of tears or even rupture (Niek van Dijk, 2007, 13-14).

In addition to subacromial impingement also superior glenoid impingement, known as internal impingement, is studied to cause shoulder pain and dysfunction. This theory suggests that the inner fibres of the supraspinatus tendon, the fibres of the posterior superior labrum and the long head of biceps tendon can be impinged between the greater tuberosity of the humerus and the posterior superior glenoid in shoulder abduction- external rotation and abduction- internal rotation. (Belling Sørensen & Jørgensen, 2000; Lewis et al, 2001, 462; Niek van Dijk, 2007, 14.) Abduction and external and internal rotation occur during the throwing motion from the stride phase to the follow through phase, being extremely stressful during the arm cocking phase. (Zachazewski et al. 1996, 338-341.)

Tight joint capsule can change the normal movement of the joint, which can cause excessive translation of humeral head. This again can lead to impingement due to the narrowed space within subacromial space. Capsule tightness can occur due to adhesive capsulitis, immobilization, after trauma or postoperatively. (Lewis et al, 2001, 464; McClure et al, 2006, 1087.)

4.2 Instability

According to Belling Sørensen & Jørgensen (2000, 267) secondary impingement occurs due to the instability of the shoulder. The word instability is referring to structural or functional deficit of the shoulder, which causes translation of the humeral head, hyperangulation or too much rotation of the shoulder joint. During the baseball throw the arm is moving approximately from 175º of shoulder external rotation to 80° of internal rotation only in 30 milliseconds. This places the rotator cuff muscles and other shoulder stabilizers under a high stress. The velocity and accuracy of the throw may suffer from instability of the shoulder joint. (Niek van Dijk, 2007, 27.) Instability can be a consequence, not only of muscle weakness or fatigue, but of muscle imbalance. For instance the shoulder internal rotators are often too strong compared to the external rotators. This is because of the number of internal rotators is larger and they are also naturally stronger muscles. (Zachazewski et al, 1996, 350; Liebenson, 2005.) The strength

of external rotation should be approximately 66% of the strength of internal rotation (Niinikoski & Rinta- Mänty, 2007, 9).

Scapular stability is essential in throwing motion. Scapula stabilizers offer dynamic support for the humeral head during arm movements. The position of scapula is directly proportional to humeral head position in glenoid fossa, which again affects the rotator cuff function. (Lewis et al, 2001, 465; Niinikoski & Rinta-Mänty, 2007, 5.) According to Lin, Hanten, Olson, Roddey, Soto-quijano, Lim, & Sherwood, (2006, 1066) and Niinikoski & Rinta-Mänty (2007, 5) scapular protraction, upward rotation and posterior tipping are decreased and scapular elevation is increased among subjects with shoulder impingement. This indicates that optimal scapular mobility is also essential in maintaining the normal range of movement and function of the shoulder. The retraction- protraction motion can be even 15-18 cm during the throwing motion. (Niemi, 2007, 23.)

4.3 SLAP lesions

SLAP (Superior Labrum Anterior Posterior) lesion often occurs during the deceleration or late cocking phases of the throw when the biceps is eccentrically slowing down the arm motion (Cooper, 1997, 23; Dutcheshen, Reinold & Gill, 2007, 97; Kuhn, Lindholm, Huston, Soslowsky & Blasier, 2003, 377). Abduction-external rotation increases the stress of the labrum significantly (Rhee, Lee & Lim, 2005, 377). The labrum is an anchor point for the ligaments of the shoulder capsule, thus offering stability to the shoulder. The long head of biceps is usually also attached to the superior labrum and has an important role as the dynamic stabilizer of the shoulder joint during the throwing movement starting from arm cocking and continuing to the follow through phase of the throw. If SLAP lesion occurs, the inferior glenohumeral ligament is under significantly increased stress. (Cooper, 1997, 23.) SLAP lesion can be detachment, prolapse or tears of the superior labrum. They can be divided to types I-IV. In type I lesion superior labrum is fraying, but the labral surface remains attached. Type II lesion is the detachment or “peeling back” of superior labrum. Type III is a buckethandle

detachment of the labrum. Type IV is the same as III lesion in addition to the tears of long head of biceps. The most common lesion of the four is SLAP lesion type II. SLAP lesions are frequently associated with other shoulder pathologies, such as rotator cuff tears, impingement, Bankart tears and joint arthrosis. (Dutcheshen et al, 2007, 97; Niek van Dijk, 2007, 7, 21-22.)

5 PLAYING POSITIONS IN FINNISH BASEBALL

In Finnish baseball there are nine players in the out field. The pitcher is positioned in the home base with the batting team. The pitcher usually does a great amount of throwing during the game. The throws are often quick and sometimes forced to do in difficult positions. (Suomen Pesäpalloliitto ry, 2008, 5; Wikipedia, 2008.)

The two fore fielders have quite similar throwing actions than the pitcher during the game; quick decisions and difficult throwing postures. The length of the throw however is not usually very long. The four midfielder's roles in the game vary from each other. The two players in the 2nd and 3rd bases at the sides of the field do not necessarily have as much throwing during the game as the other two midfielders that play more in the centre of the field. These players have to be able to throw accurately and sometimes quite long distances. (Suomen Pesäpalloliitto ry, 2008, 5; Wikipedia, 2008.)

The amount of the throws of the two back fielders depends quite much on the batting team and also the team mates in front of them. The throws they perform are often long and powerful. Sometimes back fielders are able to go towards the ball before they catch it, which makes the throwing a little easier, but they are still forced to do a maximal performance. (Suomen Pesäpalloliitto ry, 2008, 5; Wikipedia, 2008.) There are also situations when the back fielders have to throw long distances in bad posture, which causes excessive stress to the throwing arm (Zachazewski et al. 1996).

There are many different set pieces in different situations of the game, thus the players can be playing several positions during one game. Only back fielders and pitcher usually stay in their position throughout the game. (Suomen Pesäpalloliitto ry, 2008, 5; Wikipedia, 2008.)

6 THE RESEARCH QUESTIONS

The purpose of the study was to find out the prevalence of shoulder problems, the connection of the age and the amount of playing years to the occurrence of shoulder problems among Finnish female baseball players playing in Superpesis. In addition the effect of the playing position was considered in the study.

The research problems of the study are:

1. The incidence of shoulder problems among Finnish female baseball players playing Superpesis.
2. The effect of playing years and age to the incidence of the shoulder problems.
3. The effect of playing position to the incidence of shoulder problems.

7 RESEARCH PROCESS

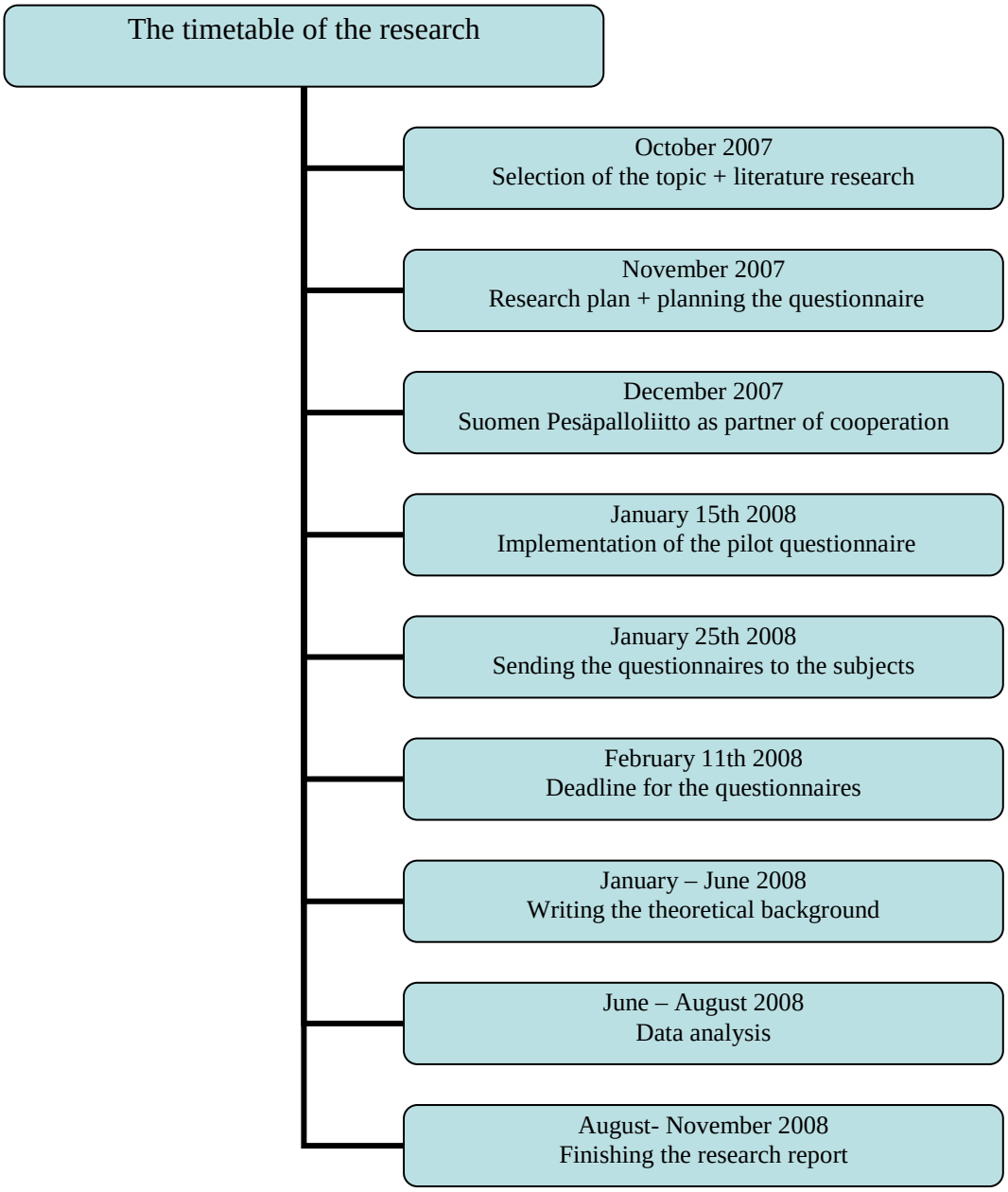
Planning of the study was started in October 2007. Literature review was done simultaneously to support the need for the study and to find theoretical background for it. The research plan and the questionnaire (Appendix 1) for data collection were done after deciding the topic in November 2007. In the end of the

year 2007 Suomen Pesäpalloliitto was asked as the partner of cooperation of the study and the research agreement (Appendix 2) was signed on January 2008.

A pilot study to assess the questionnaire was implemented in January 2008. After the revision of the questionnaire, it was sent to the contact person to Suomen Pesäpalloliitto, who delivered it to the actual subjects on January 25th. In the covering letter, the deadline for the questionnaire was 11th of February. The subjects, however, needed some reminding and extra time in answering the questionnaire. In the end, the questionnaires were received in two parts; approximately 30 answers in the beginning of March and the rest at the end of March 2008.

During spring 2008 part of the theoretical background was written and continued in the beginning of the June. The data analysis started in June 2008. It was done by entering the answers from the questionnaires to Tixel computer programme. The questionnaire consisted of many questions that may affect the incidence of shoulder problems. During the data analysis had to be decided what to consider in the final report and what irrelevant parts to leave out. Writing the thesis report continued throughout the summer 2008. Table 1 presents the progression of the study.

Table1. Research process



The research data was collected as an epidemiologic survey, which included 15 questions. The questionnaire (Appendix 1) was done in Finnish, because it is the mother tongue of the players. There were 12 multiple choice questions and three possibilities to write open answers.

The questionnaire was piloted on January 15th 2008. The piloting was done to test the suitability of the questionnaire for the study. The subjects in the pilot questionnaire were a group of female baseball players, who play at lower division

than the actual study group. In total ten players got the questionnaire and all of them answered the pilot questionnaire. From those ten answers some ideas arose how to revise the original questionnaire more suitable for the actual subjects.

The feedback from the pilot questionnaire was positive. However few changes for the questionnaire were done on the grounds of the answers the subjects had given. The cover letter was specified with one sentence advising the subjects to read the questions carefully. Also the estimated time when the thesis should be ready and the approximate answering time of the questionnaire were told. The actual content of the questionnaire was also slightly modified. One question concerning the frequency of the throwing exercises was added to the section one. At the time it seemed to be good to know how often the players do exercises that include throwing.

From the pilot study the author noticed that questions 1.5, 3.2, 4.1, needed a little modification. Question 1.5 needed to be made clearer. The last option in the question 3.2 allows the subject to describe in their own words how often and when the shoulder problem is present. This section was added after the pilot study, in case the options offered in the questionnaire are not equivalent with the symptoms. Question 4.1. was lacking the information where to move on next if the subject answered “no” in the question.

The survey was sent to all of the eleven female baseball teams that play Superpesis in Finland. The survey was delivered for the teams by a contact person in Suomen Pesäpalloliitto. The survey was addressed to the coaches of the teams, who were asked to deliver it for the players. The coaches of the teams sent the filled surveys back to the contact person in Suomen Pesäpalloliitto, who again sent them on for analyze. This way it remained unclear which teams had answered the questionnaire and the identification of the subjects was not possible. There were 11 teams playing Superpesis in the season 2008, and altogether 132 players. From these players 48 answered the questionnaire. The reason why the rest of the players did not answer remains unclear.

8 RESULTS

The age of the players who answered the questionnaire varied between 15 and 30 (average 21,52), standard deviation being 3,72. Table 2 presents the age deviation of the answered players. The amount of the playing years among the answered players varied between 7 and 23 (average 13,35) years, with 3,77 standard deviation (Table 3.).

Table 2. The player's age deviation.

Age	Frequency	%
≤17	6	13
18 - 22	24	50
23 - 29	16	33
30	2	4
Total	48	100

Table 3. The deviation of playing years.

Play yrs	Frequency	%
≤10	17	35
11 - 14	13	27
15 - 19	15	31
20 - 23	3	6
Total	48	100

8.1 The incidence of shoulder problems

The questionnaires revealed that 30 (62%) out of the 48 players, who filled out the questionnaire, have shoulder problems. All except one of those 30 players, who admitted having shoulder problems, reported that the problem appears during throwing motion. All 30 reported that the problem causes pain. The players who had shoulder pain chose the frequency of it from four different options; daily,

weekly, monthly and rarer. Only 10% reported experiencing pain daily, 27% experiences it weekly, 23% monthly and 40% rarer. The question asking the amount of pain was done by a scale from zero to ten, 10 being maximum amount of pain and 0 indicating no pain. The mean amount of pain with all of the subjects with shoulder pain was 5,13 with 1,70 standard deviation. The highest amount of pain reported was nine (9) and the lowest three (3). Table 4 presents the deviation of the pain scores.

Table 4. The amount of pain experienced among the players.

Score	Frequency	%
3	7	23
4	5	17
5	5	17
6	6	20
7	5	17
8	1	3
9	1	3
Total	30	100

The duration of shoulder pain varied between one month and 10 years. The appearance of pain was found out with multiple choice question, which included seven different claims of the pain (Table 5). The players had a chance to choose all of the matching options. The claim “daily/ continuous” means that the pain is present 24 h/day or is triggered from any movements of the arm. “Nocturnal” pain appears during the night and disturbs sleep. “During ADL’s, when moving the arm” refers to the pain, which appears for instance when the person has to lift something, during cleaning or grooming etc. “In the beginning of exercise” refers to the pain, which is present in the beginning of exercise but disappears after warming up. The claim “seasonal pain” means that the pain appears during some particular part of the season; e.g. in the beginning of the training season or in the end of the playing season.

Table 5. The appearance of the pain.

The appearance of pain	Frequency	%
Daily/continuous	3	10
Nocturnal	5	17
During ADL's, when moving the arm	4	13
During exercise	7	23
In the beginning of exercise	13	43
Seasonal	18	60
Other	3	10
Total	53	
N:	30	

8.2 The effect of playing years and age to the incidence of shoulder problems

According to the results older players have more frequently shoulder problems than the younger players. Half of the players aged 17 or less do have shoulder problems. The incidence is higher as the age increases (Table 6.); among 18-22 year olds 58% and 23-29 year olds 69% reported shoulder problems. The two players who are 30 years old or older have 100% incidence. Table 7 shows how the playing years affect to the incidence of shoulder problems. Slightly over half (53%) of the players who have played baseball 10 years or less do have shoulder problems. Those who have played 11-14 years the incidence is 69%. Players who have played 15-19 or 20-24 years the incidence is 67%.

Table 6. The effect of age to the incidence of shoulder problems.

	-17	18 - 22	23 - 29	30	Total
no	50%	42%	31%	0%	38%
yes	50%	58%	69%	100%	62%
N	6	24	16	2	48

Table 7. The effect of playing years to the incidence of shoulder problems.

	-10	11 - 14	15 - 19	20 - 24	Total
no	47%	31%	33%	33%	38%
yes	53%	69%	67%	67%	62%
N	17	13	15	3	48

8.3 The effect of playing position to the incidence of shoulder problems

The playing positions of the answered players varied. Almost half of the players (21) reported their position in mid field. There were also ten fore field and ten back field players. Five of the players were pitchers and two reserve players. The highest incidence of shoulder problems was among back field players, of whom 90% reported shoulder problems. The result among pitchers who answered the questionnaire revealed that 4 out of 5 do have shoulder problems. The percentage of experiencing shoulder problems among mid fielders was 62% and 30% among the fore fielders. With reserve players the result was 50%.

9 CONCLUSIONS

This study has revealed that 62% of the answered players do have shoulder problems at some level. The number is significantly higher when comparing to standard population (46,8% reported shoulder pain) (Viikari-Juntura, Nykyri and Takala, 2007, 23). Pain is the most usual complaint among the players. All except one of the 30 players with shoulder problems connect the pain in throwing motion. Only one of the 29 players states that the pain is present also during batting. Seven of the players report that the pain is also present during other exercise, e.g. strength training. This makes the connection between the throwing motion and shoulder pain even stronger.

According to the results, the players who have played 10 years or less, have the least amount of shoulder pain. The incidence among them, however, is as high as 53%. Players who have played longer have significantly (almost 20%) higher incidence of shoulder problems. Thus, it can be concluded that there is a connection between playing years and shoulder problems. Moreover the age seems to play an important role in the incidence of shoulder pain.

The results are showing that the playing position in the out field also plays a role in the incidence of shoulder problems. Based on this study it can be concluded that there is a connection between the prevalence of shoulder problems and the playing position of back fielders (90% prevalence) and pitchers (80% prevalence). Fore fielders seem to have the least incidence of shoulder pain. The mid fielders have quite a high incidence (62%) of shoulder pain.

10 DISCUSSION

Deciding the topic was probably the hardest part of this bachelor's thesis. After several months of consideration this topic was invented. It felt interesting and possible to carry through. The content of the thesis was quite clear from the beginning. The decision which shoulder lesions to present and which to leave out was made by reading literature that is related to the topic. Looking for the articles for the framework took the longest time. Finding the relevant and the newest possible information was not always easy. From studies already done, new ideas arose for the questionnaire. The questionnaire was made quite simple, trying to avoid too many and irrelevant questions.

The questionnaire served well for this study. It gave the answer for the main questions of the study. Piloting the questionnaire gave important information of its suitability for the study. It gave ideas how to make some of the questions clearer

to answer. In addition to the main questions the questionnaire gave information of the history of the players and the nature of the pain, which were sufficient for this study. It offered also some irrelevant information that was not used. Mostly the feedback of the questionnaire was positive; the subjects thought that it was clear and easy to answer. Some players however found it hard to decide the amount of pain (question 2.3), because it may vary in different situations. Also question 2.1 caused difficulties to some players. Answering "yes" to the question whether they have shoulder problems or not, the players were not required to have an ongoing problem at the moment but generally. This fact should have been emphasized. Few questions of the validity of the study arose; did the players understand the questions properly? Would they have answered differently if the questions had been formed in other way? There was some discussion about the way of presenting the tables in this thesis. The distribution of age and playing years in the tables 6 and 7 are not equal, which may give slightly different results than with equal distribution. The percentages that were received with equal distribution of age and playing years did not change the results of the thesis significantly.

The questionnaire was sent only to the female players playing in Superpesis. The reliability of the study would be stronger if the questionnaire would have been sent also to other adult leagues and maybe also male players. However the limits had to be set and it was decided to draw the line for female players in this particular league. There could have been possibility to have 132 answers from these female players only, which would have given more reliable results. However, only 36% of the players who received the questionnaire returned it, which makes the reliability of the study lower than expected. The teams should have been reminded more persistently to answer the questionnaires by calling them or sending email directly to them. The fact that the questionnaires were not sent directly to the players has to be considered. It can only be presumed that everyone received the questionnaire. Sending the questionnaires directly to the players would have raised the costs and still necessarily would not have increased the amount of answers. Some of the players might not have been willing to answer or just forgotten about the questionnaire. This study, however, gives an indication of the incidence of the shoulder problems. It can be noted that it is a common problem and it exists among several players.

Shoulder pain is a common musculoskeletal problem also among general population (Geraets et al, 2004, 33). Viikari-Juntura, Nykyri and Takala (2007) made a study of shoulder problems among standard population in Finland. They found out that 46,8% of people over 18 years of age that took part in the study, had experienced shoulder problems. Altogether 8028 people over 30 years old and 1894 people aged 18 to 29 took part for the study. Even though the study population was significantly older than the baseball players in this study, the amount of shoulder problems remained lower among standard population. According to Lin et al (2006, 1066) and Nawoczenski et al (2006, 1605) some occupational activities, overhead sports and wheelchair activities can increase the risk of shoulder dysfunction. These studies suggest that overhead sport and other activities above shoulder level are large risk factors in exposing to shoulder problems.

The main aim of this study was to find out the incidence of shoulder problems among female baseball players playing in Superpesis. Shoulder pain and dysfunction have been studied a lot worldwide, especially among professional baseball pitchers. In this light the result of this study is not surprising. According to the results of the thesis the shoulder problems among female baseball players playing in Superpesis are common. It is significantly more common than with standard population (62% vs. 46, 8%). Shoulder problems with most of the players are seasonal or only in the beginning of the exercise, before the shoulder has warmed up. Almost half (40%) of the players with shoulder problems reported that they experience the pain more rare than once a month. Only 10% feels the pain daily. The amount of pain experienced with mean result of 5,13 is not very high.

All except one of the players with shoulder problems reported that the pain occurs during throwing motion. This suggests not only that the throwing motion triggers the pain but also that it could be the cause of the pain. This is most likely due to the strenuous motion the shoulder has to perform during throwing. The maximal external rotation is performed in cocking phase, in the beginning of throwing motion, which causes high stress for the shoulder joint. Bad throwing postures

increase the stress and the forces the shoulder has to bear during the throw. The shoulder static and dynamic stabilizers play crucial role in prevention of shoulder problems. (Cooper, 1997, 20; Zachazewski et al. 1996, 338-341, 346)

The results are showing that there is a connection between the amount of playing years and the incidence of shoulder pain. According to Zachazewski et al (1996, 350) and Lewis et al (2001, 463) repetitive stress in the extreme positions of the shoulder joint cause fatigue and micro trauma of the stabilizing structures which may lead to inflammation and impingement within the joint. Players that have a long history as a baseball player have been stressing the shoulder structures continuously for several years, and naturally have higher risk for prospective shoulder problems. The results of the questionnaire revealed that also the age plays a role in the incidence of the shoulder problems. There is a connection between age and the amount of playing years, which could explain why older players have more shoulder problems compared to younger players. Also the study of Viikari-Juntura, Nykyri and Takala (2007, 24) revealed that the age is increasing the risk of chronic shoulder syndrome among standard population.

The results considering the incidence of shoulder problems among players in different playing positions were a little surprising. Large variability of the answers between the playing positions was not expected. The study showed that the pitchers and the back fielders are most likely to have shoulder problems. The percentages of shoulder problems among these players were 80% (pitchers, n=5) and 90% (back fielders, n=10). The technique of the throw between pitchers and the back fielders can be quite different due to the different role of the players. Maybe the reason for the high percentage of shoulder problems among pitchers is the significant role in the out field and the very large amount of throwing during the game. In addition their throwing has to be very accurate and fast and often performed in difficult positions, which increases the stress to the shoulder structures. The back fielders again have to perform very powerful and long distance throwing during the game and often maximal performance is required. The amount of the throwing varies between the games, but some games can be extremely stressful for the shoulder. The midfielders of whom 62% reported shoulder problems can also have quite high amount of throwing during the game.

The low amount of the shoulder problems among the fore fielders was little surprising. Only 30% of them reported having shoulder problems. One explanation for the great incidence of the shoulder problems among pitchers and the back fielders could be that their role during the out field game is the same all the time. The mid fielders and the fore fielders usually change their positions several times during the game and this changes also the amount and the distance of their throws. Due to the low percentage of the answers for the questionnaire, further studies are required to confirm the effect of the playing position on shoulder problems.

Prevention is the best treatment of shoulder problems. According to the study of Fleisig et al (1999) teaching the right technique as early as possible and building up muscle strength is essential part in prevention of shoulder injuries. The rehabilitation of shoulder problem can be a very long process. The beginning of the rehabilitation includes submaximal exercises, first below shoulder level and later on in higher levels. In addition range of motion exercises and manual therapy are noticed to be useful. Checking the right throwing technique and ergonomics can be helpful. In the later stages strengthening and improving the endurance of rotator cuff and scapula stabilizers play an important role. In the last stage the exercises can be more functional and preparing the player for the throwing motion. (Niinikoski & Rinta-Mänty, 2007, 7-9) Balancing between the optimal mobility and stability is often very challenging in many sports.

Several unsolved questions arise from this study; why are the shoulder problems so common among these female players? Is there something that they do wrong in their training? Or is there weakness in their shoulder stabilizers? Also the question why some players in same playing position and same amount of training do have the problem and others do not would need more studies to solve out. Do they do something differently? Could the problems be prevented somehow? Or is the throwing motion just too stressful for the shoulder joint? Further studies would also be required to find out if the playing positions really have a role in the incidence of shoulder pain and if the situation would be the same among male players. As Lewis et al (2001) state shoulder lesions are often multifactorial, and the aetiology sometimes remains unclear. This research provides new ideas to

study this difficult and common problem, which affects both overhead athletes and standard population.

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APPENDIX 1

Hei!

Olen fysioterapiaopiskelija Satakunnan ammattikorkeakoulusta. Olen tekemässä opinnäytetyötä, jonka aiheena on olkapäävaivojen yleisyys naispesäpalloilijoiden keskuudessa. Työn tulisi valmistua joulukuussa 2008. Tutkimusmateriaalin olen päättänyt hankkia käyttäen kyselylomaketta, joka on liitetty tähän kirjeeseen ja johon toivoisin teidän vastaavan. Luethan jokaisen kysymyksen huolella ennen vastaamista.

Kyselyyn vastaaminen on täysin vapaaehtoista. Vastaaminen kestää noin viisi minuuttia. Tämän kyselyn perusteella ei voi tunnistaa vastaajan henkilöllisyyttä. Vastaukset käsitellään luottamuksellisina vain tutkijan toimesta ja niitä käytetään ainoastaan tähän tutkimukseen. Kyselyn lopussa on varattu tilaa kommentoida kyselyä vapaasti.

Kiitokset vastauksestasi ja onnea pesiskaudelle 2008!

Tuuli Virtanen

1. Taustatiedot

1.1 Ikä _____vuotta

1.2 Kuinka kauan olet pelannut pesäpalloa? _____vuotta

1.3 Pelipaikka_____

1.4 Kuinka monta kertaa viikossa harjoitteluusi sisältyy heittämistä? ____kertaa/viikossa

1.5 Harrastatko muuta liikuntaa, joka vaikuttaa olkapäähän (säännöllisesti) pesäpallon lisäksi?

- □ en
- □ kyllä, mitä?_____
  - Kuinka usein? _____kertaa viikossa

2. Olkapäävaivat

2.1 Onko sinulla olkapäävaivoja?

- □ ei (siirry kohtaan 5)

- □ kyllä, Kuinka usein?
  - □ päivittäin
  - □ viikottain
  - □ kuukausittain
  - □ harvemmin

2.2 Miten kuvailisit vaivaa?

_____
_____

2.3 Jos kuvailit vaivaa kipuna, kuinka suurena sitä kuvailisit? (Ympyröi oikea vaihtoehto)

0	1	2	3	4	5	6	7	8	9	10
ei kipua										pahin mahdollinen kipu

2.4 Oletko loukannut olkapääsi onnettomuudessa tai muussa urheilulajissa kuin pesäpallossa?

- □ en
- □ kyllä, miten? _____
  milloin?_____

3. Vaivan esiintyvyys.

3.1 Kuinka kauan vaiva on jatkunut? _____

3.2 Kuinka usein olkapää vaivaa? Valitse kaikki vaihtoehdot, jotka sopivat.

□ Vaiva on päivittäistä ja jatkuvaa myös levossa.

□ Vaiva esiintyy myös öisin ja häiritsee nukkumista.

□ Vaiva esiintyy päivittäisissä toiminnoissa vain olkapäätä liikuttaessa.

□ Vaiva esiintyy vain rasituksessa ja jatkuu koko rasituksen ajan.

□ Vaiva esiintyy rasituksen alussa, mutta menee ohi olkapään lämmettyä.

□ Vaiva on kausiluontoista.
Milloin? (esim. vain harjoituskaudella, vain pelikaudella, harjoituskauden alussa, pelikauden lopussa)_____

□ Vaiva esiintyy muussa yhteydessä. Missä?
_____
_____

3.3 Vaiva esiintyy
□ heittäessä
□ lyödessä
□ muussa harjoittelussa, missä?_____

3.4 Estääkö vaiva harjoittelun/ pelaamisen tällä hetkellä?
□ ei
□ kyllä

4. Olkapäävamman hoito.

4.1 Oletko ollut hoidettavana olkapäävaivan takia?
□ en (siirry kohtaan 5)

□ kyllä, olkapääni on leikattu, milloin? _____
□ kyllä, mutta ei ole leikattu

4.2 Olkapäätäni on hoitanut

- □ lääkäri
- □ fysioterapeutti
- □ muu _____

5. Palaute kyselystä

5.1 Kysely oli

- □ selkeä
- □ epäselvä, miksi?_____

5.2 Vastaaminen oli

- □ helppoa
- □ vaikeaa, miksi?_____

5.3 Oliko jokin kohta erityisen epäselvä/ vaikea ymmärtää?

- □ ei
- □ kyllä, mikä? _____
  miksi_____

_____

Kommentit:

_____
_____
_____
_____

APPENDIX 2

Hello!

I am a physiotherapy student from Satakunta University of Applied Sciences. As my Bachelor's Thesis I am going to study the incidence of shoulder problems among Finnish female baseball players. The study should be finished in December 2008. I have decided to collect the data for the study by a survey, which is attached for this letter and which I would hope you to answer. Please read every question carefully before answering.

Answering this survey is completely voluntary. It takes approximately five minutes to answer. The answers are handled confidentially by the researcher and no one can be identified from them. The answers are used only to this study. In the end of the questionnaire there is space to comment the survey freely.

Thank you for your reply and good luck with the season 2008!

Tuuli Virtanen

1. Background information

1.1 Age _____years

1.2 How long have you played baseball? _____years

1.3 Position_____

1.4 How many times a week your training includes throwing? ____times/week

1.5 Do you have any other (regular) hobbies that involve use of shoulder in addition to baseball?

□ no
□ yes, what?_____

- How often? _____times/week

2. Shoulder problems

2.1 Do you have shoulder problems?

□ no (move to section 5)

□ Yes, How often?
□ daily
□ weekly
□ monthly
□ rarer

2.2 How would you describe the problem?

_____
_____

2.3 If you described the problem as pain, how extreme would you describe it? (Circle the right option)

0	1	2	3	4	5	6	7	8	9	10
no pain										the worst possible pain

2.4 Have you hurt your shoulder in an accident or other sport than baseball?

□ no
□ yes, how? _____
when?_____

3. The nature of the problem.

3.1 For how long has the problem lasted? _____

3.2 How often is the shoulder bothering you? Choose all of the equivalent options.

□ Daily, appears also in rest.

□ Appears also at nights and bothers sleeping.

□ Appears in ADL's only when moving the shoulder.

□ Appears only when stressing and continues throughout the exertion.

□ Appears in the beginning of exertion, but disappears when the shoulder is warming up.

□ The problem is seasonal.
When? (e.g. only during training period, only during the season, in the beginning of training period, in the end of season)_____

□ The problem appears in other context. When?
_____
_____

3.3 The problem appears
□ in throwing
□ batting
□ other training, which one?_____

3.4 Does the problem hinder your training/ playing at the moment?
□ no
□ yes

4. Treatment of the shoulder problem.

4.1 Have you had any treatment for your shoulder problem?
□ no (move to section 5)

□ yes, my shoulder has been operated, when?_____
□ yes, but it has not been operated.

4.2 My shoulder has been treated by

□ a doctor
□ physiotherapist
□ other _____

5. Feedback from the questionnaire.

5.1 The questionnaire was

□ clear
□ unclear, why?_____

5.2 Answering was

□ easy
□ difficult, why?_____

5.3 Was some part specifically unclear/ hard to understand?

□ no
□ yes, which one? _____
why?_____
_____

Comments:
_____
_____
_____
_____