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ERGONOMIC TECHNIQUES FOR MAILMAN WORKING IN SORTING OFFICE- AN ERGONOMIC POSTER

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The purpose of this thesis was to create two ergonomic posters for one of Posti Group Oyj's sorting office. The ergonomic posters were done based on an ergonomic assessment done to mailman working in sorting office. The ergonomic assessment was conducted by videotaping six volunteered mailmen while they were sorting mail in their own work stations. Rapid upper limb assessment (RULA) and RULA sheet were used as a reference for this thesis to evaluate the working ergonomics of mailmen.

Sorting of mail requires handling of letters, newspapers, advertising leaflets and parcels. It includes standing, walking, sitting and repetitive movements of upper extremities. These repetitive movements and static positions of shoulders above 30° are causing physical stress to the neck and shoulder girdle area. Sorting mail can take approximately half of the work day, and it's done mostly in a sitting position. This can cause an excessive amount of stress in the lumbar spine.

Mailman working in sorting offices are being exposed to a lot of musculoskeletal problems due to their lack of education for ergonomics. By neglecting ergonomically proper working positions, like correct sitting posture, mailmen are more prone to develop different musculoskeletal disorders. The aim of this thesis was to find the most problematic areas in mailmen's working ergonomics when sorting mail by making an ergonomic assessment. Based on the assessment, two ergonomic posters were made as an educative tool to mailman by the author.

The ergonomic posters include theoretical and practical information, pictures and written instructions on how to improve and prevent ergonomics when sorting mail. It is important for mailmen to understand the importance of working ergonomics. The techniques are chosen based on the ergonomic assessment.

CONTENTS

1 INTRODUCTION

The idea for this thesis started from the combinations of physiotherapy studies in Satakunta University of Applied sciences and a summer job in one of Posti's sorting office. Interest towards musculoskeletal problems and the prevention of them were one reason for selecting this topic. Client was also interested in preventing and treating mailmen's most typical musculoskeletal problems.

Mailman working in sorting offices are being exposed to a lot of musculoskeletal problems due to their lack of education for ergonomics. Sorting mail requires standing, sitting, walking, repetitive, dynamic and static movements especially in the upper extremities. These static movements of upper extremities and sedentary work effects negatively to the neck and shoulder girdle area causing musculoskeletal disorders. Mail sorting is mostly done in a sitting position which is actually one of the most physically loading positions of lumbar spine causing lower back pain. By neglecting ergonomically proper working positions, mailmen are more prone to develop different musculoskeletal disorders.

It is important to identify the physical stresses for the sake of one's own ergonomics and therefor the employee's wellbeing. By minimizing the stress factors of work, the working ergonomics of employees can be improved, and the ability to work and function for as long as possible can be maintained. With good planning and by controlling the work load it is possible to successfully eliminate unnecessary strain at work.

To give more information and guidance about sorting mail ergonomically best way possible, two ergonomic posters were made based on an ergonomic assessment done to mailman working in sorting offices. These posters are mainly developed for one of the sorting offices, but those can be shared with other sorting offices around Finland if needed.

2 PURPOSE OF THE THESIS

The purpose of this study was to make two ergonomic posters as an educative tool for mailman working in sorting offices. The aim was to find the most problematic areas in ergonomics when sorting mail, and to increase the knowledge of working ergonomics. Based on the ergonomic assessment, two ergonomic posters were made as an educative tool.

The purpose of the product is to work as an educative tool for mailmen that have mail sorting as a part of their work day. This product will guide workers to reduce the risk factors for developing a musculoskeletal disorder, and to help workers to recover from static working positions in a more productive way. With the help of health promotion product mailmen should learn the meaning of proper ergonomic working positions.

3 LOADING OF THE WORK

Stress factors describe factors related to work or work environment like physical environmental factors, ergonomics, working time, psychosocial factors and individual factors (Lindström 2002, 11). Other factors affecting on the physical loading of the work are the ability to produce force, the needed amount of force, working positions, how repetitive the work is, how well the person knows his/her job and the temperature of the workplace. The arrangements of the workplace, demands of vision, the structure and design of the workplace and work equipment effects on the produced force and working positions. Factors affecting on the control of the work, mental loading and the risk of accidents are the expertise of handling work equipment, expertise of the work process, total work load, possible distractions affecting on attention, lighting and noise. (Launis & Lehtelä 2011, 22.) Individual factors like age, mental and physical capacity are also important (Lindström 2002, 12).

When some or none of these factors do not conform to a healthy standard, it can cause immediate physical load, resulting in changes in human’s physiological and mental

state or an accident can result from these factors. The extend of physical load depends on how powerful and long-lasting the environmental factors are. Most of the physical loading recovers within a short period of time or after the exposure has ended. (Lindström 2002, 11.)

Physical loading can be discussed when stress factors start to cumulate and recovery time becomes long. Then effects of physical loading may be constant tiredness, different restrictions of musculoskeletal functioning and other possible work-related disorders or injuries. (Lindström 2002, 12.) It is important to have breaks during the work for prevention of muscle- and joint ailments. Breaks of couple of minutes at least once an hour enhances the effectiveness and handling of the work, more than a longer break once a day. Breaks reduces the strain on the eyes and improves thinking. (Website of Työterveyslaitos 2015.)

3.1 Physical loading of the work

Physical stress factors of work include physically demanding work, handling of heavy loads, static or awkward working positions and repetitive work. Physically demanding work, handling of heavy loads, working with a humped back and accidents are some of the most common reasons for back pain. Also, too low or unilateral physical loading/stress for example constant sitting position, may cause ailments. In addition, dissatisfaction to work, monotonous work and the inability to influence on one's work are connected to back pain. (Lindström 2002, 13-14.)

Working with elevated arms, static working positions, physically heavy work and draught exposes to neck pain. Neck- and shoulder problems are, in fact, the most common musculoskeletal problems among working age people in all work fields in Finland. Monotonous work, rush and lack of control of work can increase the symptoms. Static sitting position, constant joint action of eye and hand, and constant movements of upper extremities and fingers are typical in sedentary work. In addition, poor ergonomics of work station can cause awkward position of neck, holding of arms and long-lasting tension of shoulder muscles. (Lindström 2002, 14.)

The position of both neck and upper extremity effects on the physical loading of neck and shoulder girdle. The best position on muscle-wise of the neck and cervical spine is the neutral position of head. Significant biomechanical loading fallen upon cervical spine like forward position of neck, the weight of a helmet and/or static force on shoulder girdle when carrying can be the cause of degeneration of cervical spine. The muscle tension in the neck is greater in forward position of the neck than in the erect position. The extreme positions of neck can cause headaches, and neck and shoulder pain. It is known that the inner pressure of supraspinatus muscle in the shoulder girdle can rise tremendously and decrease the blood circulation of muscles already in 30° of shoulder abduction like shown in Figure 1. The higher and further the upper extremities are when working, the bigger the muscle tension of the shoulders are. The position of the neck and shoulder girdle is good when the position of the back is as erect as possible or somewhat tilted backwards when seated, neck is in a neutral position, muscles of the shoulders are relaxed, and the angle between upper arm (brachium) and torso is as small as possible, preferably smaller than 30°. (Kukkonen & Takala 2001, 148- 151.)

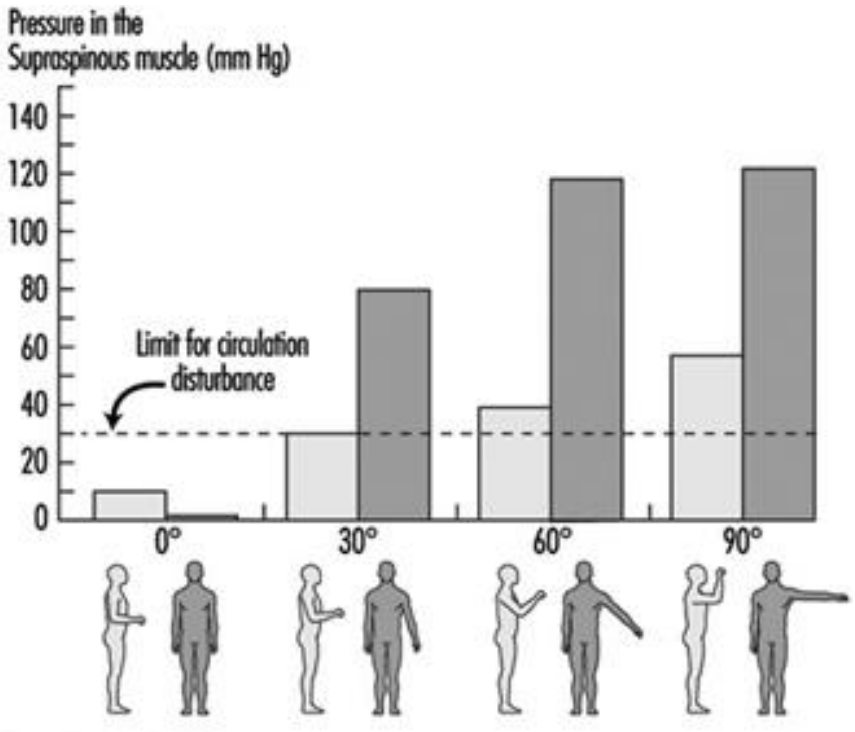


Figure 1. The pressure in the Supraspinatus muscle in shoulder abduction and flexion. Pressure over 30 mmHg is assumed to stop the blood circulation of the muscle. (Kukkonen & Takala 2001, 148)

Repetitive movements and excessive use of force are bad for upper extremities. Elevated positions of upper limb, strong rotations of forearm, extreme positions of wrists, and fast movements of fingers increase the risk of ailments. The inability to influence on one's work, monotonous work and stress about working time increases the susceptibility to upper extremities ailments. (Lindström 2002, 14.) The extreme positions of joints need to be prevented because of the length of the muscles are either at their maximum or minimum, and the lever of arms are at their minimum when producing movement and force. The structures of joints can also be compressed or excessively stretched in extreme positions. These positions can be used every now and then in a relaxed and unloading movements, but when repetitions and force increases extreme positions should be avoided. Recommended working positions of upper extremities are shown in Figure 2. (Launis & Lehtelä 2011, 198.)

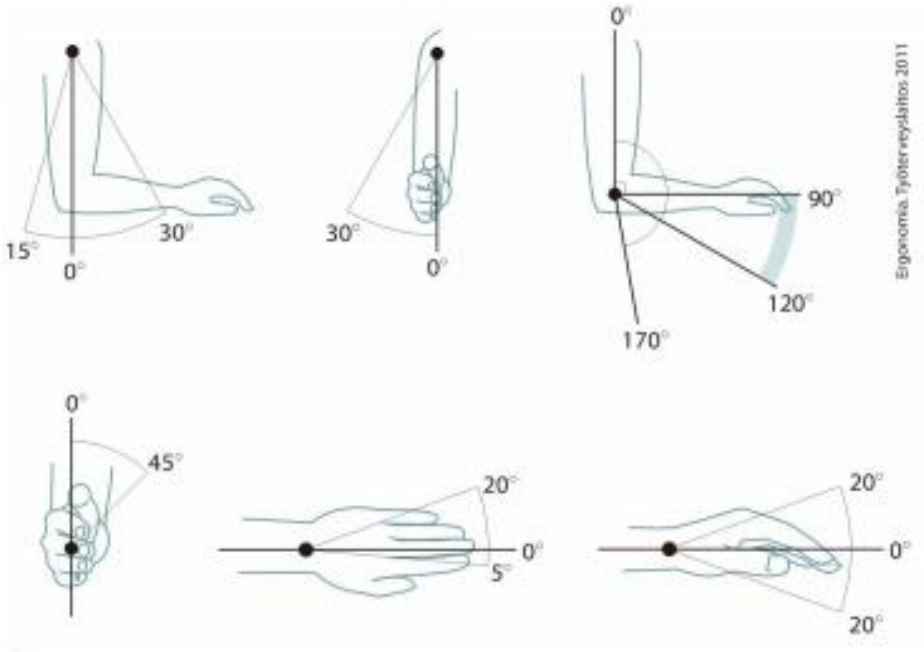


Figure 2. Recommended positions of upper extremity (Launis & Lehtelä 2011, 198)

3.2 Standing and sitting

When standing, the human body is in a vertical position. For decades standing has been toughed to be a static position but resent studies done with three-dimensional (3D) pressure sensors, three-dimensional (3D) optoelectronic camera systems and electro-neuromyography (ENMG) have shown that standing is dynamic and it requires a lot of low-power activity in different parts of the human body. People who perform a lot of standing may experience foot pain, swelling in lower extremities, muscle tension and lower back pain. Increased body mass makes standing heavier for the lower extremities. Therefore, it is required that people working in a standing position and who are overweight use special shoes that support the arches of the feet. (Sandström & Ahonen 2011, 196.)

A good standing posture is quite upright position where the spine forms two S-shaped low curves when looking from the side of the body. Thorax and pelvis are then on their intermediate position. Head is above the thorax following the spine. Shoulder girdle is on its intermediate position and muscles affecting it are as relaxed as possible. Lower extremities are naturally under the hips feet slightly rotating outwards. Resent researches in physical loading of back and support of spine with the help of muscle action and postural control have shown promising results that by promoting muscle action and muscle control it is possible to prevent and treat back problems. (Sandström & Ahonen 2011, 196.)

Nowadays most of the working is performed in a sitting position. According to studies sitting position is one of the most physically loading positions to lumbar spine. People working in a sitting position should move as often as possible so that the metabolism and blood circulation of tissues in the lumbar spine will stay in a proper level. In an ideal sitting posture a person sits on the ischium so that the pelvis is on a neutral position. Then it is possible to maintain the spine in its neutral position where there is lordosis of lumbar and cervical spine, and mild kyphosis of thorax spine. This neutral position of sitting allows quite relaxed sitting. Sitting comfortably in this position depends on how resistant and how much oxygen postural muscles (erector trunci) of the back can restore and supply. There is a lot of iron-bearing myoglobin in the postural

muscles of the back. Myoglobin absorbs oxygen from blood, restores it and gives oxygen to metabolism. Therefore, postural muscles can hold the correct position of the spine whole day. (Sandström & Ahonen 2011, 196-197.)

Ideal sitting posture has for long been a position where shins are upright, thighs are almost horizontally and spine upright where lumbar spine is in a mild lordosis. Research has shown that this 90-degree angle between spine and thighs are physically loading intervertebral discs of the spine in a harmful way. According to the research the least harmful position for intervertebral discs is an angle of 135 degrees or more between thighs and upright position of torso. (Sandström & Ahonen 2011, 196-197.) In a sitting position, lower back should be almost in a similar position as in the standing position, where the spine is in its natural lordosis. In this position of the lumbar spine, the vertebras are located against each other so that the pressure is spread equally to the intervertebral disc like shown in the Figure 3. (Launis & Lehtelä 2011, 175.)

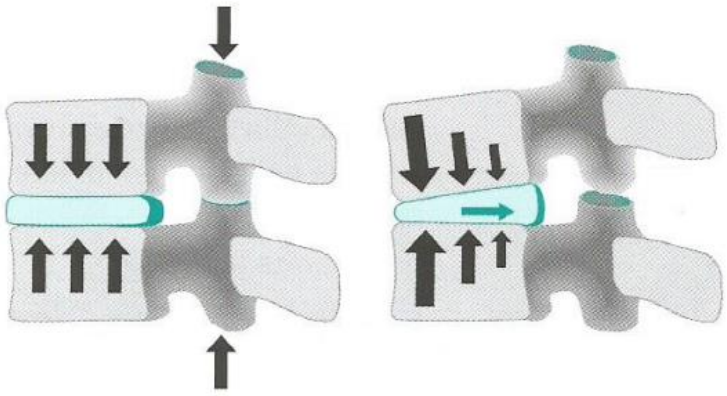


Figure 3. Vertebras of the lumbar spine in a natural curve (on the left) and in lumbar flexion (on the right). The arrows show how the pressure is divided. (Launis & Lehtelä 2011, 175)

In a survey done by Callaghan & McGill (2001) they studied the lumbar spine kinematics, trunk muscle activation periods and spinal joint loading during standing and unsupported sitting. The flexed curvature of the lumbar spine has been suggested to cause back pain and especially disc herniation. This increased flexion of the spine is a result of seated postures. According to the study already two hours of sitting caused high level of muscle activation in upper and lower erector spinae. The results show that long lasting static loads can cause fatigue injury mechanism because of low but

long lasting muscle contraction and/or long lasting flexed postures of the spine. This can lead to damage to the posterior component of annulus fibrosus, the center of the intervertebral disc. According to the study standing seems to be a good way to recover from sitting. Sitting should be paused with standing, and with small dynamic movements like the change of lumbar spine posture. Then the activity levels of muscles would change. This could prevent the cause of low back injuries. (Callaghan & McGill 2001, 280-294.)

3.3 Lifting

The generally advised lifting technique is the squat technique in which the knees are flexed and the back is as erect as possible. This lifting technique has been questioned because intervention studies have failed to show health effect of the squat lift. In a review written by Dieen et al. (2000) were comparing two different lifting methods, squat and stoop. Results showed that there were no significant differences between squat and stoop techniques when looking at the spinal compressions. Compression forces and net moments were found to be somewhat higher in squat than in stoop technique. The squat lift caused lower net moments when the load was lifted from between the feet. Bending moments and shear force affecting on the spine seemed to be lower in the squat lifting. In this study, it was unable to be proven that squat lifting would prevent low back pain. It was suggested that preventing low back pain one should focus on other aspects of lifting, such as asymmetry, speed, load mass, and vertical and horizontal position of the load.

The squat lift and stoop lift was compared also by Neumann (2010), like shown in Figure 4. Here it was also mentioned that squat lift is toughed to be a safer way of lifting but that there was actually no strong evidence supporting this. Squat lift can reduce the demands of tissues in the low back like in the extensor muscles but it causes stronger demands on the knees. However, stoop lift can cause large and possible damage and shear forces on the discs of lumbar spine. Then again the stoop lift is metabolically more efficient than squat lift when looking at the level of oxygen consumption. Instead of using squat or stoop lifting people have chosen to use a freestyle technique. The lifter can combine some of the benefits from squat lifting with the metabolically

more efficient stoop lift when using a freestyle lifting technique. (Neumann 2010, 410.)

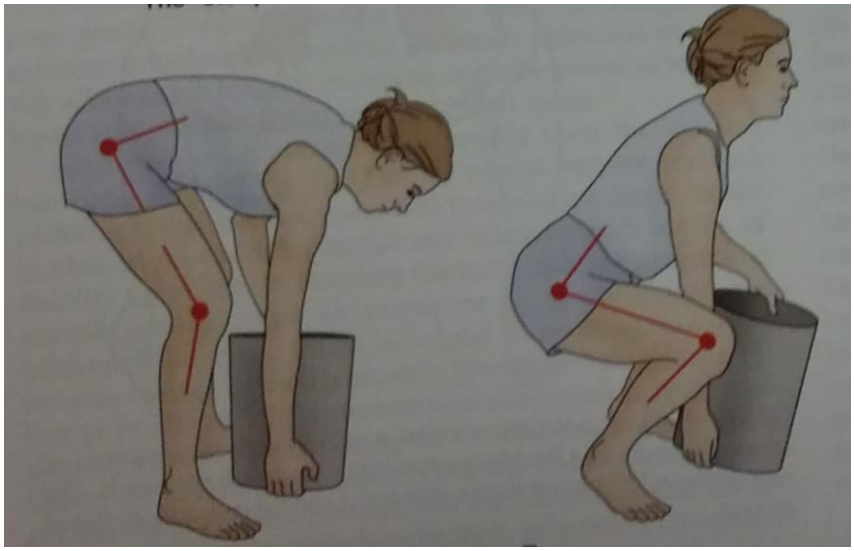


Figure 4. Two styles of lifting. The stoop lift is shown in the left and the squat lift is shown in the right. The rotations are shown at the knee and hip joints. (Neumann 2010, 410)

4 ERGONOMICS

The term of ergonomics comes from Greek words ergon (work) and nomos (laws). Ergonomics is the scientific discipline that covers the understanding of interactions among humans and the profession that applies principles, theory, data and methods to design in order to utilize well-being of human and overall system performance. Professionals of ergonomics contribute to the evaluation of tasks and design, products, jobs, systems and environments in order to make them compatible with the abilities, needs and limitations of people. (Website of the IEA 2015.)

Ergonomics is a systems-oriented discipline which now reaches across human activities all aspects. There should be a wide understanding of the full scope of the discipline of practicing ergonomists. Ergonomics hold a holistic approach in which considerations of social, physical, cognitive, organizational and environmental factors are

taken into account. Ergonomists usually work in application domains or economic sectors. (Website of the IEA 2015.)

Ergonomics is a holistic approach, but in practice there is often a need to focus on only some of its aspects. Physical ergonomics focuses on the adaptation of physical activity in line with the human anatomical and physiological characteristics. Physical ergonomics focuses on designing working environment, workstation, work equipment and working methods. (Website of the Työterveyslaitos 2015.) Significant topics include working postures, repetitive movements, materials handling, safety, health, work related musculoskeletal disorders and workplace layout (Website of the IEA 2015).

Cognitive ergonomics is concerned with mental processes, such as memory, reasoning, perception and motor response (Website of the IEA 2015). Cognitive Ergonomics focuses on the adaptation of the systems and their interfaces. The goal is to get them to respond to the human information processing characteristics. Cognitive ergonomics is emphasized with systems and their user interfaces (displays and controllers) and the presentation of information in the design. (Website of the Työterveyslaitos 2015.) Significant topics include mental workload, work stress, skilled performance, decision-making, human reliability and human-computer interaction (Website of the IEA 2015).

Organizational ergonomics focuses on the coordination of the technical -and social system. It emphasizes when planning for example the design of personnel, work processes, comprehensiveness of work and working time arrangements. Organizational ergonomics is closely related to well-being and its determinants. (Website of the Työterveyslaitos 2015.) Significant topics include communication, work design, design of working times, participatory design, crew resource management, teamwork, cooperative work, community ergonomics, new work paradigms, quality management, virtual organizations and telework (Website of the IEA 2015).

5 POSTI GROUP OYJ

Posti Group Oyj is one of the biggest corporation employer in Finland. Posti Group Oyj's area of business are Postal services, Parcel and Logistic Services, Itella Russia and OpusCapita. Posti provides employment in variety of positions, including production tasks, supervision of work, customer service, sales work, task of an expert and international tasks. (Website of Ammattinetti 2015.)

In 2014 Posti's net sales were 1,859 million euros and they employed approximately 23,000 employees. Posti manages the flow of commerce in 10 countries, including Finland which is the owner of Posti Group. Other countries are Russia, Sweden, Denmark, Norway, Germany, Estonia, Poland, Latvia and Lithuania. (Website of Posti 2014.)

5.1 Products and services

Posti Group Oyj is a company of a service sector which is specialized in handling of customer's data- and product flow. Posti's services help companies and organizations sell and market, deliver letters and parcels and invoice. Posti's tasks range from sorting letters and parcels, and from distribution to sales, customer service, planning and consultancy as well as ICT and management tasks. Posti's most important task in Finland is to offer daily postal services. Posti Group Oyj consists of almost 1 000 post offices, pickup points for parcels and Posti's parcel machines. (Website of Ammattinetti 2015.)

Posti Group Oyj serves its customers in Northern Europe, Central Europe and Russia. International turnover accounts for about a quarter. The most important customer branches are trading, media, financing, telecommunication and public sector. Posti's services are manufactured in four business groups. (Website of Ammattinetti 2015.)

Postal services offer delivery services for letters, parcels, magazines and advertisements, by which companies can reach their customers productively. In postal services mailmen work in mail delivering and sorting offices. Parcel and logistical services

support and develop the business of their customers by providing service logistics solutions for land, sea and air freight, parcel delivery, warehousing and other contract logistics. Posti's logistics services include domestic transportation and distribution and logistics information systems. (Website of Ammattinetti 2015.)

5.2 Job description of a mailman

Mail carriers work is moving and visible customer service work. They move on delivery routes on foot, by bike, by car or moped, serving daily almost all Finnish households and companies. In addition to mail delivery the work also includes the sorting of the mail. In the morning sorting of the mail is done together with co-workers, and during the day mail carries meet customers. Sorting mail requires promptness, diligence and ability to cooperate. In some duties, a good physical condition is needed as part of the package are large in size. (Website of Ammattinetti 2015.)

Mail is sorted in eight sorting centers (post center) and four smaller terminals in different parts of Finland. In sorting centers, they price and receive mail, load cars, transfer loads by forklift, and label and sort shipments. (Website of Ammattinetti 2015.) Posti Group Oyj is using a sorting process that is based on postcode and streets alphabetical and numerical order, so called ABC method. This alphabetical sorting enhances the delivery of letters, magazines and marketing shipments. First shipments are organized in ascending order within the postal codes and inside the postal code on shelves alphabetically by street names. Inside the street names the house numbers are sorted in ascending order. Sorting shelves of mailman’s workstation are shown in Figure 5. (Website of Posti 2015.)

Figure 5. Workstation of a mailman (Silja Alantie 2016)

6 PHYCICAL LOADING OF MAIL SORTING

Repetitive work is a work in which one work phase takes less than 30 seconds or work phase contains repetition of the same movements for more than half of the work phase time, regardless of the length of the phase of work (Website of Työterveyslaitos 2015). Mail sorting with the new ABC method is a form of repetitive work of average physical strain. To avoid work-related ailments should, for example, to ensure that the shelves, chairs and aids adjustment options are available and everyone can do them. This came out in a project, done together with Posti Group Oyj and Finnish Institute of Occupational Health, called *Liikuntaelinten kuormittuminen ja ergonomia postin lajittelutyössä*. The project was carried out between the years of 2001 and 2002, and the results were completed in December 2003. The ergonomic effects of the new ABC method and new equipment used in Posti Group Oyj were researched in three different Post offices of Helsinki. The research was funded by the Finnish Work Environment Fund. (Website of Työsuojelurahasto 2004.)

Based on video analysis approximately half of the workday is mail sorting. In sorting mail the static stress of upper extremities, movements on the side of the body and the

external rotations strain the structures of the shoulder joint, as well as shoulder and neck muscles. Continuous extension of elbow, key pinch grips and movements that require extreme extension of fingers strain muscles of the elbow and forearm. (Website of Työsuojelurahasto 2004.) In mail sorting shoulder joints are often in a 90-degree angle or even more. In multiple ergonomic guides, repetitive upright position of over 60 degrees of shoulder joints are toughed to be harmful and should be avoided. Standardized working positions of upper extremities are shown in Figure 6. (Website of Työterveyslaitos 2014.) Upper limb repetitive work has been found to be a risk factor for tenosynovitis, lateral and medial epicondylitis and carpal tunnel syndrome. In a repetitive work there often occurs neck and shoulder tension and muscle soreness (Website of Työsuojelurahasto 2004.)

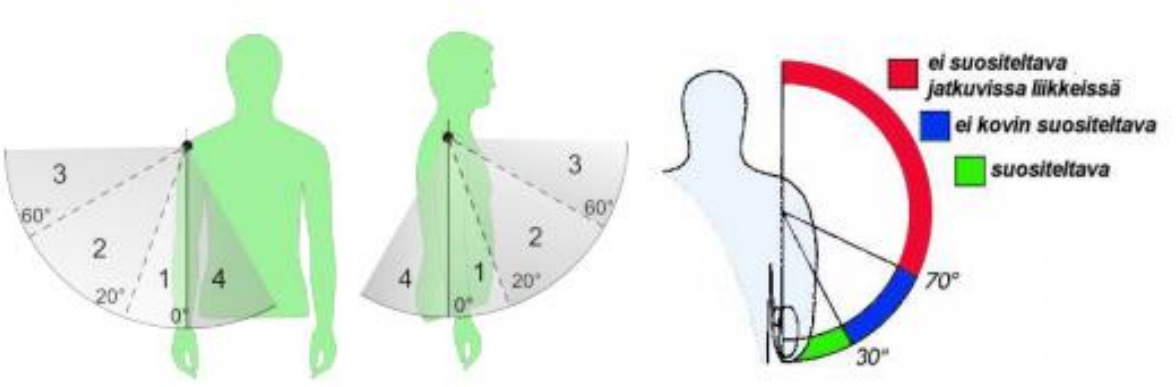


Figure 6. On the left and in the middle: the standardized working positions of shoulder joint. On the zones of 3 and 4 the positions are recommended to be used only rarely. On the right: recommendations of working positions according to Finnish Institute of Occupational Health (green: recommended, blue: not highly recommended, and red: not recommended in repetitive movements). (Website of Työterveyslaitos 2014)

In the survey the employees informed suffering from some neck, shoulder - and upper extremity ailments. In the hand's perspective, the frequency of the work is significant in mail sorting. Awkward working positions are a significant risk factor for different musculoskeletal ailments, so possible changes in the work equipment, workplace structures, breaks in the work and the organization of work are necessary. The lower back ailments that the survey encountered are most likely related to mail delivery. In mail sorting loading of the back is not the essential risk factor. (Website of Työsuojelurahasto 2004.)

7 THESIS PROCESS

Thesis process started on August 2015 when the author contacted the client Posti Group Oyj like shown in Table 1. After working in one of the sorting office during the previous summer as a mailman, an idea appeared on making an ergonomic assessment for Posti. After discussing with the client and with tutoring teacher it was agreed that this would be a good topic for thesis. It was decided that an ergonomic assessment about mailman sorting mail would be made. Based on this ergonomic assessment an ergonomic guide would be made for the client.

After all the agreements had been signed, the author started working on the theoretical background on November 2015. The project started by the search of suitable references and then the writing process could begin. The author could finish most of the theoretical background on May 2016, and could decide on which ergonomic assessment tool to use. After this the client was contacted, and a day was agreed when the author could go to the Posti's sorting office and videotape mailmen while sorting mail. On the 2nd of June 2016 six volunteers were videotaped one by one, and the author could finish videotaping during the same day. After this there was a summer break from working on the thesis, but on August 2016 the process started again with the analyzation of videos and writing results.

In the autumn 2016 there was a discussion on what type of an ergonomic guide should be made. Together with tutoring teacher it was decided that instead of making an ergonomic guide, ergonomic posters would suite better for this occasion. This way the client could place the posters on the wall at their workplace where employees could easily look guidance from there. On September 2016, the author started planning the ergonomic posters based on the results received from the ergonomic assessment. The ergonomic posters included pictures and written instructions on how to treat and prevent musculoskeletal diseases and pain.

Table 1. Thesis process.

August- September 2015	Finding a thesis topic based on a summer job

October 2015	Presenting a thesis topic to Posti Group Oyj
November 2015	Study plan presentation by the opponent
November- December 2015	Working on theory
January- February 2016	Working on theory
May 2016	Finishing theory + choosing the ergonomic assessment tool
June 2016	Making an ergonomic assessment
August- September 2016	Writing the thesis
September- October 2016	Making the ergonomic posters
November 2016	Finishing and presenting the thesis

This thesis is called a practice based thesis. Practice based thesis means the development of working life that is aiming on developing practical functioning of work, guidance, organization and/or rationalization. Depending on the field of business it can be for example a guide directed to professional practice, instructions or guidance like a guide for orientation, environmental program or a safety instruction. It can also be an implementation of some event like stand, conference, organizing an international meeting or an exhibition depending on the field of study. Based on the target group the execution can be a book, folder, guide, exhibition, development plan, webpages, cd or any other concrete product or project. The output of a practice based thesis can also be planning and implementing an event. It is important that in the practice based thesis of university of applied sciences combines practical implementation and a written report from the project in the means of research communications. (Vilkka & Airaksinen 2003, 9.)

Practice based thesis includes two parts; practical implementation, so called product/project, and a written report from the project. The output of a practice based thesis should always be based on theory, and therefor the report of a practice based thesis

should always include a theoretical framework. Practice based thesis evaluation focuses on how the product has been planned, how the process has been and how it has been reported. (Website of Virtuaali Ammattikorkeakoulu 2016.)

8 ERGONOMIC ASSESSMENT

It is vice to use one ergonomic assessment tool throughout the assessment. This way it is easier to proportion and compare stress factors to each other. Other significant matter is to learn a method that doesn't require huge investments, and that is cheap and fast to carry through. Complicated measurement tools often require too much time, and they aren't suitable in practice. It must be clarified what the project is aiming for when selecting a suitable ergonomic assessment tool. It is viable to search field- specific ergonomic assessment tools available for the purposes of the project. Based on preliminary knowledge and observation of the work it can be decided whether the assessment will be done from the whole work process or only from a shorter period of working time. There should also be an understanding of the quality of the muscular work's stress factors, whether the muscle work is dynamic, static or repetitive. (Vilkka & Airaksinen 2003, 109-110.)

For ergonomic assessment, the author chose to use Rabid Upper Limb Assessment sheet (RULA sheet, Appendix 2) from assessment tool RULA (Appendix 1) to help analyze ergonomics of mailman. RULA is a fast-ergonomic assessment tool designed mainly for sedentary work and/or work that requires minimal moving (Website of Työterveyslaitos 2010). RULA was developed to evaluate workers ergonomic risk factors associated with musculoskeletal disorders (MSD) of upper extremities. RULA considers postural and biomechanical load requirements of work tasks on the upper extremities, trunk and neck. A special worksheet is used to evaluate repetition, body posture and force. Scores are entered in section A for the arm and wrist, and section B for the trunk and neck. After collecting and scoring all the data a single score can be compiled to show the level of MSD risk. (Website of Ergonomic Plus 2015.)

RULA was chosen to be as an ergonomic assessment tool because it is said to be a method that is fast, observational, valid, and reliable and it doesn't require any expensive equipment. RULA is designed especially for sedentary and static job descriptions which describes mail sorting well. RULA is also a good choice because it can be applied in a specific way where analyst can decide which postures to analyze. It can also be applied in work shift while observing a person performing the task. (Budnick 2013.)

RULA is also a good method because it is relatively easy to use, and it doesn't require much training. One other good point of RULA is that the procedure has been computerized, so it is available for all computer users. RULA is a valuable tool because it can be combined to other techniques without an increase of time when assessing working methods. It can also be used in new workplaces to assess that they don't create unsuitable working positions. (Karwowski & Marras 1998, 445.)

After deciding which ergonomic tool the author would use to analyze mailmen's ergonomics when sorting mail, the assessment was ready to be done. The author went to the Posti's sorting office on the 2nd of June 2016 to videotape six mailmen while they were sorting mail. After all six workers were videotaped it was possible to analyze the videos with the help of RULA sheet (Appendix 2). Like in the RULA sheet the author analyzed mailmen's use of right and left upper extremities (shoulders, elbows and wrists), neck, trunk and whether their legs and feet were supported and evenly balanced or not.

9 RESULTS

All six workers were videotaped with Samsung S4 smartphone on the 2nd of June 2016. Workers were videotaped one by one while they were sorting mail on their workstations. The aim was to videotape their working ergonomics which could then later be analyzed with the help of RULA sheet. The analyzation of videos was started on the 22nd of August, and was done by 26th of August. The author was successfully able to get results from both upper extremities, neck, trunk and legs.

The results showed that 4/6 used their right upper extremity when sorting mail, whereas one could use both upper extremities equally, and one sorted mail with the left side and took mail off from the shelves with right side. These 2/6 have an equal physical loading on their upper extremities because they can use both sides during mail sorting. Most of the mailmen (4/6) were sitting while sorting the mail. When analyzing mailmen's shoulder joints the results showed that 4/6 had internally rotated shoulders. When sorting mail, all the six mailmen had over 30° of shoulder flexion several times per minute, which is more than recommended. All the subjects had 0° angle on their shoulder joint in the hand which was holding the mail. Subjects were statically holding their shoulder joint in this position during the whole time when sorting mail, except when they were boxing up the mail.

The elbow on the upper extremity which the person uses for sorting the mail was overly extending (even 170°) with 5/6 of the subjects. The same number of subjects had their elbow joint several times per minute in an angle of less than recommended which was less than 90°. Half of the subjects were sorting the mail from too far were their elbow joints would overly extend, and their shoulder joints would rise too high. The elbow on the upper extremity which the person uses for holding the mail had a static position of 90° with almost all the subjects (5/6). Subjects were decreasing the physical load of elbow joint by leaning it to their side.

The wrist on the upper extremity which the subjects uses for sorting the mail was with most of the subjects in supination, ulnar deviation and in extension when sorting the mail on the uppermost shelves. When subjects were sorting the mail on the lowest shelves their wrists were in a radial deviation. Most of the subjects had their wrist on a neutral position when sorting mail on the shelves that were in the middle of the shelving unit. When taking the mail of from the shelves 3/6 of the subjects had their wrist in pronation. The wrist on the upper extremity which the subjects uses for holding the mail was in a static position most of the time with all subjects. Especially when holding small letters subjects had radial deviation on their wrist. Most of the subjects (5/6) were holding the mail so that their wrist was in supination and ulnar deviation causing stress on the ulnar side of the wrist.

Most of the subjects had too much neck extension when sorting mail on the uppermost shelves, and over 20° of neck flexion when sorting mail on the lowest shelves while sitting. Also, occasionally over 20° of neck flexion while sorting mail in standing. All the subjects have neck twist on that side where they have their mail cart. When subjects were sorting and/or taking mail off from the shelves while standing, they had trunk flexion over 20° instead of bending from the knees keeping their back straight. This over 20° of trunk flexion came up also when subjects were taking mail off from the box that was placed on the floor.

When standing, all subjects had legs and feet well supported and in evenly balanced posture especially when standing directly towards the shelves. When sitting, 4/6 could put their feet well supported on the floor and/or on something similar. There were only two out of six subjects that didn't have enough space so that they could place their feet on something to have an evenly balanced posture.

10 MAKING OF THE ERGONOMIC POSTERS

Health product is a health topic related to written or audio- visual products or observation aids meant for the population. Products like these can be guides, leaflets, posters, videos, movies or transparencies. Health product supports human interaction for example by strengthening, clarifying and observing current topics. Moreover, health products can be in support of one's memory, and help an individual or society to take part in the treatment of their own wellbeing. (Parkkunen, Vertio & Koskinen-Ollonqvist 2001, 3.)

The planning and making of the poster started on September 2016. The content of the poster was decided based on the results received from the ergonomic assessment. The results showed quite many bigger and smaller things that should be considered in mail sorting, like proper lifting technique, how and when to take breaks, how to sort the mail ergonomically efficiently, learning of the use/ load of both upper extremities

equally, and how to help muscles of neck and upper extremities to recover from static and repetitive movements.

There were couple of different versions made from the poster, and on the first one there were all the findings received from the assessment, and pictures were taken from the internet. In this version, the poster was full and almost grounded, and there was a discussion with tutoring teacher whether the chosen pictures could be used because of legal issues. After the discussion, it was decided that taking own pictures with camera would be a lot easier when considering the terms of use. In the final version, there were two posters in the size of A3, and own pictures were used. The content included findings received from the ergonomic assessment but also things that client requested to be included, like when to take breaks, and how to prevent neck and upper extremity pain. The other poster includes ergonomic instructions on how to work ergonomically efficiently, and the other poster includes different exercises on how to treat and prevent musculoskeletal pain.

The exercises used in the poster were decided based on the results and from client's request. The most problematic areas in mail sorting seem to be neck and upper extremity pain, and therefor exercises to reduce and prevent neck- and upper extremity pain were included in the posters. Most of the exercises used in the posters are from randomized controlled study about neck pain. The participants recorded to benefit from the exercises used in the study. (Taimela, et al. 2002, 299, 309, 313-314.) Not all the exercises were able to be used in the posters but the ones that were easy to carry through, that didn't need any equipment and that were suitable for neck and upper extremity problems, were chosen. Similar kind of exercises were used in the webpage of Finnish Institute of Occupational health in *Toistotyöntekijän jumppa* which was also used as a reference. The posters included instructions on when to take breaks, and how to take breaks from sedentary type of work, how to lift heavy objects and how to use upper extremities when sorting mail.

The colours used in the posters (orange, grey and blue) were chosen based on the colours that Posti often uses on their webpages, and on a newspaper, that is directed for the staff of Posti, called *Me postilaiset.* Also, the model on the posters uses a blue shirt that is one of the uniform used in Posti. The author wanted to use these small details

so that the posters would look like they were made just for Posti's use. It was important that the posters would have clear pictures, small amount of text to be reader-friendly and nice to look at.

11 CONCLUSIONS

To conclude all the findings received from the videos, there was somewhat smaller and bigger issues when assessing working ergonomics. One of the main findings was the unilateral way of using upper extremities. Most of the workers (4/6) were unable to use both upper extremities equally when sorting mail, resulting in unequal physical loading of muscles, joints and blood circulation. Most of the subjects were sitting while sorting mail making the work sedentary, and physically loading for the lumbar spine.

Other significant finding was the angles of shoulder and elbow joints when sorting mail. Everyone had over 30° of shoulder flexion, and extreme positions of elbow flexion and extension several times per minute during mail sorting. In addition to this, all of the subjects had to perform great amount of static holding of shoulders, elbows and wrists. All subjects had great working positions in their neck and wrists when sorting mail to the shelves in the middle. Negative findings came when sorting mail to the upper and lowermost shelves, resulting in excessive amount of neck flexion and extension, and ulnar and radial deviation of wrists.

Another significant finding was how the subjects could control their lower back. Most of the subjects were working with humped back, increasing the risk of developing musculoskeletal diseases of lumbar spine. Findings of the lower extremities were mainly positive, whereas most of the subjects were working in balanced and well supported posture.

12 DISCUSSION

Evaluation of one's own work is a part of practical thesis. It is important to evaluate things like the idea/ subject of the thesis, execution and the report. The idea of the thesis can include the description of the topic, idea or problem, aims of the thesis, theoretical framework and the target group. The reader should be able to understand what the aims of the thesis were, and how the project was started. The most important part of thesis evaluation is to achieve the aims of the thesis. The tools to achieve the aims and to collect the study material are included in the evaluation of execution. This means the things related to making of the actual product. When evaluating the report, it is important to consider how critical view the writer could achieve, and is the report coherent and convincing. (Vilkka & Airaksinen 2003, 154-159.)

It is important to remember to evaluate the product and project in a critical way. Main points of the evaluation include the idea of the project, how the aims were reached, and the functionality of the project's content and layout from the target group's point of view. Sometimes the product doesn't succeed, and the aims aren't reached. Therefore, it is important to also evaluate possible failures, and consider where these results came from. (Vilkka & Airaksinen 2003, 161.)

The aim of the thesis was to make an ergonomic poster for mailmen working in sorting offices. With the help of an ergonomic poster mailmen could learn and therefor concentrate on their working ergonomics when sorting mail. Mailmen are prone to develop musculoskeletal disorders due to their lack of information in ergonomics. By educating mailmen to work ergonomically efficient it is possible to reduce the amount of sick leaves and increase the wellbeing of employees. The subject of the thesis is topical because there is more and more sedentary type of work, which is the main cause of neck, shoulder girdle and low back pain. Mail sorting is mainly done in sitting and therefore mailmen are more prone to develop musculoskeletal disorders of neck, shoulder girdle and low back.

The project started by looking for references to be used in the theoretical framework. This was one of the most time-consuming parts of the thesis because there was a need

for familiarizing the topics, and finding the main points from the theory to be used in the thesis. The aim was to use maximum of ten-year-old references, but unfortunately even older references had to be used due to lack of newer information. When the theory was mostly written, there was a discussion with tutoring teacher on what kind of a product should be done, and how the information should be gathered. There was an idea on interviewing the employees, videotaping them when sorting mail and making an ergonomic guide based on the results received from the interview, and from the ergonomic assessment. However, it was concluded that it would be too much work for bachelor's thesis to make an interview and an ergonomic assessment. It was also discussed that making an actual guide would be too much, and that an ergonomic poster, that could be placed on the wall of the sorting center, would be more practical for the employees of Posti. Therefore, it was decided that only an ergonomic assessment would be made by videotaping the employees, and based on the findings received from the assessment, two ergonomic posters would be made for the client.

Finding six volunteers to be videotaped was fairly easy since the employees didn't mind being assessed and videotaped. It was a shame that there was no proper video camera to be used but luckily a regular smartphone worked just fine. The actual videotaping, like space requirements, should've been planned better because in some cases it wasn't possible to shoot from all angles. The analyzation of the videos was quite time consuming since all videos needed to be watched several times to get the results from both upper extremities (shoulder, elbow, wrist), neck, back and feet, and to look the videos from front, back and both sides.

After the videos were analyzed and results were received it was possible to start making the two ergonomic posters. Making the posters was harder than toughed. It was difficult to decide on what exercises and ergonomic tips to be placed in to the poster since there was quite a lot of things that could be used based on the results. There was no rush on making the product but at times there was a lack of motivation because in the middle of this thesis process it turned out that ABC- method of sorting mail would be changed into a new type of sorting method called Syli-Zip. Change into this new method gave the feeling that the thesis process, and especially the ergonomic assessment was done for nothing since Syli-Zip differs quite a lot from the ABC- method.

Tutoring teacher encouraged to continue with the original plan, other vice the thesis should've been totally changed, and there was no time for that.

The aim of the thesis wasn't reached as wanted because the actual product turned out to be a poster instead of a guide. It was impossible to fit all the wanted exercises and instructions about improving working ergonomics, and instead of making only one poster, two posters were made. From this thesis project the author could learn a lot from ergonomics, how to choose an ergonomic tool and make an ergonomic assessment, and how to analyze the results. There was also a lot of new knowledge received from sitting and standing, especially from the physiological and ergonomic point of view. After working with this type of physiotherapy topic it will give great tools and experience on working as an occupational physiotherapist, and with ergonomics in the future.

One thesis topic could be making an ergonomic assessment on this new way of sorting mail called "Syli-Zip". This means that the ABC- method will be replaced with plank board that is placed either on the table or on one's lap. There mailman will sort mail to the delivering order. (Parviainen 2016). This is totally different way of sorting mail and it has already started to be used in some sorting centers. Another thesis topic could also be comparing these two types of sorting methods (ABC and Syli-Zip) from the ergonomic point of view to see which would be ergonomically more beneficial for the employees. Another idea for thesis topic is to arrange an educational session for mailmen about their ergonomics. This way the employees can ask questions, be guided and learn more efficiently about ergonomics in sorting office.

REFERENCES

Budnick, P. 2013. The Trouble with RULA (Rabid Upper Limb Assessment). Ergoweb 6.3.2013. Referred 18.5.2016. https://ergoweb.com/the-trouble-with-rula-rapid-upper-limb-assessment-2/

Callaghan, J. P. & McGill, S. M. 2001. Low back joint loading and kinematics during standing and unsupported sitting. Ergonomics 3, 280-294. Referred 17.9.2016. https://www.researchgate.net/publication/12111141_Low_back_joint_loading_and_kinematics_during_standing_and_unsupported_sitting

Dieen, J.V., Hoozemans M.J.M. & Toussaint, H.M. 2000. Stoop of squat: A review of biomechanical studies on lifting technique. Clinical Biomechanics 14, 685-696. Referred 27.9.2016. https://www.researchgate.net/publication/12754455_Stoop_or_squat_a_Review_of_Biomechanical_Studies_on_Lifting_Technique

Karwowski, W. & Marras, WS. 1998. The Occupational Ergonomics Handbook. Boca Raton: CRC Press LLC. Referred 14.9.2016. https://books.google.fi/books

Kukkonen, R. & Takala, E-P. 2001. Niska- hartiaseutu. In: Kukkonen, R., Hanhinen, H., Ketola, R., Luopajärvi, T., Noronen, L. & Helminen P. 2001. Työfysioterapia. Yhteistyötä työ- ja toimintakyvyn hyväksi. Helsinki: Työterveyslaitos

Launis, M. & Lehtelä, J. 2011. Ergonomia. Helsinki: Työterveyslaitos.

Lindström, K., Elo, A-L., Kandolin, I., Ketola, R., Lehtelä, J., Leppänen, A., Lindholm, H., Rasa, P-K., Sallinen, M. & Simola, A. 2002. Työkuormitus ja sen arviointimenetelmät. Helsinki: Työterveyslaitos.

Neumann, D.A. 2010. Kinesiology of the musculoskeletal system. Foundations for Rehabilitation. Second Edition.

Parkkunen, N., Vertio, H. & Koskinen- Ollonqvist, P. 2001. Terveysaineiston suunnittelun ja arvioinnin opas. Helsinki: Terveyden edistämisen keskus.

Parviainen, U. 2016. Sylillinen postia. Me postilaiset. 3/2016.

Sandström, M. & Ahonen, J. 2011. Liikkuva ihminen- aivot, liikuntafysiologia ja sovellettu biomekaniikka. Lahti: VK-Kustannus Oy.

Taimela, S., Airaksinen, O., Asklöf, T., Heinonen, T., Kauppi, M., Ketola, R., Kouri, J-P., Kukkonen, R., Lehtinen, J., Lindgren, K-A., Orava, S., Virtapohja, H. 2002. Niska- ja yläraajojen ennaltaehkäisy, hoito ja kuntoutus. Jyväskylä: Gummerus Kirjapaino Oy.

Vilkka, H. & Airaksinen, T. 2003. Toiminnallinen opinnäytetyö. Helsinki: Tammi

Website of Ammattinetti. Referred 21.11.2015. http://www.ammattinetti.fi/ammattialat/detail/103_ammattiala;jsessionid=99678912FAC78CB0E5071AC112C03731?link=true

Website of Ergonomics Plus. Referred 17.5.2016. http://ergo-plus.com/wp-content/uploads/RULA-A-Step-by-Step-Guide1.pdf

Website of International Ergonomics Association. Referred 28.11.2015. http://www.iea.cc/whats/index.html

Website of Posti. Referred 11.1.2016. http://www.posti.fi/liitteet-yrityksille/ohjeet/eralajittelu-kimputus-yksikointiopas.pdf

Website of Posti. Referred 21.11.2015. http://www.posti.com/postigroup/postiinbrief/

Website of Rabid Upper Limb Assessment. Referred 22.8.2016. http://www.rula.co.uk/RULASheet.pdf

Website of Työsuojelurahasto. Referred 11.1.2016. https://www.tsr.fi/tutkimustietoa/tata-on-tutkittu/hanke/?h=101275&n=tiedote

Website of Työterveyslaitos, Referred 17.5.2016. http://www.ttl.fi/fi/ergonomia/menetelmat/rula/Sivut/default.aspx

Website of Työterveyslaitos. Referred 10.2.2016. http://www.ttl.fi/fi/verkkokirjat/Documents/Kuorma_kevenee_yhteistyolla.pdf

Website of Työterveyslaitos. Referred 11.1.2016. http://www.ttl.fi/fi/ergonomia/tyon_fyysisia_kuormitustekijoita/toistotyo/sivut/default.aspx

Website of Työterveyslaitos. Referred 17.5.2016. http://ergo.human.cornell.edu/Pub/AHquest/RULAworksheet.pdf

Website of Työterveyslaitos. Referred 28.11.2015. http://www.ttl.fi/fi/ergonomia/Sivut/default.aspx

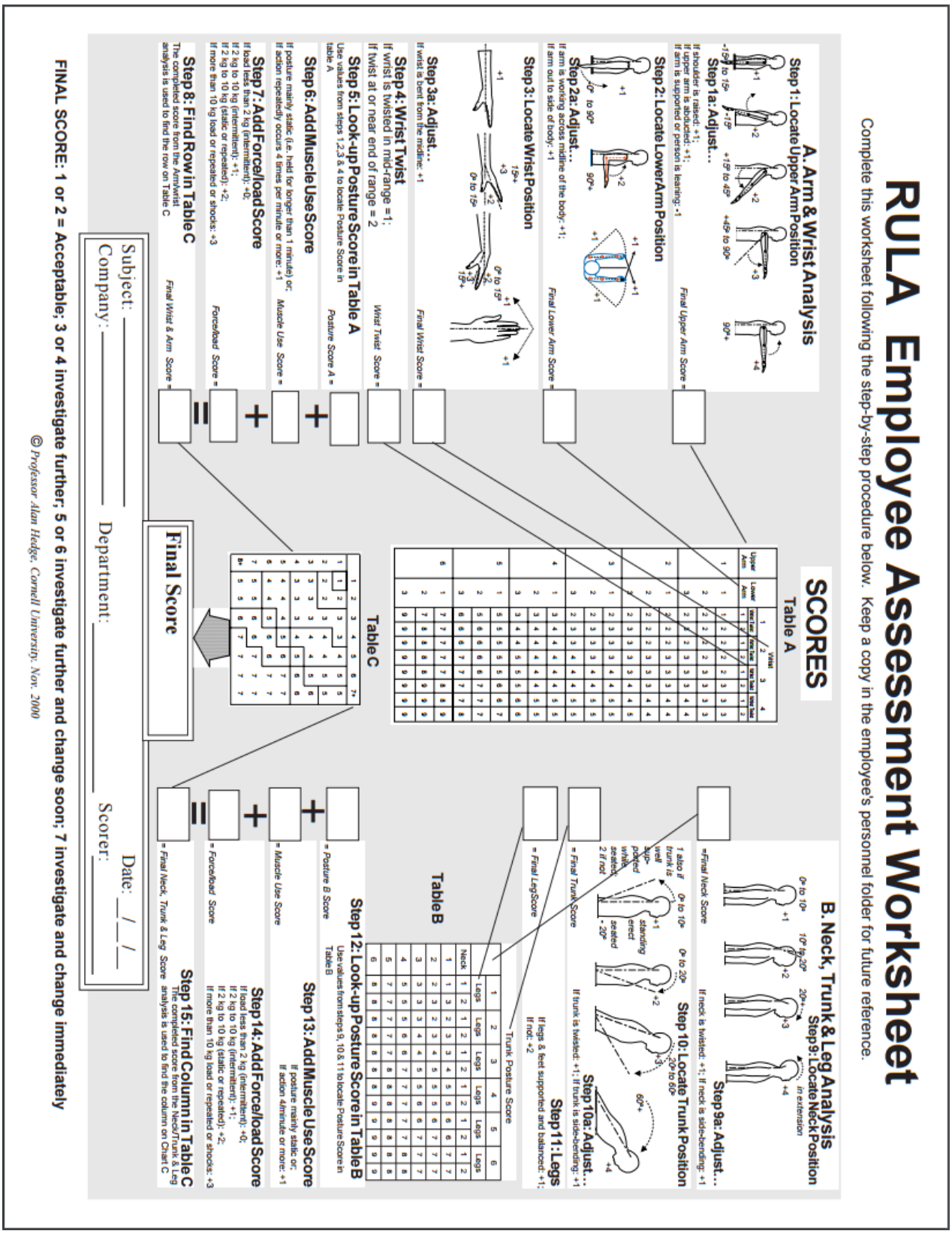
Website of Työterveyslaitos. Referred 3.10.2016. http://www.ttl.fi/fi/ergonomia/tyon_fyysisia_kuormitustekijoita/tauota_tyotasi/Documents/toistovenytys.pdf

Website of Työterveyslaitos. Referred 5.2.2016. http://www.ttl.fi/fi/ergonomia/tyon_fyysisia_kuormitustekijoita/tauota_tyotasi/sivut/default.aspx

Website of Virtuaali Ammattikorkeakoulu. Referred 29.8.2016. http://www2.amk.fi/digma.fi/www.amk.fi/opintojaksot/030906/1113558655385.html

APPENDIX 1

RABIT UPPER LIMB ASSESSMENT (RULA)



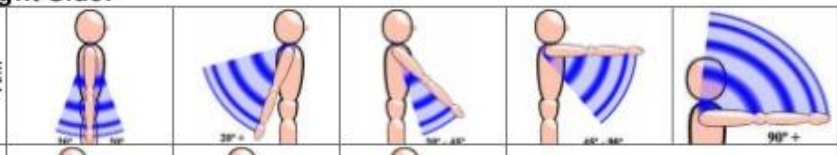
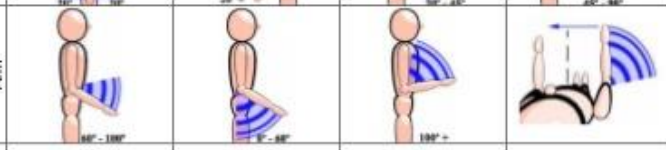
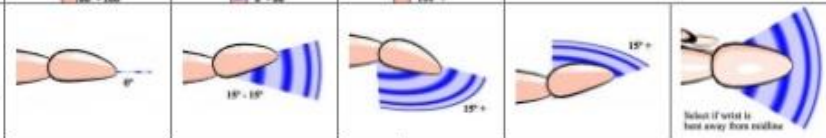
APPENDIX 2

RABIT UPPER LIMB ASSESSMENT SHEET (RULA SHEET)

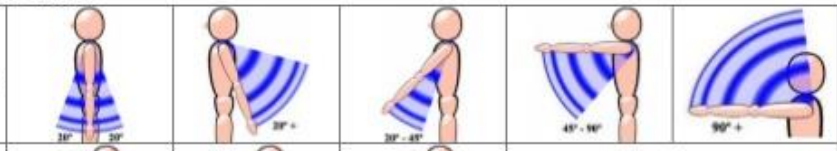
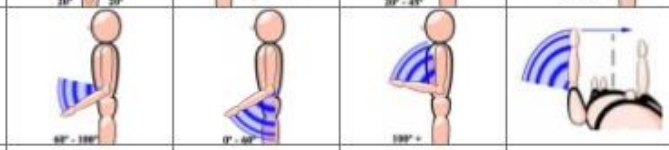
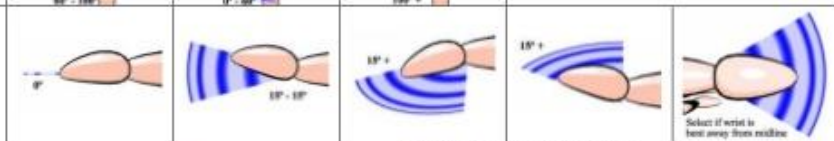
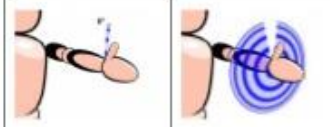
RAPID UPPER LIMB ASSESSMENT

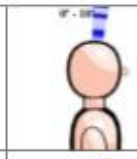
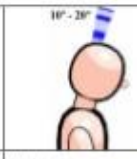
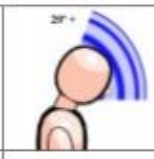
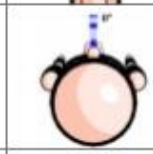
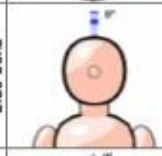
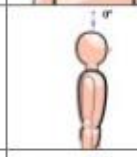
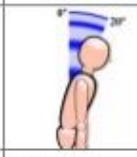
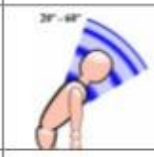
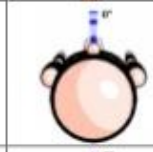
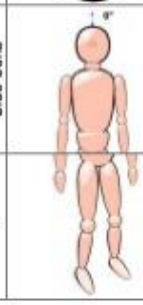
Client:	Date/time:	Assessor:

Right Side:

Right Upper Arm						❑ Shoulder is raised ❑ Upper arm is abducted ❑ Leaning or supporting the weight of the arm
Right Lower Arm						❑ Working across the midline of the body or out to the side
Right Wrist						❑ Wrist is bent away from midline
Right Wrist Twist			Force & Load for the Right hand side	SELECT ONLY ONE OF THESE: ❑ No resistance ❑ less than 2kg intermittent load or force ❑ 2–10kg intermittent load or force ❑ 2–10kg static load ❑ 2-10kg repeated loads or forces ❑ 10kg or more intermittent load or force ❑ 10kg static load ❑ 10kg repeated loads or forces ❑ Shock or forces with rapid build-up		
Muscle Use	❑ Posture is mainly static, e.g. held for longer than 1 minute or repeated more than 4 times per minute					

Left Side:

Left Upper Arm						❑ Shoulder is raised ❑ Upper arm is abducted ❑ Leaning or supporting the weight of the arm
Left Lower Arm						❑ Working across the midline of the body or out to the side
Left Wrist						❑ Wrist is bent away from midline
Left Wrist Twist			Force & Load for the Right hand side	SELECT ONLY ONE OF THESE: ❑ No resistance ❑ less than 2kg intermittent load or force ❑ 2–10kg intermittent load or force ❑ 2–10kg static load ❑ 2-10kg repeated loads or forces ❑ 10kg or more intermittent load or force ❑ 10kg static load ❑ 10kg repeated loads or forces ❑ Shock or forces with rapid build-up		
Muscle Use	❑ Posture is mainly static, e.g. held for longer than 1 minute or repeated more than 4 times per minute					

Neck					
Neck Twist					
Neck Side-bend					
Trunk					
Trunk Twist					
Trunk Side-bend					
Legs		Legs and feet are well supported and in an evenly balanced posture.		Legs and feet are NOT evenly balanced and supported.	
Force & Load for the neck, trunk and legs	**SELECT ONLY ONE OF THESE:** ❑ No resistance ❑ less than 2kg intermittent load or force ❑ 2–10kg intermittent load or force ❑ 2–10kg static load ❑ 2-10kg repeated loads or forces ❑ 10kg or more intermittent load or force ❑ 10kg static load ❑ 10kg repeated loads or forces ❑ Shock or forces with rapid build-up				
Muscle Use	❑ Posture is mainly static, e.g. held for longer than 1 minute or repeated more than 4 times per minute				