

Lateral epicondylalgia

**A new structured treatment program
with an inter-disciplinary approach**

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*“The only way to discover the limits of the possible is
to go beyond them into the impossible.”*

Arthur C Clarke

*“Our greatest glory is not in never falling,
but in getting up every time we do”*

Confucius

Abstract

Background: Lateral epicondylalgia is a common musculoskeletal diagnosis, thus there exist no structured effective treatment program and no evaluative questionnaire specific for lateral epicondylalgia. Overall aim: This thesis evaluates a structured treatment program with an interdisciplinary approach, and cross-culture adapts and translates a questionnaire for lateral epicondylalgia.

Study I: *Aim:* To evaluate a new multidisciplinary structured home training program for patients with lateral epicondylalgia compared to conventional attendance. *Method:* The study had a prospective design. A total of 78 patients with lateral epicondylalgia were recruited and were divided into two groups, 51 entered the intervention group and 27 entered the control group. The intervention group was treated with a specific home training program, ergonomic advice and when necessary wrist and/or night bandages. The control group was treated with conventional treatment. Pain and function were evaluated by the Patient Rated Forearm Questionnaire, PRFEQ and strength and stamina with an electronic hand power gauge. Sick-leave absence was collected via the Regional Social Insurance Office. *Results:* After four weeks the intervention group experienced less sick-leave, less pain, better function and returned to work earlier than the control group. After 16 weeks the intervention group still had significantly better function and had less sick-leave. Their pain decreased but not significantly. No difference in grip strength between the two groups. *Conclusion:* A structured home training programme can improve function and reduce sick-leave in patients with lateral epicondylitis.

Study II: *Aim:* To translate and cross-culturally adapt the questionnaire “Patient-rated Tennis Elbow Evaluation” into Swedish PRTEE-S; (Patientskattad Utvärdering av Tennisarmbåge), and to evaluate the reliability and validity of the questionnaire. *Methods:* The Canadian questionnaire, “Patient-rated Tennis Elbow Evaluation” (PRTEE), was cross-culturally adapted for the Swedish language according to well-established guidelines. Fifty-four patients with unilateral epicondylalgia were assessed using the PRTEE-S (Patientskattad Utvärdering av Tennisarmbåge), the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), and the Roles & Maudsley score to establish the validity and reliability of the PRTEE-S. Reliability was determined via calculation of the intra-class correlation coefficient (ICC) the internal consistency was assessed by Cronbach's alpha, and validity was calculated using Spearman's correlation coefficient. *Results:* The test-retest reliability, using the ICC, was 0.95 and the internal consistency was 0.94. The PRTEE-S correlated well with the DASH ($r = 0.88$) and the Roles & Maudsley score ($r = 0.78$). *Conclusion:* The PRTEE-S represents a reliable and valid instrument to evaluate the subjective outcome in Swedish speaking patients with lateral epicondylalgia, and can be used in both clinical settings and research.

Study III: *Aim:* To describe health care professionals' treatment choices, their cooperation with other professionals and their perceptions regarding the treatment of acute lateral epicondylalgia. *Method:* The study had a quantitative descriptive study design with a summative approach to qualitative analysis using content analysis. All Orthopaedic Surgeons, General Practitioners, Physiotherapists and Occupational Therapists in a county were asked to answer a questionnaire with 18 dichotomous, multiple response, multiple-choice questions and three open-ended questions. *Results:* Participants n=321. The findings of the qualitative analysis dealt with perceptions of interdisciplinary cooperation and treatment which resulted in five categories; Right level of care, Increased quality of care, Decreased quality of care, Side effects and Inadequate treatment. Almost half of the General Practitioners and Orthopedic Surgeons felt potential risks associated with their treatment methods. Advantages from interdisciplinary cooperation were higher rated than disadvantages. *Conclusion:* Interdisciplinary cooperation in the treatment of patients with acute lateral epicondylalgia benefits the patients by shortening the rehabilitation period and provides health care professionals the opportunity for an improved learning and exchanging experiences. There was a strong will to cooperate and the risks of side effects with corticosteroid injections and NSAID are well-known although they are the most common treatments. Treating the patient at the right level of care could minimize side effects. These basic conditions must be met in order to improve health care quality.

Study IV: *Aim:* To evaluate whether patients with lateral epicondylalgia, two years after they were treated by a structured program, had less pain or function loss and if recurrent episodes and sick-leave days differed compared to a control group. *Method:* This study had a prospective design with a two year follow-up. The intervention group (n=103) were referred to a physiotherapist and an occupational therapist working together with a structured treatment program. The control group, chosen from the same diagnose code (n=194) were treated with various treatments. The outcome measures were pain, function, rates of recurrences and sick-leave using a questionnaire two years after their visit at the health care center. *Result:* More than half of the patients experienced some pain and function loss from their elbow. The intervention group had less sick-leave absence at the time for the first visit, less pain and function loss and fewer periods of recurrences and needed less additional therapy if a recurrence occurred. *Conclusion:* This disease is not always a self-limiting condition and needs treatment. A structured treatment and to teach the patients how to treat themselves if the symptoms re-occur, seems to be an effective way. The patient will not need additional treatment and do not need to be on the sick list.

The main findings: With a structured program and by using interdisciplinary cooperation in the treatment of lateral epicondylalgia, the absence from work could decrease, the pain and the function loss was less for the patient, side-effects were minimized and the program could be an outlined and effective way for the health care professionals to treat the patient and to evaluate lateral epicondylalgia both clinical and in science.

Sammanfattning på svenska

Bakgrund: Lateral epicondylalgi är en vanlig muskuloskeletal diagnos, ändå finns inget strukturerat effektivt behandlingsprogram eller någon utvärderingsenkät specifikt för lateral epicondylalgi. Övergripande syfte: Denna avhandling utvärderar ett strukturerat behandlingssätt med en interdisciplinär approach samt kulturpassar och översätter en enkät för lateral epicondylalgi.

Studie I: *Syfte:* Att utvärdera en ny strukturerad multidisciplinär hemträningssätt för patienter med lateral epicondylalgi i jämförelse med konventionella metoder. *Metod:* Studien hade en prospektiv design. Totalt 78 patienter med lateral epicondylalgi rekryterades och indelades i två grupper, 51 patienter i interventionsgruppen och 27 patienter i kontrollgruppen. Interventionsgruppen behandlades med ett specifikt hemträningssätt, ergonomisk rådgivning och vid behov handledsstöd och/eller nattbandage. Kontrollgruppen behandlades med konventionella metoder. Smärta och funktion utvärderades med Patient-rated Forearm Questionnaire, PRFEQ och styrka och uthållighet med en elektrisk handstyrkemätare. Sjukfrånvaro hämtades från den regionala Försäkringskassan. *Resultat:* Efter fyra veckor hade interventionsgruppen mindre sjukfrånvaro, mindre smärta, bättre funktion och återvände till arbetet tidigare än kontrollgruppen. Efter 16 veckor hade interventionsgruppen fortfarande signifikant bättre funktion och mindre sjukfrånvaro. Även smärtan minskade men detta var inte signifikant. Det var ingen skillnad i greppstyrka mellan de två grupperna. *Konklusion:* En strukturerad hemträningssätt kan förbättra funktion och minska sjukfrånvaro för patienter med lateral epicondylalgi.

Studie II: *Syfte:* Att översätta frågeformuläret "Patient-rated Tennis Elbow Evaluation" till svenska, PRTEE-S; (Patientskattad Utvärdering av Tennisarmbåge), anpassa till svenska förhållanden samt utvärdera formulärets reliabilitet och validitet. *Metod:* Det kanadensiska frågeformuläret, "Patient-rated Tennis Elbow Evaluation" (PRTEE), anpassades till svenska förhållanden enligt väl etablerade instruktioner. Femtiofyra patienter med ensidig lateral epicondylalgi ingick. PRTEE-S "(Patientskattad Utvärdering av Tennisarmbåge)" användes tillsammans med "Disabilities of the Arm, Shoulder and Hand questionnaire" (DASH), och "Roles & Maudsley" utvärderingspoäng för att fastställa validitet och reliabilitet för PRTEE-S. Reliabiliteten bestämdes genom uträkning av intra-klass korrelation koefficient (ICC), för att säkerställa innehållet användes Cronbach's alpha, och validiteten mättes genom beräkning av Spearman's correlation coefficient. *Resultat:* Test-retest reliabiliteten som beräknades med ICC, var 0.95 och innehållskoefficienten var 0.94. PRTEE-S korrelerade bra med DASH ($r = 0.88$) och Roles & Maudsley poängen ($r = 0.78$). *Konklusion:* PRTEE-S är ett reliabelt och valid instrument för att utvärdera den subjektiva upplevelsen hos svensk-talande patienter och kan användas såväl i klinisk verksamhet som i vetenskapliga undersökningar.

Studie III: *Syfte:* Att beskriva sjukvårdspersonalens val av behandling, samarbete med andra professioner och deras upplevelser vid behandling av patienter med akut lateral epicondylalgi. *Metod:* Studien hade en kvantitativ deskriptiv design i kombination med en summerande kvalitativ innehållsanalys. Alla ortopedläkare, distriktsläkare, sjukgymnaster och arbetsterapeuter i Halland svarade på ett frågeformulär bestående av 18 ja/nej frågor, flervalsfrågor samt tre öppna frågor. *Resultat:* Deltagarantalet var 321. Den kvalitativa innehållsanalysen av upplevelser från samarbete och behandling av akut lateral epicondylalgi resulterade i fem kategorier; Rätt vårdnivå, Ökad vårdkvalitet, Minskad vårdkvalitet, Bieffekter samt Inadekvat behandling. Nästan hälften av distriktsläkarna och ortopedläkarna upplevde potentiella risker associerade med deras behandlingsval. Fördelarna av samarbete var fler än nackdelarna. *Konklusion:* Samarbete när det gäller behandling av akut lateral epicondylalgi kommer patienten tillgodo i form av förkortad rehabiliteringsperiod och ger sjukvårdspersonalen möjlighet till att utveckla lärandet samt att utbyta erfarenheter. Det fanns en stark önskan att samarbeta och riskerna med kortisoninjektioner och NSAID är välkända trots att det är de vanligaste behandlingarna. Om patienterna behandlas på rätt vårdnivå kan biverkningar minimeras. Dessa grundförutsättningar måste tillgodoses för att förbättra vårdkvaliteten.

Studie IV *Syfte:* Att utvärdera om patienter som behandlats med en strukturerad behandlingsmetod, två år tidigare, hade mindre smärta eller funktionsbortfall, och om återfall och sjukskrivningsdagar skiljde sig i jämförelse med en kontrollgrupp som behandlades konservativt. *Metod:* Studien hade en prospektiv design med en tvåårsuppföljning. Interventionsgruppen (n=103) remitterades till en sjukgymnast och en arbetsterapeut som samarbetade med ett strukturerat behandlingssätt. Kontrollgruppen (n=194) rekryterades från samma diagnoskod och behandlades med varierande behandlingar. Utvärderingen gjordes genom att besvara ett frågeformulär angående smärta, funktionsbortfall, återfall samt sjukfrånvaro två år efter besöket på vårdcentralen. *Resultat:* Mer än hälften av patienterna i hela studiegruppen upplevde någon form av smärta och funktionsbortfall när det gällde armbågen. Interventionsgruppen hade mindre sjukfrånvaro vid besöket på vårdcentralen, mindre smärta, mindre funktionsbortfall samt färre perioder av återfall och behövde mindre av kompletterande behandlingar för sina återfall. *Konklusion:* Denna sjukdom är inte alltid självläkande utan behöver behandling. En strukturerad behandlingsmetod samt att lära patienterna självbehandling om symptomen återkommer verkar vara en effektiv rehabiliteringsmetod. Patienten behöver inte ytterligare behandlingar och behöver inte vara sjukskriven.

Huvudfynd: Med ett strukturerat behandlingssätt och genom att använda interdisciplinärt samarbete, kunde sjukfrånvaron minska, smärta och funktionsbortfall minska, biverkningar från behandlingen minimeras, en överskådlig och effektiv behandlingsrutin för sjukvårdspersonalen användas samt lateral epicondylalgi utvärderas både kliniskt och i forskning.

Original papers

- I** Nilsson P, Thom E , Baigi A , Marklund B, Månsson J
A prospective pilot study of a multidisciplinary home training programme for lateral epicondylitis
Musculoskeletal Care 2007; 5:36-50

- II** Nilsson P, Baigi A, Marklund B, Månsson J
Cross-cultural adaptation and determination of the reliability and validity of PRTEE-S (Patientskattad Utvärdering av Tennisarmbåge), a questionnaire for patients with lateral epicondylalgia, in a Swedish population
BMC Musculoskelet Disord. 2008; 9:79

- III** Nilsson P, Lindgren E-C, Månsson J
Lateral epicondylalgia. A quantitative and qualitative analysis of interdisciplinary cooperation and treatment choice in the Swedish health care system
Submitted

- IV** Nilsson P, Baigi A, Swärd L, Möller M, Månsson J
Lateral epicondylalgia; A structured treatment program better than corticosteroids and NSAID in the long run
Submitted

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Abbreviations/Definitions

Chi 2: Statistical test used in nominal data. Size, often not more than five.

Concentric muscle force: When a muscle shortens while producing force.

Credibility: For example; authors worked both individually and together as a multi-professional team during the various steps of the analysis process, thereby strengthening the trustworthiness of the results.

Cross-cultural adaptation: To put e.g. a questionnaire into another cultural it may need some adjustments for functioning the same way as the original culture it was developed in.

Dependability: For example; there was no connection between the respondents and the individuals who analysed their results, the answers were thought to have been given correctly.

Eccentric muscle force: When a muscle lengthens while producing force.

Fisher's exact t-test: Alternative statistical test to Chi 2. Minimal value in one cell is less than five.

Generability: In what way the study can be transferred into a wider prospect.

ICC: Intraclass Correlation Coefficient

ICD 10: International Classification of Diseases

ICF: International Classification of Functioning, Disability and Health

IQR: Interquartil range. The difference between the first quartile and the third.

LE: Lateral epicondylalgia

Median: The numeric value separating the higher half of a sample, a population, or a probability distribution, from the lower half. The median of a finite list of numbers can be found by arranging all the observations from lowest value to highest value and picking the middle one. 1, 7, 9, 10 and 17 is 9 the median (but 8,8 is the mean). If there is a few values that differ from the others, this is a good value.

Mean: The sum of all variables divided by the number of observations in a population.

NSAID: Non-Steroidal Anti-Inflammatory Drugs

Power: The probability of finding a significant association when one truly exists.

PRFEQ: Patient-rated Forearm Evaluation Questionnaire

PRTEE-S: Patient-rated Tennis Elbow Evaluation – Swedish

Reliability: The consistency or repeatability of measures.

Transferability: For example; the total eligible population had the opportunity to participate, and individuals of various ages who had differing occupations were included. Therefore, the answers were considered to reflect the reality of the population.

Triangulation: Triangulation refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings.

Trustworthiness: Contains of credibility, dependability and transferability and explains the study's reliability.

Type I error : The probability that a true hypothesis is neglected.

Type II error: The probability that a false hypotheses is accepted.

WHO: World Health Organization

Validity: The degree to which the tool measures what it claims to measure.

Z-value: The difference between a value and the mean divided by SD

Introduction

Primary health facilities are often the first place where patients seek help for most problems of musculoskeletal origin, and the first health care professional the patient meets is often the General Practitioner (GP). Lateral epicondylagia is a common musculoskeletal problem. There exists no general way to treat this kind of disease. Sometimes the GP refers the patient to a physiotherapist or an occupational therapist, and sometimes they do not. Physicians are not sure where to refer the patients, and physiotherapists and occupational therapists are not familiar with working together to treat lateral epicondylagia.

In the 1990s, more and more teams were built to promote collaboration among professionals. Teams in Swedish health care centers often consisted of a GP, a physiotherapist, an occupational therapist and sometimes a nurse. This useful experience benefitted the patient because it helped to have different professionals look at the same disease from different perspectives. The waiting times to be seen by the different health care professionals were sometimes long, mostly to see the GP, which delayed the therapy. This delayed the rehabilitation, caused patients unnecessary suffering and further prolonged the sick-leave time.

My interest in this research area focuses on collaboration, especially between the physiotherapist and the occupational therapist. If a structured method to effectively treat the patient could be established, it would make the patients' rehabilitation for lateral epicondylagia much easier. The physician would know where to send the patients, and the patients could get help more quickly. The patient may not even have to see a physician.

Musculoskeletal pain and functional loss could result in sick-leave absence, which costs society, the employer and the employee substantial money. A cost-effective way to treat the patient is recommending that the patients train at home to gain the strength they need to function at work or in their spare time. If they use a wrist support, they could still work and use the support when there is an absolute need for it. However, the support should not be used daily and definitely not all day long, or it may cause the muscles to rely on the support and become increasingly weaker. Problems that occur during the night could be improved by using a night bandage that prevents the elbow from being kept in a flexed position. This could prevent sleep from being disturbed and could help to avoid the pain caused by holding the elbow in too much flexion, which sometimes makes it difficult for the patient to extend the elbow in the morning.

In the treatment area of lateral epicondylagia, there exist several different treatments, with more or fewer side effects. Corticosteroids and NSAIDs have well-known side effects and are still very common treatments for musculoskeletal

diseases like lateral epicondylalgia. Finding a method that minimizes these side effects was one of the desired outcomes of the studies. This structured method would require an easily understandable evaluation form, and at this time, there was none in the Swedish language that concentrated on the elbow. The best one recommended by some researchers was in English.

This thesis examines a structured method to treat lateral epicondylalgia over both the short and long term. The method could be used by health care professionals as an effective routine approach in the rehabilitation of lateral epicondylalgia with minimal side effects, could help the patient achieve an effective recovery, and if the problem re-occurs, could provide the knowledge to treat it.

Background

Musculoskeletal disorders

Musculoskeletal disorders are common problems in primary health care. Musculoskeletal conditions are the most common self-reported work-related disease, with high costs incurred from long-term disability [1]. Medial and lateral epicondylalgia is relatively common among working-age individuals in the general population [2]. Lateral epicondylalgia has been found to be the second most frequently diagnosed musculoskeletal disorder of the upper extremities in a primary health care setting [3]. Verhaar reported an incidence of 2 % in the adult population [4]. In Sweden, this disease has a yearly incidence of 1 % and a prevalence of 1-3 % [5] and is common in both males and females. The prevalence does not differ between men and women and is highest in subjects aged 45-54 years [2] [6], which means that it occurs in individuals of working age. However, individuals in their 20s or 80s could also be affected.

The disease might be caused by sudden monotonous work for which the individual is not properly in shape. Disorders of the upper limb account for 53 % of complaints from maintenance work and catering in an offshore industry, and more than half of 2,000 office workers reported musculoskeletal problems of some kind, which indicates that this is a large problem [7] [8]. Repetitive/constrained work is harmful not only in industrial settings, but also in the office and non-office/non-industrial settings [9]. The upper limb disorders involve the neck, shoulder, arm and hand. The increased access to computers and the internet could also have an influence, as well as the fact that individuals work less with their bodies and more with their brains because industrial factories have adopted so many machines that we do not have to move as much as in the past. In a working population, this is a great problem and a frequent cause of sick-leave absence. Socioeconomic variables could be important predictors of an adverse outcome among workers with a sickness absence of eight or more weeks [10].

Some studies report socioeconomic differences for patients suffering from lateral epicondylalgia, and others do not [6] [10]. This disease is associated with non-neutral postures of the hands and arms, use of heavy hand-held tools and high physical strain measured as a combination of forceful work, non-neutral posture of the hands and arms, and repetition [11]. Furthermore, it is associated with low social support at work among women [11]. Musculoskeletal disorders were more prevalent among females than among males. Interestingly, repetitive/constrained work versus varied/mobile work were for most measures approximately the same for both genders [9]. In addition to the current practice of prescribing exercises for the wrist extensor muscles, research suggests that appropriate activation of the stabilizing muscles of the shoulder and cervical spine also must be considered by the practitioner [12].

The term epicondylitis suggests an inflammatory cause; however, no evidence of acute or chronic inflammation is found [13]. Lateral epicondylitis seems to be a self-limiting condition from which most patients recover in one year [14], but it is a relapsing condition with recurring episodes [6] [14]. It is feasible that resuming manual work after treatment may hinder recovery or increase the risk of relapse [15]. This condition has no gold standard for treatment and is treated in several ways.

Primary health care in Sweden

Sweden's entire population has access to health care services. The Swedish health care system is government-funded and heavily decentralized. The health care system in Sweden is financed primarily through taxes levied by county councils and municipalities. County councils have complete authority over hospital structure in Sweden. Either an executive board or an elected hospital board at the county level determines the management structure of hospitals within its county.

County councils have similar authority over primary health care centers, which differ from government-funded health care centers in that they are responsible for providing most outpatient care. County councils heavily regulate the establishment of new health care centers and private physicians, physiotherapists, occupational therapists and other health care professionals. An approved establishment is required to start working privately. In international comparisons, the Swedish health care system has been seen to perform well. In recent years, market-oriented, demand-driven health care reforms have aimed at free choice of provider by patients, and patients make their own choice of which health care center they should be listed at [16]. By January 2010, all county councils are forced to have introduced what is known as the customer's choice system in primary care. This started in 2007 as a pilot project in the county of Halland. The system entails patients choosing whether they would prefer to go to a private or public health

center. If a health care professional does not have an agreement, the patient will have to pay the full charge without any funding from the government [17].

Health care professions

Treatment for lateral epicondylalgia could be given by a number of health care professionals, including osteopaths, chiropractors, and naturopaths. The most common in primary health care, however, are physicians, physiotherapists and occupational therapists.

General practice

A General Practitioner (GP) is a medical practitioner who treats acute and chronic illness and provides preventive care and health education for all ages. The term general practitioner or GP is common in the Republic of Ireland, the United Kingdom and several Commonwealth countries. In these countries, the word physician is largely reserved for certain other types of medical specialists, notably in internal medicine. In these countries, the term GP has a clearly-defined meaning; in North America the term has become somewhat ambiguous [18]. The GP is usually the first professional the patient meets in Swedish primary health care, even though this is about to change. The GP performs the diagnosis and is also able to prescribe the patient sick-leave if necessary, which none of the other professionals are able to do. The GP can choose to treat the patient or to refer for wider treatments.

Physiotherapy

Physicians like Hippocrates and Galenus are believed to have been the first practitioners of physical therapy, advocating massage, manual therapy techniques and hydrotherapy to treat people in 460 B.C. The earliest documented origins of actual physical therapy as a professional group date back to Per Henrik Ling, the “Father of Swedish Gymnastics”, who founded the Royal Central Institute of Gymnastics in 1813 for massage, manipulation and exercise. In 1887, physiotherapists were given official registration by Sweden’s National Board of Health and Welfare. Research catalyzed the physical therapy movement. The first physical therapy research was published in the United States in March 1921 in *The PT Review* [19]. The physical therapist’s extensive knowledge of the body and its movement needs and potential is central to determining strategies for diagnosis and intervention. The practice settings will vary according to whether the physical therapy is concerned with health promotion, prevention, treatment/intervention, habilitation or rehabilitation. Physical therapists operate as independent practitioners and as members of health service provider teams and are subject to the ethical principles of the World Congress of Physiotherapy. They are able to act as first-contact practitioners, and patients/clients may seek direct services without referral from another health care professional. Physical therapy

provides services to individuals and populations to develop, maintain and restore maximum movement and functional ability throughout the lifespan. This includes providing services in circumstances where movement and function are threatened by aging, injury, disease or environmental factors. Functional movement is central to what it means to be healthy [20]. The physical therapy process includes the entire session in which the physiotherapist and the patient meets and includes the examination/assessment, evaluation, diagnosis, prognosis, plan of care/ intervention and re-examination [20].

Occupational therapy

Occupational therapy is a client-centered health profession concerned with promoting health and well being through occupation. The primary goal of occupational therapy is to enable people to participate in the activities of everyday life. Occupational therapists achieve this outcome by working with people and communities to enhance their ability to engage in the occupations they want to, need to, or are expected to do, or by modifying the occupation or the environment to better support their occupational engagement. Occupational therapy is practiced in a wide range of public, private and voluntary sector settings, such as the person's home environment, schools, workplaces, health centers, supported accommodation, housing for seniors, rehabilitation centers, hospitals, and forensic centers. Clients are actively involved in the occupational therapy process. The outcomes are client-driven and diverse and measured in terms of participation, satisfaction derived from occupational participation and/ or improvement in occupational performance. The majority of countries regulate occupational therapy as a health profession and require specific university level education [21].

Team treatment

Multidisciplinary

- Multidisciplinary: investigators bring complementary skills and knowledge to a research problem, but their efforts are not integrative [22].

Working multidisciplinary means working in a team or group consisting of representatives from several different professional backgrounds who all have different areas of expertise, with each discipline approaching the patient from its own perspective. Multidisciplinary working is often seen as revolutionary by skill-centered specialists, but it is simply a fundamental expression of holistic guidance. In primary health care, it usually consists of two or more health care professionals working together toward the same goal, e.g., getting the patient back to work. It is common for multidisciplinary teams to meet regularly, in the absence

of the patient, to “case conference” findings and discuss future directions for the patient’s care. Multidisciplinary teams provide more knowledge and experience than disciplines operating in isolation. The use of the term multidisciplinary has in recent years been overtaken by the term interdisciplinary for what is essentially holistic working by another name [23].

Interdisciplinary

- Interdisciplinary: investigators work together using an integrative approach to solve a research problem [22].

The adjective interdisciplinary was initially most often used in educational circles when researchers from two or more disciplines pool their approaches and modify them so that they are better-suited to the problem. Interdisciplinary studies as a process seeks to synthesize broad perspectives, knowledge, skills, interconnections, and epistemology in an educational setting. Interdisciplinary approaches could facilitate the study of subjects that have some coherence but that cannot be adequately understood from a single disciplinary perspective. Interdisciplinary team approaches, as the word itself suggests, integrate separate discipline approaches into a single consultation. That is, the patient-history taking, assessment, diagnosis, intervention and short- and long-term management goals are conducted by the team, together with the patient, at the one time. One of the risks of interdisciplinary teams is that traditional hierarchies, or dominant personality types (or both), may interfere with the process [23].

Different health care professionals approach the same problems differently according to their education and their occupational paradigm [24]. Interdisciplinary teams have some obvious advantages over multidisciplinary, the most obvious being the patient-centered approach. Furthermore, it provides a stimulating work environment within which staff can learn about, and even conduct, some of the assessments and interventions traditionally carried out by other disciplines (where it is safe and appropriate for them to do so). When done well, it is an extremely efficient method of operating, with both time and cost savings from the lack of duplication and need for follow-up case conferencing. One of the unexpected advantages of the interdisciplinary teams may be the evolution of new workforce roles, developed through the identification of service system gaps not always visible in multidisciplinary teams [23].

Self-treatment

A majority of participants had internal views, i.e., showed an attitude of taking personal responsibility for musculoskeletal disorders, and did not place responsibility for the management out of their own hands or onto employers. However, attributing shared responsibility between the self and medical professionals was also found [25]. For example, a home training program can make the patient take more active responsibility for their own body and their own problems. If the symptoms reoccur, the patient knows what to do and does not need any additional treatment [26].

Level of care

One advantage of interdisciplinary cooperation was that the patients had more of an opportunity to be treated at the appropriate level of care. Patients had a greater chance of being treated with extreme competence if they were treated at an adequate level of care, e.g., patients with lateral epicondylalgia should not be treated by orthopedic surgeons and physicians in the first place [26]. Patients should get the treatment at the appropriate level of care, which is described in the LEON principle as the lowest and most effective level of care [27]. Musculoskeletal disease is an area in which physiotherapists and occupational therapists can act as experts because that is their field of knowledge. Physicians must have competence in other areas like internal illness and may not have the skills of that special competence of muscles and occupational environment, e.g., ergonomics.

Quality of care

Quality of care is an expression that assesses whether or not the care meets expected goals [28]. Health care's efforts should be evaluated regarding science and evidence-based knowledge. Health care professionals should have this knowledge and be able to conduct their work according to this knowledge. The results should be evaluated and analyzed to be improved where necessary. Critical outcomes for decreased quality of care could result from a lack of resources that result in difficulties when a health care professional lacks the time and knowledge to appropriately cooperate. If insufficient treatment is provided by someone in an interdisciplinary team, the cooperative effort fails, and there is a decrease in the quality of care. There could also be communication problems; for example, different professionals provide contradictory information to patients, which will leave the patient in doubt of whom to trust [26].

Rehabilitation

Several articles have stated that most patients will improve with proper counseling and rest [29]. Although usually self-limiting, symptoms may persist for over one year in up to 20 % of the patients [30]. Smidt et al. [14] clearly confirm that lateral epicondylitis is a self-limited condition in most patients, based on the merging

of two prospective randomized trials [31, 32]. As it turns out, severe pain, an extended duration of symptoms, and the presence of concomitant neck pain at baseline are associated with higher pain scores at 12 months. Implications for the future management of lateral epicondylalgia should be in terms of a greater focus on interaction with the workplace regarding job modifications to reduce physical demands during recovery [33]. The patients should become more active in their own recovery process. They should be transitioned from the passive treatments into more active rehabilitation. In cases where patients are prevented from working, great care should be taken to activate and rehabilitate the patient [34].

Epistemological and ontological frame

Barbosa da Silva and Andersson thought it was important to separate methodological and ontological reduction because the latter cannot be described in biomedical terms [35]. Thus, ontological reduction is not encouraged in physiotherapy when interpreting research results [36].

The health of a patient can be based on an understanding from the complex indivisible whole (holistic approach) and from the parts (positivistic approach) at the same time. Even though the two approaches, holistic and positivistic, are rooted in different epistemological and ontological positions they should not be seen as contrasts. Qualitative and quantitative research methods complement each other because knowledge from both natural and human sciences is used. The target of physiotherapy as a field of science is to develop knowledge that can be applied to the practice of physiotherapy in order to enhance the well-being and the movement and functional capacities in people [36].

Empiricism

The term empirical was originally used to refer to some ancient Greek practitioners of medicine who rejected adherence to the dogmatic doctrines of the day, preferring instead to rely on the observation of phenomena as perceived in experience. What early philosophers described as empiricist and empirical research have in common is the dependence on observable data to formulate and test theories and come to conclusions. Empiricism is an inference of evidence-based practice and experience. It is based on research in reality, observations and experimental tests, and hence, experiences rather than predetermined theories.

My interest in this research area was established during my work as a physiotherapist in a health care center. I observed that the patients with lateral epicondylalgia had no structured way to be guided to the right level of care. Health care professionals did not know to whom they should refer the patient or sometimes how to treat the patient. Working together with an occupational therapist could be the most optimal way to treat a patient with the most common work-related disorder. There

are few studies in interdisciplinary treatments of musculoskeletal disorders and none in the treatment of lateral epicondylalgia. A treatment program that makes the patient active, managing the treatment at home with a minimum of therapeutic efforts, should be optional for health care centers with waiting lists for patients. I was interested in whether this was possible, and as my experience of how to treat patients with lateral epicondylalgia grew, my interest in conducting empirical research grew.

Social insurance in Sweden

The decision to issue sickness certification for a patient in Sweden should be based on the physician's assessment of the reduction in the patient's work capacity due to a disease or injury [37]. The Swedish Parliament has decided what social insurance should cover. The rules imply a "chain of rehabilitation" with clear time frames for the Swedish Social Insurance Agency to evaluate employees' work capacities.

Since 2007, each diagnosis has received a recommendation for the eventual sick-leave time. It is difficult to deviate from these frames. A limit has also been introduced for how long people can receive sick-leave payments, normally 364 days, after which people can apply for an extension of payments up to a maximum of 550 days. During the first 90 days of sick-leave, the first assessment of an employee's work capacity will be made. Another such assessment will follow after this period to determine whether the employee will ever be able to return to the workplace or will be in need of further rehabilitation, or whether another job will be more suitable. After 180 days, the Regional Social Insurance Office will estimate whether the employee is able to return to work and whether the person can find another job in the labor market. Compensation in the case of work incapacity can be obtained from the age of 19 years, and the so-called "sickness compensation" can be obtained by people aged between 30 and 64 years. You must apply to receive certain benefits. If you are employed, the first 14 days will be covered by the employer. After that, you can obtain sickness benefit when you no longer receive sick pay from your employer, i.e., if you are ill for a longer period than 14 days. The first sick day is a qualifying day, which means that you will not receive any sickness benefit for this day. If you are self-employed, you can choose a longer waiting period, which will reduce your social security contributions.

Everyone who is on sick-leave for more than seven days must have a doctor's certificate. The doctor's certificate is used by your employer and the Regional Social Insurance Office to assess whether you are entitled to sick pay and sickness benefit. It does not automatically entitle you to these benefits. Your doctor should describe in the certificate how the illness affects your work capacity and state how long you need to be on sick-leave. You can receive full, three-quarter, half

or a quarter sicknesses benefit depending on how much you must refrain from working. To avoid the period of sick-leave for the same diagnosis varying from doctor to doctor and in different parts of Sweden, there are recommendations stating the periods of sick-leave for different diagnoses [38].

Diagnose lateral epicondylalgia

Non-articular causes of elbow pain include muscle strains, ligamentous injuries, epicondylitis, olecranon bursitis, and compressive neuropathies. Overuse and trauma commonly cause these conditions. The history and physical examination differentiate them from an intra-articular process such as synovitis. To diagnose lateral epicondylalgia there are some tests that should be positive to be certain of the right diagnosis. Active and passive movements of the elbow are rarely decreased, though some pain could occur with complete extension, especially if the forearm is pronated [39]. Swelling is also seldom present.

This diagnosis could be difficult if one is not used to examining the patient according to the criteria for lateral epicondylalgia. There are several differential diagnoses, such as radial nerve entrapment, radiocapitellar chondromalacia or osteochondritis dissecans capitulum, that could be mistakenly given.

A diagnosis that is not correct could mean that the wrong treatment would be given to the patient, which may worsen the symptoms or leave the patient with no effectual treatment at all. Incorrect diagnosis could also mean that all of the patients in a study may not have the right diagnosis.

- Pain upon palpation of the lateral epicondyle and the common extensor origin.
- The “chair lifting test” or the “coffee cup test” in which the patient feels pain at the lateral epicondyle when picking up a full cup of coffee [40].
- “Mills’ test” in which full pronation combined with complete wrist and finger flexion prevents full elbow extension or, at least, a feeling of resistance at the elbow and pain at the epicondyle [41].
- “Maudsley’s test” or the “middle-finger test”, in which resisted extension of the middle finger when the elbow is fully extended and the forearm is pronated causes pain at the lateral epicondyle [42].

Disabilities from lateral epicondylalgia

Histopathological findings indicate that tennis elbow is a degenerative condition, called tendinosis, of the common extensor tendon, with the extensor carpi radialis brevis tendon more commonly implicated as the primary location of tendinosis. Despite the absence of inflammation, patients with tennis elbow still present with

pain [43] which affects the grip-strength in the hand. Musculus extensor carpi radialis brevis has its origin on the lateral epicondyle of humerus and insertion in the base of the third metacarpal bone. The muscle has a combined function as it flexes the elbow but also dorsal extends and radial deviates the hand at wrist. The extensor carpi radialis brevis tendon has a unique anatomic location that makes its undersurface vulnerable to contact and abrasion against the lateral edge of the capitulum during elbow motion [44]. As an extension of pain and decreased grip-strength, work may not be suitable for the patient, resulting in sick-leave.

Psychological factors

Low social support and depression are two other factors that could increase the problems and worsen the experience of pain [11, 45]. Aaron Antonovsky was a sociologist and academic whose work concerned the relationship between stress, health and well-being.

A key concept in Antonovsky's theory is how specific personal dispositions serve to make individuals more resilient to the stressors they encounter in daily life. Antonovsky identified these characteristics, which he claimed helped a person better cope and remain healthy by providing that person a "sense of coherence" about life and its challenges [46]. With less decision authority at work, the stressors may prolong the disease [47].

Evaluation forms

Available questionnaires

The Disabilities of the Arm, Shoulder and Hand (DASH)

The DASH is a self-reported questionnaire designed to measure upper limb disabilities and symptoms [48]. It uses a single-scale, 30-item questionnaire of upper extremity function and symptoms. The DASH Outcome Measure was jointly developed by the Institute for Work & Health and the American Academy of Orthopedic Surgeons (AAOS).

The minimum score is 30 points; the maximum score is 150 points. The DASH score is calculated as the total score minus 30 divided by 1.2 [49]. However, an optional module score may not be calculated if there are any missing items. It consists of 21 questions concerning special functional tasks with a five-degree in which 1 = no difficulty and 5 = unable to perform. The next two questions concern limitations to work activities and whether the patients have had to limit social activities. The next five questions concern pain, one regarding pain during night and the second regarding the capability to cope with the problem. A shorter version called the QuickDASH is also available. Both tools are valid, reliable

and responsive and can be used for clinical and/or research purposes. However, because the full DASH Outcome Measure provides greater precision, it may be the best choice for clinicians who wish to monitor arm pain and function in individual patients. The five-degree scale could be too small to achieve any changes.

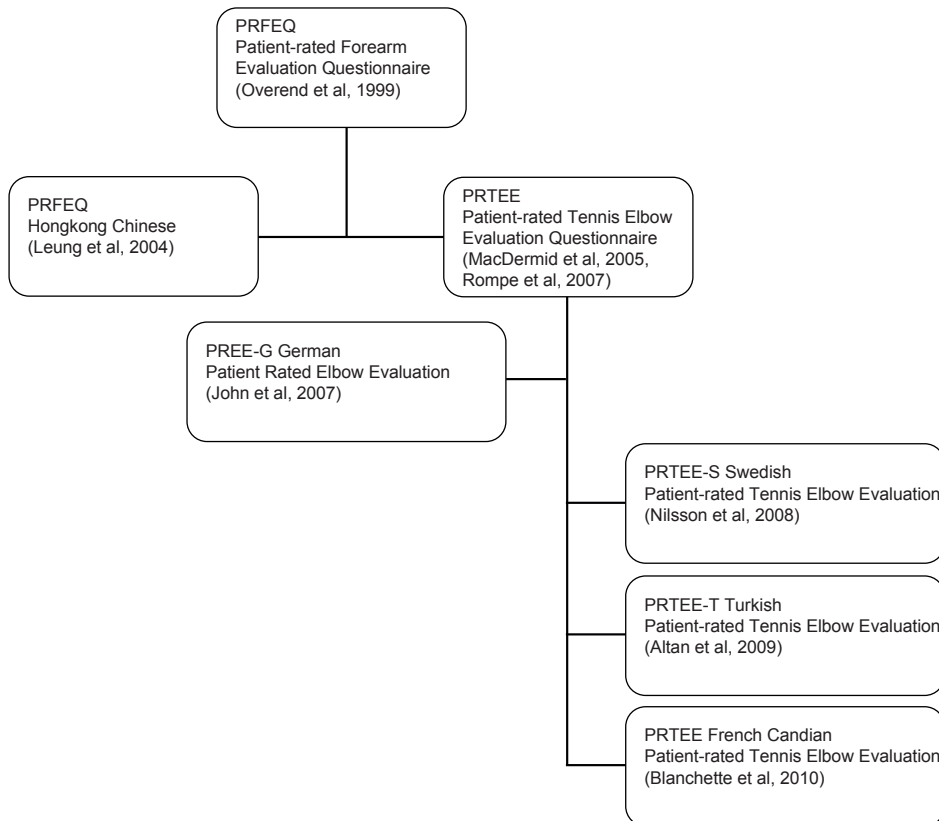


Figure 1. The Patient-rated Forearm Evaluation Questionnaire presents cross-cultural adaptations and translations

Patient-rated Forearm Evaluation Questionnaire (PRFEQ)

In Canada in 1999, a first questionnaire was developed that focused on the elbow, and not the hand or shoulder, and only on lateral problems. This questionnaire is called the “Patient-rated Forearm Evaluation Questionnaire” (PRFEQ) [50] and was generated in a similar fashion as the scale for the “Patient-rating of Wrist and Disability” [51]. The answers to each of the 15 questions in the questionnaire were given on a visual analogue scale from 0–10, where 0 indicates no pain/no problem with function, and 10 indicates worst pain conceivable/unable to carry out the function. The first five questions concern pain during the last week; the following six questions concern function over the last week for specific tasks

like “lifting a cup”, and the last four questions concern general function over the last week like “spare time, e.g., sport activities”. JC MacDermid was the developer of the PRFEQ, which was first published and used for a master’s thesis by Jen Wuori (supervisor JC MacDermid); the main thesis on bracing for tennis elbow was published later [52]. Dr. Tom Overend, a committee member, was the first to publish the reliability of the scale [50]. To assist with tool construction, the authors performed a literature review in which they looked at the physical requirements for performing a variety of functional activities and studies that had used standard patient questionnaires to evaluate the two basic outcomes, pain and function. The PRFEQ was based on two sources: Stratford et al. [53] and the wrist questionnaire mentioned above [51], which was used at the Hand and Upper Limb Center at St. Joseph’s Health Center in London. The questionnaire assessed patients’ subjective pain and functional disability for the previous week. It took only five minutes to complete the questionnaire, which provided a very quick way to assess the patients’ experiences regarding their elbow disease [50]. In 2005, the PRFEQ was considered to be the most reliable, reproducible and change-sensitive questionnaire for the lateral epicondyle. In this study, the PRFEQ was compared to the “Visual Analogue Scale” (VAS), the DASH, the Medical Outcomes Study 36-item Short-Form Health Survey and the pain-free grip strength measurement.

Newcomer et al. recommend that the PRFEQ should be used as a standard outcome measure in research on lateral epicondylalgia [54]. In 2005, the PRFEQ was updated slightly by the developer JC MacDermid to accommodate findings from different research groups and to improve clarity. Some words were changed so that it could be used all over the world. For example, the question concerning the function “carrying a grocery bag” was updated to “carrying a grocery bag or a brief-case by the handle”, which is a more up-to-date question and may even apply better to both genders [55]. The scoring of this questionnaire is consistent with the “Patient-rated Wrist Evaluation” and “Patient-Elbow Evaluation”. This questionnaire, not to be misleading in the desired outcome, was now called the “Patient-Tennis Elbow Evaluation”. In 2007, this updated version was validated and considered to be reliable for this disease [56]. It is always difficult to compare studies when different measures are used. A universally used clinical outcome, based on this questionnaire, would make it easier to compare the effects of treatment and possibly facilitate the decision making regarding the best way to treat patients.

The PRFEQ was translated into Hong Kong Chinese [57], and because the updated PRTEE version has already been written in English, translating it into Swedish would make for a third language and would serve as a way to spread this form of evaluation throughout Scandinavia. To the authors’ knowledge, there was no such questionnaire in Sweden. In 2007, John et al. translated PREE into German,

and the German questionnaire became PREE-G [58]. This questionnaire is not as specialized for lateral epicondylalgia as the PRTEE, which was translated into Turkish in 2009 [59] and in 2010 into French-Canadian [60] (Fig 1).

Liverpool Elbow Score (LES)

LES was developed in tertiary care and has not yet been tested in primary health care. This questionnaire has been validated and tested for reliability and sensitivity to changes with good results. However, this questionnaire was developed for orthopedic surgeons first. It consists of a patient-answered questionnaire (PAQ) with nine questions and a clinical assessment with six questions. The questionnaire has been tested on 63 patients in which the diagnosis of rheumatoid arthritis and osteoarthritis dominated (n=33), and only eight patients with lateral epicondylalgia were represented. This questionnaire is easy to fill out, but a large disadvantage is that it cannot be completed by mail because it also includes six questions that require a professional to be present. That limits the questionnaire because it cannot be easily used in follow-up studies [61]. In 2007, LES was tested if it could be used as a postal questionnaire for the assessment of outcomes after total elbow arthroplasty with good results, but it was still not specific to the lateral side of the elbow, instead focusing on surgical results [62].

Mayo Elbow Performance Score (MEPS)

MEPS is another elbow questionnaire developed and used mostly by orthopedic surgeons [63]. It consists of four parts: pain, motion, stability and function. For the pain section, patients can choose among four different intensities (none, mild, moderate, or severe) by checking a box. The motion concerns the degree of the arc of motion in the elbow (>100, 50-100, <50). The stability concerns the stability of the elbow joint (stable, moderate instability or grossly unstable). Finally, the section that is most comparable to the PRFEQ and LES concerns five different tasks, all combined with activity of daily life, such as combing hair, for which the patient checks the box for what he/she is able to do. This total gives a score that matches excellent, good, fair and poor. MEPS is not as precise as LES and PRFEQ and is more concentrated on daily life in general and not on specific tasks that you might do in your spare time. A weakness is also that it is a clinician-completed score.

Visual Analogue Scale (VAS)

VAS is probably the most common scale for evaluating pain of different kinds in different parts of the body [64]. It can also be used as a functional scale. VAS is a response scale that can be used in questionnaires. It is a measurement instrument for subjective characteristics or attitudes that cannot be directly measured. From the patient's perspective, this spectrum appears continuous; for example, their pain does not take discrete jumps, as a categorization of none, mild, moderate and

severe would suggest, as in MEPS. The VAS was devised to capture this idea of an underlying continuum. Operationally, a VAS is usually a horizontal line, 100 mm in length, anchored by word descriptors at each end. When responding to a VAS item, respondents specify their level of agreement to a statement by indicating a position along a continuous line between two end-points, such as 0= no pain and 100= worst pain ever. The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimeters from the left-hand end of the line to the point that the patient marks.

During the initial use of the VAS instrument, the patient marked a line with a pen. This was sometimes considered difficult for the patients, and therefore, Choinière et al. developed the Visual Analogue Thermometer (VAT) [65]. The difference is that it consists of a rigid plastic cardboard strip of white color with a horizontal black opening, 10 cm long by 2 cm wide. The left and right extremities of this opening are identified by the expressions “no pain” and “unbearable pain”. The opening is covered with a red opaque band that slides from left to right by means of a strip located on the back of the thermometer. On the back, there is a 10-cm ruler graduated to the nearest mm with the extremities corresponding to the exact demarcation limits.

To facilitate understanding, the research assistant explains to the subject that the device is like a thermometer except that instead of measuring body temperature in degrees, it measures pain intensity. As the strip is moved across the opening, the increasing intensity of pain is shown by the red band [65]. This is probably the most common way to evaluate pain in primary health care today. Because such an assessment is clearly highly subjective, these scales are of most value when looking at change within individuals and are of less value for comparing across a group of individuals at one time point. It could be argued that a VAS is trying to produce interval/ratio data out of subjective values that are at best ordinal [66].

Roles & Maudsley Score

The Roles & Maudsley score has four gradations: 1 = excellent, meaning no pain with full movement and full activity; 2 = good, meaning occasional discomfort with full movement and full activity; 3 = fair, meaning some discomfort after prolonged activity; and 4 = poor, meaning pain and limited activity [42]. This score was developed for orthopedic surgeons to evaluate pain, function and activities at the same time. Stratification into only four levels of severity, however, lacks sensitivity to document changes in clinical condition. In contrast, measuring the strength of the handgrip or measuring forearm endurance are objective methods, although they cannot document the impact of the condition on daily function [57].

Cross-cultural adaptation

Cross-cultural adaptations of questionnaires are needed in multilingual research, but little is known about the effectiveness of specific translation methods. Perneger et al. compared a rapid translation developed over three months in Geneva in 1992 (Geneva version). It was based on three initial translations, one synthesis, and two pre-tests with a comprehensive adaptation developed by the International Quality of Life Assessment Project between 1991 and 1994 (IQOLA version), which involved back-translations, focus groups, the development of equidistant response options, item difficulty and quality ratings, and multiple pre-tests.

A majority of known-group comparisons were compatible with theory, for both versions. In conclusion, the two versions had similar psychometric properties, despite extensive differences in the development process. This suggests that a moderately resource-intensive translation may produce adequate results [67].

The translation and adaptation group carried out a review of the most common culture adaptation processes. These were the American Association of Orthopedic Surgeons (AAOS), the Association of Test Publishers, the EORTC group, the Euro QoL group (EuroQoL Group, unpublished), the Evidence: Clinical and Pharmaceutical Research, the FACIT group, the Health Outcomes group (HOG), the Health Utilities Inc. (HUInc), the International Quality of Life Assessment (IQOLA) group, the Kidney Disease Quality of Life (KDQOL), the Medical Outcomes Trust (MOT) and the World Health Organization [68].

The steps for all the adaptations were as follows: preparation, in which the initial work carried out before the translation work begins; forward translation, the translation of the original language, also called source, version of the instrument into another language, often called the target language; reconciliation, the comparison and merging of more than one forward translation into a single forward translation; back translation, the translation of the new language version back into the original language; back translation review, the comparison of the back-translated versions of the instrument with the original to highlight and investigate discrepancies between the original and the reconciled translation, which is then revised during the process issue resolution; harmonization, the comparison of back translations of multiple language versions with each other and the original instrument to highlight discrepancies between the original and its derivative translations and to achieve a consistent approach to translation problems; cognitive debriefing, testing the instrument on a small group of relevant patients or lay people in order to test alternative wording and to check understandability, interpretation, and cultural relevance of the translation; review of cognitive debriefing results and finalization, the comparison of the patients' or lay persons' interpretation of the translation with the original version to highlight and amend discrepancies; proofreading, final

review of the translation to highlight and correct any typographic, grammatical or other errors; and the final report, which is written at the end of the process to document the development of each translation.

Overall, they found more areas of agreement on principles of good practice than disagreement. The areas of greatest disparity were reconciliation and approaches to harmonization because of the widely differing approaches to carrying out those steps [68]. Beaton et al. developed an easy and structured way to perform cross-cultural adaptation and translation that has been widely used in several studies [69]. Its steps are easy to understand and provide the translator a well-described and established guideline to follow.

Grip strength

Patients with lateral epicondylalgia have problems with activities that include gripping, such as gripping a cup of coffee. Therefore, grip strength is useful as an outcome measure and gives a quantitative measure of the treatment results [70]. It can also be used as a motivation factor because the outcome gives the patient instant feedback when a follow-up control is done. The two most commonly used are represented here.

Dynamometer

The grip strength can be tested in two ways when using a dynamometer. In the “pain-free grip strength” test, the patients are supposed to slowly squeeze a dynamometer until they begin to feel discomfort. The pain-free grip strength is measured three times, and the mean value is calculated and used for analysis. In the “maximum grip strength” test, the patient is asked to squeeze the dynamometer as hard as they can three times, with short rest in between. The maximum value is used for analysis [71]. It could be measured with both flexed elbow or extended elbow. With the later alternative, the test is more painful [72]. It could also be measured in five different grips, and studies have shown that both men and women have the highest grip strength in position three. Bechtol [73] showed that men have greater grip strength in position three but women in position two. Harkonen recommends that, to secure the evaluation, the measurement should be in all positions [74]. This could be time demanding and difficult to present.

GRIPPIT

GRIPPIT is an electronic hand-power gauge whose precision and inter-observer reliability have shown to be high [75]. The GRIPPIT consists of an elliptical handle with electronic force transducers based on strain gauges and a base on which an arm guide is mounted. The strength is automatically recorded every half second. The mean value is a value of all recordings over this time and is therefore a measure of stamina over 10 seconds. The GRIPPIT is placed on a table

with the patients seated in front of the instrument upright in an adjustable chair with feet supported. The patient's forearm is placed in the arm support. Hence, the shoulder joint was positioned at 10–15 degrees and the elbow joint at 75–85 degrees of flexion. The grip handle mounted on the fixed base and the use of the forearm guide ensured that the wrist and hand were placed in a position that was minimally affected by gravity. The measurement process is performed over 10 seconds and indicates a maximum, mean and final value. The patient cannot see the results, and the measurement should be performed twice to guarantee that the patient has understood what to do. It is easy to perform but requires that the instrument to be in one place; it cannot be moved to another room or it might need to be recalibrated. This test is also used as an evaluating factor in the Test Instrument for the Profile of Physical Ability, which is often used among Swedish physiotherapists and occupational therapists [76].

Outcome measures

Pain

Pain is one of the most common reasons for seeking medical advice [77]. Lateral epicondylalgia defines a condition of varying degrees of pain or point tenderness on or near the lateral epicondyle. The International Association for the Study of Pain (IASP) [78] defines pain as the following:

“An unpleasant experience associated with actual or potential tissue damage or described in terms of such damage”

Pain is, in other words, associated with emotional and psychological reactions and is a sensation that cannot be evaluated objectively. The pain experience includes several components: first the sensational function, then reaction (affective) and finally cognitive components. [79]. The literature often describes pain in four well-established categories.

Nociceptive pain This kind of pain can be somatic and results from injury to part of the body such as bones, joints and soft tissues. It is usually well localized. Visceral pain results from the internal organs. It is not as well localized as somatic pain.

Neuropathic pain This kind of pain results from injury to nerves in either the central nervous system or the peripheral body.

Psykogen pain Pain that depends on psychological factors.

Idiopathic pain Pain that cannot be related to currently known pathophysiological mechanisms.

There are mainly two categories concerning pain duration, acute and chronic. Acute pain is the type of pain that comes on suddenly and signals that something is wrong. Chronic pain is the type of pain that results when the underlying cause of pain cannot be treated. It has usually been on-going for more than three months. It is persistent and sometimes debilitating.

Function

In an acute injury, the body undergoes an inflammatory response. Special inflammatory cells make their way to the injured tissues to help them heal. However, lateral epicondylalgia does not involve inflammation [13]. Instead of inflammatory cells, the body produces a type of cells called fibroblasts [80]. When this happens, the collagen loses its strength. The tears try to heal, but constant strain and overuse keep re-injuring the tendon. In chronic medial epicondylalgia, muscle function and pain measures show a less-impaired function of the arm than in chronic lateral epicondylalgia. Peak torque and produced work in wrist flexion are significantly reduced. Supination and pronation are also reduced by 10-15%. Chronic lateral epicondylalgia produces a significant limitation in the muscle function of the hand, wrist and forearm, and the limitations tend to correlate with disability rather than with pain [81].

The International Classification of Disease (ICD-10) produced by the World Health Organization in 1993 distinguishes between etiology, pathology and manifestations of disease but is based principally on etiology. The International Classification of Impairments, Disabilities and Handicaps, WHO classification from 1980, now ICF [82], is partly based on the ICD but differs from it in several respects. It recognizes impairment as an exteriorized loss of structure or abnormality of function at the organ level, disability as a restriction of actions at the person level and handicap as a set of disadvantages within the individual's particular social context. Thus, three different levels are involved with, in most cases, impairment leading to disability and disability leading to handicap [83] (Fig 2).

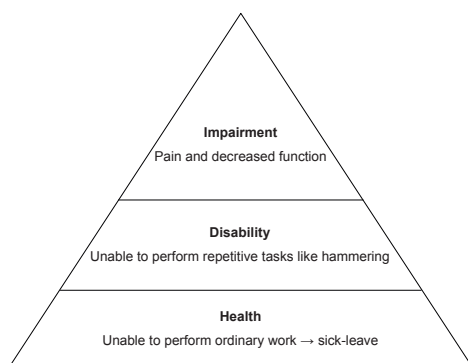


Figure 2. Example of classification for lateral epicondylalgia in “International Classification of Functioning, Disability and Health” (ICF)

Sick-leave

The socio-economic costs for a certain disease or a certain health problem include direct costs, which result from the treatment given, but also indirect costs that result from loss of productivity from sick-leave. The strongest predictors for sickness certification were patient's and GP's assessments of reduced work capacity [37]. A Swedish study revealed that a majority of physicians prescribed sick-leave in combination with anti-inflammatory treatment or cortisone injections [34]. Upper extremity disorders are prevalent in working populations. In a Finnish study with 168 participants, 56 % self-reported a productivity loss. Productivity loss was associated with pain intensity, pain interference with work or fear-avoidance beliefs [84].

The most common work-related disorder at the elbow is lateral epicondylalgia [43]. An interaction was found between repetitive movements of the arms and forceful activities for the risk of lateral epicondylalgia, which is relatively common among working-age individuals in the general population. Physical load factors, smoking, and obesity could be determinants of epicondylalgia [2]. In Quebec alone, over 1500 workers have made claims to the Worker's Compensation Board for lateral epicondyle pain, which generated a cost of \$8000 CDN and an average of 62 days of work absenteeism [85]. It is also prevalent in individuals who perform a combination of forceful and repetitive activities in their daily life or in their spare time, including athletes and wheelchair users [43]. It is important to start rehabilitation early. Long periods of sick leave are generally counterproductive [86].

Treatment methods

Corticosteroid injections

Corticosteroid injections, together with NSAIDs, are the two most common treatment therapies among GPs in Swedish primary health care [24, 34]. The injection of corticosteroid inside the tendon has a deleterious effect on the tendon tissue and should be carefully used [87]. Verhaar et al. compared the effects of local corticosteroid injections with physiotherapy as advocated by Cyriax in the treatment of tennis elbow. At six weeks, the corticosteroid injections had decreased the pain and improved the grip strength. They recommended this treatment because it is a rapid way to treat lateral epicondylalgia [88]. Several studies have shown that there exists a short-term relief from pain [32, 89]. A review by Barr et al. suggested that corticosteroid injections are effective at the short-term follow-up, and physiotherapeutic interventions are effective at the intermediate and long-term follow-ups [90]. Bisset et al. found that corticosteroid injections were statistically and clinically superior at six weeks but significantly worse at 52 weeks compared to wait-and-see and physiotherapy [91]. In the long-term (six months),

a corticosteroid injection did not provide a clinically significant improvement in the outcome of lateral epicondylalgia, and rehabilitation was suggested to be the first line of treatment in patients with a short duration of symptoms [92]. However, there is a trend for symptoms to recur some months after steroid injection [31, 93]. Patients with chronic lateral epicondylalgia should not be given this treatment at all, because there is virtually no inflammation present in the chronic stage, the use of anti-inflammatory treatment must be questioned [34, 94]. There are several side effects reported in combination with corticosteroid injections. For example post-injection flare, facial flushing, and skin and fat atrophy are the most common side effects [95].

Non-Steroidal Anti-Inflammatory Drugs (NSAID)

NSAID are, together with the above-mentioned corticosteroid injections, the most common treatment among GPs in Swedish primary health care [24, 34]. They can be given both orally or in gels for muscle and soft tissue treatments. Ibuprofen gel has been not shown to be an effective treatment for muscle soreness [96]. Adequate studies are lacking to show a benefit of oral NSAIDs past four weeks, and there are surprisingly few studies showing positive results. There are several side effects, most of them from digesting, such as complaints of abdominal pain with oral diclofenac [97]. In the chronic stage of lateral epicondylalgia, there is no evidence for the treatment at all [34, 94].

Acupuncture

Acupuncture involves the stimulation of specific points by the insertion of needles. In its original form, acupuncture was based on the principles of traditional Chinese medicine. Traditional acupuncturists understand health in terms of a vital force or energy called “Qi”, which circulates among the organs along channels called meridians. Health care professionals who use acupuncture could vary a lot regarding how the treatment is performed. The same disorder or even the same patient could be treated differently according to particular acupuncture points chosen, the depth and duration of needling, and the method and intensity of needle stimulation [98]. In Sweden, physiotherapists treating patients with acupuncture reported side effects. Minor bleeding or hematoma were reported following nearly one in five treatments, and other minor adverse effects such as fatigue or sweating were rare. There were no serious complications [99]. The Cochrane review series concluded that there was insufficient evidence to support the use of acupuncture to achieve long-term results for lateral epicondyle pain. However, the results did indicate that acupuncture provided a short-term relief [100].

Ultrasound

Ultrasound therapy uses high-energy sound waves (above the range we hear) to help ease painful joints and muscles. Ultrasound treatment is performed by

guiding the waves into the body from the head of an ultrasound machine. When sound waves come into contact with air, it causes a dissipation of the waves, and so a special ultrasound gel is placed on the skin to ensure maximal contact between the treatment head and the surface of the skin. Sound waves penetrate the muscles to cause deep tissue/muscle warming. This promotes tissue relaxation and therefore is useful in treating muscle tightness and spasms. The warming effect of the sound waves also causes vessel vasodilatation and increases circulation to the area that assists in healing. A review revealed insufficient evidence to provide a scientific foundation for the clinical use of therapeutic ultrasound for the treatment of people with pain and soft tissue injury [101]. Haker et al. treated patients with lateral epicondylalgia with pulsed ultrasound or placebo for ten minutes, two to three times/week for ten treatments in total. There was no significant difference in relation to subjective or objective outcomes between the groups after the treatment period or at the one year follow-up, and ultrasound could therefore not be recommended for lateral epicondylalgia [102]. This conclusion is based on the absence of evidence for a biological rationale for the use of therapeutic ultrasound [101].

Braces

Forearm bracing

Lateral counter-force bracing is believed to reduce the magnitude of muscle contraction, which in turn reduces the degree of muscle tension in the region of muscular attachment. The counter-force brace is essentially an inelastic cuff that is worn around the proximal forearm, against the forearm extensors. In theory, the brace constrains full muscle expansion when the muscle contracts and diminishes muscle activity, and therefore the force generated by the muscle. A forearm counterforce brace has no effect on strength, but it increases the pain threshold [103].

Hand orthosis

The results show that, in patients with lateral epicondylitis, a brace has a shorter beneficial effect than ultrasound and laser therapy in reducing pain [104]. Physical therapy was superior to brace only at six weeks for pain, disability, and satisfaction. Contrarily, brace-only treatment was superior for the ability to perform daily activities. Combination treatment was superior to braces for the severity of complaints, disability, and satisfaction. At 26 weeks and 52 weeks, no significant differences were identified, and conflicting results were found. Brace treatment might be useful as an initial therapy. Combination therapy has no additional advantage compared to physical therapy but is superior to braces only for the short term [105]. The wrist extension splint allows a greater degree of pain relief than does the forearm strap brace for patients with acute lateral epicondylalgia [106].

Although the epicondyle bandage was not found to be superior to the wrist splint in another study, the suggestion is that it could be favored over the splint because it is more practical and cosmetically acceptable [107]. Brace treatment compared to no-bracing resulted in significant pain reduction, improved functionality of the arm, and improvement in the pain-free grip strength, and these beneficial effects were sustained for 24 weeks [108].

Night bandage

A night bandage that prevented the elbow from being held in flexion could ease pain during night and prevent pain when trying to extend the elbow in the morning. The bandage was made of a soft bandage and a neoprene plastic plate that was kept in the crook of the arm. If the patients had forearm strength higher than the mean value (women: right arm 236 N, left arm 224 N; men: right arm 433 N, left arm 393 N), they were not given a night-bandage because this could cause stasis, which would impair the treatment [109].

Ergonomics

Hong et al. recommends an evaluation of environmental factors influencing outcomes and an assessment of patient and work-related factors that may explain the course of symptoms, thereby alleviating disability and costs [110]. A systematic review of the literature was conducted on the associations between the type of work, physical load and psychosocial aspects at work and the occurrence of specific elbow disorders. Repetitive movements >2 h/day were associated with lateral epicondylalgia [111]. The frequency of forceful exertion or a combination of forearm supination and forceful lifting were significant physical factors and should be considered for prevention strategies [112]. The usual adjustments for computer workers, such as keyboards with an alternative force-displacement of the keys or an alternative geometry, have limited evidence for their effectiveness [113]. Management should perhaps focus on work stations, postures, and behaviors [114]. However, other studies have shown that adjusting the working environment before returning to work would reduce the risk for recurrence [109, 115].

Training programs

There is evidence that exercise is a key component of a management strategy [12]. Studies have shown the importance of eccentric training [116] and stretching, but there is uncertainty whether concentric training is less effective than eccentric training [117]. Patients that performed stretching had less pain and less palpation tenderness and had better range of motion compared to patients with elbow braces [118]. Training programs consisting of eccentric, concentric and isometric exercises combined with stretching have been shown to be an effective treatment for the management of lateral epicondylalgia [109]. A passive standardized rehabilitation program compared to eccentric exercises based on the repetitive

lengthening of the active musculo-tendinous unit showed a more marked reduction of pain intensity, mainly after one month of treatment, an absence of strength deficit on the involved side through bilateral comparison for the forearm supinator and wrist extensor muscles, an improvement in the tendon image as demonstrated by decreasing thickness, a recovered homogenous tendon structure and a more marked improvement in disability status during occupational, spare time and sports activities [119]. Progressive exercise showed beneficial long-term effects compared to ultrasound treatment in terms of pain alleviation and working ability, and the functional overall condition of the patients was also better. Exercise may be able to prevent chronicity and should hence be tried and recommended [120].

Others

A review has determined, with exception from the above-mentioned, that a number of treatments, including manipulations and mobilizations, phonophoresis, Rebox and ionization with diclofenac, all show positive effects in the reduction of pain or improvement in function for patients with lateral epicondylalgia [121]. There is also evidence showing laser therapy and pulsed electromagnetic field therapy to be ineffective in the management of this condition [122]. Another study reported low-level laser therapy to be more effective than the brace and ultrasound treatment in improving grip strength according to a study from Oken et al. [104].

Deep Transverse Friction must be applied transversely to the specific tissue involved, unlike superficial massage given in the longitudinal direction parallel to the vessels, which enhances circulation and the return of fluids. Cyriax and Cyriax used Deep Transverse Friction in combination with Mill's manipulation, which is performed immediately after the friction treatment. For it to be considered a Cyriax intervention, the two components must be used together in the order mentioned. Patients must follow the protocol three times a week for four weeks. This treatment demands several visits to the health care professional and places considerable strain on the therapists hands [123, 124].

Even Botulinum injections have been studied in Hong-Kong, but the side effects were too severe. Botulinum toxin injection may improve pain over a three-month period in some patients with lateral epicondylalgia, but injections may be associated with digit paresis and weakness of finger extension [125]. Initial treatment should be conservative and is successful in up to 90 % of cases. Surgical treatment of lateral epicondylalgia should be used only as a last resort. Both open and arthroscopic methods are acceptable, and their results are considered to be excellent [126].

Summary of problem areas

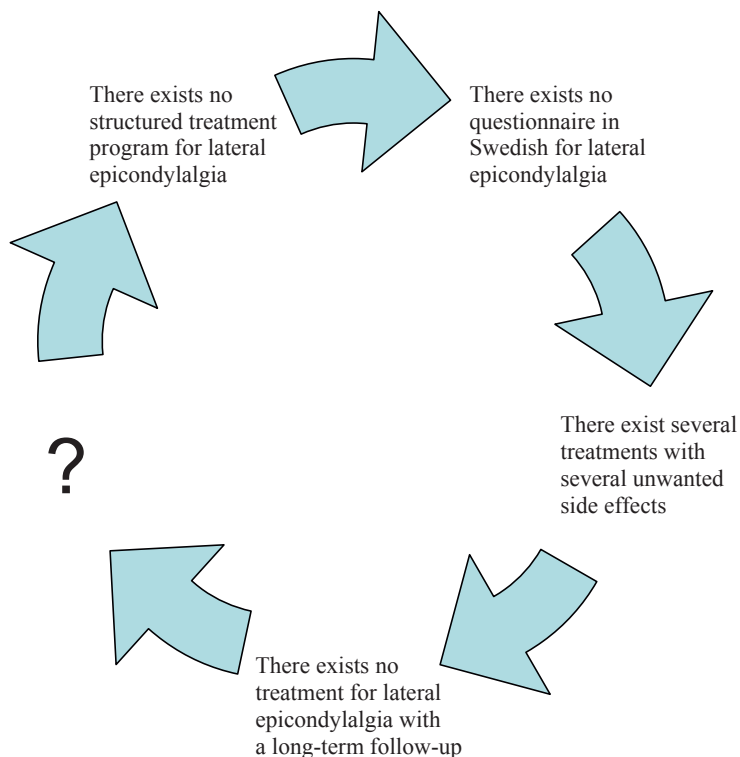


Figure 3. Summary of problem areas

- There exist many different treatments for lateral epicondylalgia, but there exists no structured treatment program, effective over both the short and long term.
- There exists no Swedish questionnaire specific for the elbow to evaluate treatment and to be used in research.
- The most common treatments in primary health care are corticosteroid injection and NSAID, which has several well-known side effects.
- There is often confusion on where to refer patients with lateral epicondylalgia. No structured rehabilitation method exists. Treatment for lateral epicondylalgia is most commonly performed by general practitioners and not by physiotherapists and/or occupational therapists, who are considered to be the appropriate level of care. No structured cooperation exists.

Hypotheses

- Pain and function loss can decrease with a structured home training program.
- A questionnaire, specific for lateral epicondylalgia, can be used for Swedish-speaking patients in both the clinic and research.
- Unwanted side effects from, for example, corticosteroid injections can be avoided.
- A structured treatment can benefit health care professionals, who could provide treatment at the appropriate level of care. Physiotherapists can work interdisciplinarily together with occupational therapists for an effective way to treat the patient.

Aims of the studies and the thesis

Overall aim of the thesis: This thesis evaluates a new structured treatment program with an interdisciplinary approach in order to find an effective method to treat, both over the short term and long term, and to cross-culturally adapt and translate a questionnaire into Swedish for evaluation of lateral epicondylalgia.

- I** The aim of this study was to evaluate a new multidisciplinary structured home training program for patients with lateral epicondylalgia compared to conventional attendance with a short-term follow-up.
- II** The aim of this study was to translate and cross-culturally adapt the questionnaire “Patient-rated Tennis Elbow Evaluation” into Swedish PRTEE-S, “Patientenskattad Utvärdering av Tennisarmbåge”, and to evaluate the reliability and validity of the questionnaire.
- III** The aim of this study was to describe health care professionals’ treatment choices, their cooperation with other professionals and their perceptions regarding the treatment of acute lateral epicondylalgia.
- IV** The aim of this study was to evaluate whether patients with lateral epicondylalgia, two years after they were treated by a structured program, had less pain or functional loss and if recurrent episodes and sick-leave days differed compared to a control group.

Methods

An overview of the studies included in this thesis can be seen below (Tab I).

Study	I	II	III	IV
Design	Prospective design	Translation and cross-cultural adaption	Qualitative and quantitative content analysis	Prospective design
Study population	78 persons	54 persons	321 persons	297 persons
Data collection	Questionnaire	Questionnaire	Survey	Two questionnaires
	Grip strength	Impairment score		
	Sickness certification data			Sickness certification data
Data analysis	Analytical statistics	Analytical statistics	Qualitative and quantitative content analysis	Analytical statistics

Table I. Methods used in the studies in this thesis

Design

A prospective design was used for studies I and IV. A cross-cultural adaptation and translation design was used in study II, and a combined descriptive quantitative and qualitative design was used in study III (Tab I).



Figure 4. Temporal aspects of data collection in the studies

Settings

All four studies were performed in southwest Sweden in the county of Halland. The intervention group was recruited from two health care centers, one in a suburban area 14 kilometers from a medium-sized city, and the other located in a medium-sized city. The control group was recruited from three other health care centers located in another medium-sized city (I). The group increased (IV) as the years went by because it was a follow-up study, and the control group also increased by recruiting patients from four additional health care centers in the same county (Fig 4). In study II, the study group was recruited from one health care center in a suburban area and one in a medium-sized city. A referral from a GP was needed (I, II, IV). The inclusion criterion for these studies was that all patients had the diagnosis code M77.1 [127]. The study group (III) was recruited from health care professionals in the county of Halland. The inclusion criterion was that all participants were orthopedic surgeons, general practitioners, occupational therapists or physical therapists. The exclusion criteria were any physical or mental diseases that resulted in difficulties in answering and understanding the questionnaire and age less than 18 years.

Study population

The study population consisted of a total of 297 patients (IV), including 78 patients from study I, and all were patients who had been diagnosed with lateral epicondylalgia, according to ICD 10, with the diagnosis code M77.1 [127] (Fig 5). In study II, some of the patients were the same as in study IV, but the study population was expanded as patients were recruited from other health care centers than those in study IV. All of the patients were recruited from primary health care centers. Study III consisted of 321 health care professionals and was a total study population from the county of Halland.

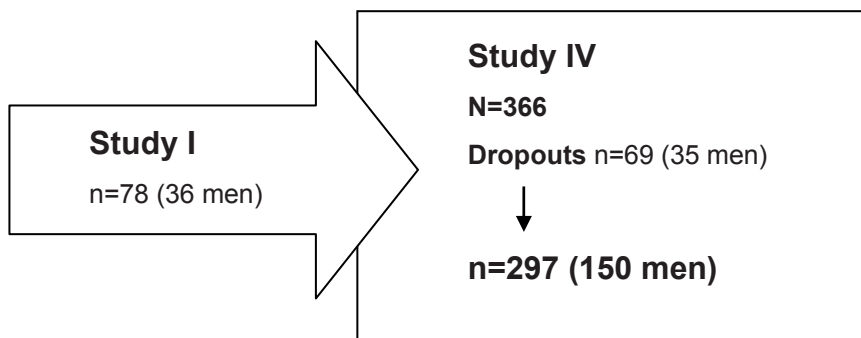


Figure 5. Patient flow for studies I and IV

Study population	Study I		Study II	Study III	Study IV	
	Interv. Group	Control group			Interv. group	Control group
Gender	27 men 24 women	9 men 18 women	29 men 25 women	119 men 202 women	55 men 48 women	95 men 99 women
Age range	32-74 years	36-67 years	20-74 years	26-67 years	19-74 years	25-85 years
Mean	48 years	48 years	46 years	48 years	50 years	52 years

Table II. Study population for study I-IV: age and gender. The study population consisted of patients in studies I, II and IV and health care professionals in study III

Study I and IV

The study group consisted of 78 patients (I) (Tab II). The intervention group consisted of 51 patients (27 men and 24 women). The age range was 32–74 years (mean 47.9 years), and 53 % were industrial workers [128]. The control group consisted of 27 patients (9 men and 18 women). The age range was 36-67 years (mean 48.2 years), and 88 % were industrial workers [128]. They were all evaluated three times. The intervention group and the control group were not equal regarding pain and function at baseline, therefore the changes within the groups, between the visits, were used for measurements (Tab III). In the intervention group, the second visit was completed by 47 patients, and 43 patients attended the third visit and completed the whole study. In the intervention group, the total numbers of dropouts were eight patients. The reasons for dropout were work (50 %) and cortisone injections (25 %), and the last 25 % declined to continue the study. In the control group, 24 patients completed the second visit, but on the third visit another 12 patients in the control group failed to appear. The total study was completed by 12 patients in the control group. At baseline, there were significant differences between the intervention group and the control group. The evaluation was therefore done by comparing the differences within the same group and comparing the difference variable with the control group.

Compliance with the home training program was checked verbally during the second and third sessions and was in the majority very good to fair. The total dropout in the control group was 15 patients. The reasons for dropouts were that 93 % declined to continue and 7 % had moved from the area. The dropouts among the controls (n=12) were compared with those who completed the third session (n=12), and there were no significant differences between those groups.

In the follow-up study two years later (IV), the intervention group consisted of same patients as in the first study, but the group was increased over the years, and new patients were recruited from four additional health care centers in the same county, resulting in a total group of 366 patients (Fig 5). Those who did not answer the questionnaire were regarded as dropouts. The inclusion criterion was all patients with lateral epicondylalgia who visited the chosen health care centers two years ago. The response frequency was 83 % in the intervention group, which consisted of 124 patients (67 men and 57 women). The response frequency was 80 % in the control group, which consisted of 242 patients (118 men and 124 women) (Tab II). The dropout analysis showed no statistical differences between the study group and dropouts regarding gender. There was a difference in the mean age between dropouts and the study group (47 vs. 51 years), which showed that non-participating patients were younger.

	n	Median (IQR)	p-värde
Grip Strength			
Intervention group	51	249 (137, 437)	0.112
Control group	27	202 (86, 266)	
Pain Score			
Intervention group	51	25 (21, 28)	0.008
Control group	27	29 (25,35)	
Function Score			
Intervention group	51	37 (30,48)	0.001
Control group	27	64 (39, 73)	
Overall			
Intervention group	51	62 (50, 79)	0.001
Control group	27	91 (64, 102)	

Table III. Descriptive statistics of baseline data (I). Comparison between the intervention group and the control group.

Study II

Physiotherapists, occupational therapists, and general practitioners at eight different health care centers in southwest Sweden asked patients with unilateral epicondylalgia if they were willing to participate in this study. All of the patients provided oral and written informed consent for this study. None of the patients had ever filled out a questionnaire concerning their forearm or elbow before. The

group consisted of 54 persons, 25 women and 29 men. The mean age was 46 years. Nine persons were on sick-leave, and 45 persons were working normally without any changes resulting from their symptoms. All of the patients who were asked to participate chose to do so, and they all completed both questionnaires. There were no dropouts (Tab II).

Study III

This was a total population study with no exclusions. All physicians, physiotherapists, occupational therapists and orthopedic surgeons who worked in primary health care, a private care setting or at hospital were invited to participate. The questionnaire was sent to a total of 391 individuals, including 144 general practitioners, 155 physiotherapists, 62 occupational therapists and 30 orthopedic surgeons. There was a response rate of 82 % in this study. After the first letter was sent, 65 % of the participants returned their questionnaire. After a reminder letter was sent, an additional 69 participants responded. There were 70 dropouts, leaving a total of 202 women and 119 men that responded (Tab II). All of the participating occupational therapists were female, and all of the participating orthopedic surgeons were male. The physicians were nearly equal regarding gender, and in the physiotherapist group, 83 % were female. The majority of the study group, 73 %, worked in the public financed health care centers. Physicians and physiotherapists had the highest rate of private practice participants (33 % and 35 %, respectively). A total of 70-80 % of the study population had >11 years of experience in their field (Tab IV).

Occupation	Whole study group (n=391)	Dropout		Study group		Answers n=321 (% of the whole study group)	Years of service			Organisation private/public	Treats acute lateral epicondylalgia yes/no
		Men	Women	Men	Women		1-5	6-10	>11		
General Practitioner	144	26	9	69	40	109 (34%)	5	9	91	36/73	99/9
Orthopedic surgeon	30	1	2	27	0	27 (8%)	1	5	20	3/22	21/5
Occupational therapist	62	0	11	0	51	51 (16%)	4	13	33	1/49	33/18
Physiotherapist	155	10	11	23	111	134 (42%)	9	9	114	46/86	105/29

Table IV. Study population in study III

Evaluation methods

Treatment and cooperation survey (III)

A survey questionnaire was used. The questionnaire consisted of 21 questions pertaining cooperation and treatments of lateral epicondylalgia. It contained 18 dichotomous, multiple-response, multiple-choice questions and three open-ended questions. We analyzed the first four questions, which described the baseline characteristics of the study group, addressing the individuals' profession, gender, number of years in practice and practice setting (private versus public). The next eight questions addressed if or in what way their LE patients were rehabilitated and potential treatment risks. The next four questions addressed if and in what way multidisciplinary cooperation existed and the advantages and disadvantages of this. Those questions were combined with three open-ended questions in which the participants were asked to describe, in their own words, their perception of the risks associated with the treatment and the advantages and/or disadvantages of cooperation.

The last question gave the participants a chance to make any comments they wished about the questionnaire itself. Face validity was assessed with a pilot questionnaire that was administrated to ten physiotherapists and occupational therapists to ensure that the respondents interpreted the questions in the same way as the constructor. No changes were made because the pilot group found the questionnaire easy to understand and interpret.

Open-ended questions

Are there any risks with your treatment of lateral epicondylalgia (yes/no).
Which?

Is there any advantage in working with another health care professional when treating lateral epicondylalgia? (yes/no).
What?

Is there any disadvantage in working with another health care professional when treating lateral epicondylalgia? (yes/no).
What?

PRFEQ for pain and function (I, IV)

Pain and function were evaluated using the PRFEQ [50]. The PRFEQ has been scientifically tested and found to be valid and reliable for this purpose [50]. The PRFEQ is reliable, reproducible, and sensitive in the assessment of lateral epicondylitis and has previously been recommended to be used as a standard outcome measure in lateral epicondylitis research [54]. The answers to each of the 15 questions in the questionnaire were given on a visual analogue scale

from 0–10, where 0 = no pain/no problem with function and 10 = worst pain conceivable/unable to carry out the function. The PRFEQ was used in two of the studies (I, IV). This instrument measures pain and function concerning the elbow over the previous week. In study I, this was measured three times; at baseline, after four weeks and after another 12 weeks. In the follow-up (IV), the PRFEQ was filled in two years after the first visit to the health care center.

Cross-cultural adaptation (II)

The questionnaire DASH and the Roles & Maudsley score were used to evaluate a new translated and culturally adapted questionnaire, the PRTEE-S (II). The cross-cultural adaptation was made according to well-established guidelines in five stages by Beaton et al [69].

The first stage is adaptation in the forward translation. Three translators translated the PRTEE from English to Swedish. In the second stage, syntheses of the translations were performed by three other individuals. This stage was accompanied by a written report documenting the synthesis process, any uncertainties, and how these uncertainties were resolved. All of the translators' solutions were taken into consideration when performing the syntheses. In the third stage, a back translation was made from Swedish into English. Working from the synthesized version of the questionnaire, and completely blind to the original version of the PRTEE, three persons translated the questionnaire back into the English language. The fourth stage, a consensus of the back translations was performed by an expert committee of five individuals. All of the previous translators' versions of the PRTEE were taken into consideration. The committee reviewed every detail and every discrepancy among the previous translations and performed a pre-final version of the PRTEE-S.

Beaton suggested four equivalences to be checked: Semantic equivalence, that the words should have only one meaning so as not to confuse the patients; grammar; idiomatic equivalence, or a check of all the colloquialisms, which turned out not to be an issue; and experiential equivalence, which means that the items and experiences of daily life were checked and that the language was adapted. For example, a question concerning “turning a doorknob” does not work in Sweden, where there are no such doorknobs. The correct task would be “turning a door handle or a key”. Finally, conceptual equivalence was verified by checking the original PRTEE and the back-translated questionnaires for all equivalences. The translators in the expert committee had to verify that the final questionnaire would be understood by the equivalent of a 12-year-old (Grade 6 reading level) as is the general recommendation for questionnaires [69]. The fifth stage, the final stage of this cross-cultural adaptation and translation process was the pre-test of the pre-final PRTEE, also referred to as face validity. Ten healthy individuals and ten

individuals with the diagnosis of lateral epicondylitis were tested with the pre-final PRTEE, which was now called the PRTEE-S (Patientskattad Utvärdering av Tennisarmbåge). Each of the volunteers completed the questionnaire and was asked if there were any words or sentences that were difficult to understand. For each question, they were asked what they thought the question meant. Both the meaning of the items, the tasks and the chosen responses were discussed. This stage ensured that the pre-final version still retained adequate equivalence in purpose. All of the questions were considered to be easy to understand by all the participants who filled out the questionnaire. There were no words that were difficult to understand, nor any sentences that did not seem adequate to fit the types of symptoms or functional problems of lateral epicondylalgia.

Validity (II,III)

Construct validity has to do with to what extent the questionnaire supports predefined hypotheses and also the degree to which the questionnaire relates to other established and accepted questionnaires. In the present context, we assessed a particular component of construct validity, called convergent validity, by measuring the correlation with other established and accepted questionnaires; for this assessment, we used Pearson's correlation coefficient. We considered that the score should correlate well with the Roles & Maudsley and with DASH.

The DASH, is a validated questionnaire designed to measure upper limb disabilities and symptoms [49]. It uses a single-scale, 30-item questionnaire of upper extremity function and symptoms. The minimum sum score is 30 points; the maximum score is 150 points. The DASH score is calculated as the total score minus 30 and then divided by 1.2. The DASH is an instrument that also contains questions that has to do with topics other than pain and function. To correlate correctly with the pain and function section, only the parts from the DASH that contained those questions were used. The DASH score was divided into symptom questions (questions 24–29) to correlate it with the pain sub-scale (questions 1–5). The DASH score was also divided into a function sub-scale (questions 1–21) to correlate it with the PRTEE-S function sub-scale (questions 6–15).

The Roles & Maudsley score has four gradations: excellent means no pain, full movement, full activity; good means occasional discomfort, full movement, full activity; fair means some discomfort after prolonged activity; and poor means pain and limited activities. The patients were asked to complete both the DASH and the PRTEE-S, and a health care professional assessed the Roles & Maudsley score. This procedure was completed twice with 30 minutes between the sessions. During the break, the patient was treated as usual and was evaluated by GRIPPIT or had the opportunity to discuss their treatment with the health care professional. Face validity was checked by testing the PRTEE-S in ten patients with unilateral epicondylalgia and in ten healthy individuals.

To increase trustworthiness (III), all of the steps of this analysis were critically and carefully scrutinized and read by the multidisciplinary research group, first alone and then as a group. The results were thoroughly discussed in the analysis process. The analysis constantly moved between the original texts and the various levels of abstraction to ensure that no data were excluded or included under more than one category. This analyzing process was used to validate the qualitative content analysis as described by Graneheim et al [129].

Reliability (II)

Internal consistency was assessed by administering the instrument to a group of patients on one occasion and estimating to what extent the items yielded similar results. This method is a way of testing the homogeneity in the questionnaire. For this test, we used Cronbach's alpha coefficient, a value which assumes that each actual item represents a retest of a single notional item and also the correlation between each individual item and the overall score.

Test-retest reliability (reproducibility) was assessed by administering the test to the same sample on two different occasions, with 30 minutes between the occasions, on the assumption that there will be no substantial change in what is measured. This technique tests the stability in the questionnaire. This property was assessed using Pearson's correlation coefficient. The ICCs were interpreted based on the subjective categories described by Fleiss [130]. ICCs of 0.00-0.40 was poor, 0.40-0.75= fair to good and greater than 0.75 = excellent.

Grip strength (I)

Grip strength has been shown to be associated with other measures of functional disability in patients with LE [131]. Strength and stamina were measured by GRIPPIT, which is an electronic hand-power gauge whose precision and inter-observer reliability have been shown to be high [75]. The GRIPPIT consists of an elliptical handle with electronic force transducers based on strain gauges and a base on which an arm guide is mounted. The strength is automatically recorded every half second. The mean value is a value of all recordings over this time and is therefore a measure of the stamina over 10 seconds. The GRIPPIT was placed on a table in front of the patient; the patient was seated upright in an adjustable chair with their feet supported. The patient's forearm was placed in the arm support. Hence, the shoulder joint was positioned in 10–15° and the elbow joint in 75–85° of flexion. The grip handle was mounted on the fixed base, and the use of the forearm guide ensured that the wrist and hand were placed in a position that was minimally affected by gravity. The measure process was performed over 10 seconds and indicated the maximum, mean and final values. The mean value has been used in the analyses (I). Grip strength was not checked in study IV.

Sick-leave (I, IV)

Sick-leave absence was collected via the regional Social Insurance Office, during the four months of treatment and the six months after the last treatment (I). In the follow-up, the sick-leave absence was collected for the two years after the first visit at the health care center for lateral epicondylalgia, and sick-leave absence was self-reported and elicited when the patient first got the diagnosis two years earlier and at the time s/he filled in the questionnaire (IV). Details of sick-leave specifically for lateral epicondylitis were collected via the Regional Social Insurance Office with permission from the patients (I). Sick-leave data for lateral epicondylalgia were also collected six months after the treatment period was finished. In the follow-up study, patients reported their sick-leave two years earlier at the time for first treatment for lateral epicondylalgia and at the time they filled in the questionnaire (IV).

Recurrence rates and additional therapy (IV)

Recurrence rates and whether the patient had a need for additional therapy were also studied. The patients answered questions two years after their first visit at the health care center regarding lateral epicondylalgia. Specifically, they were asked whether they had had any period of recurrence of lateral epicondylalgia during the last two years. If they had had any periods of recurrence, they were asked if they had received any treatment.

Treatment methods

Treatment for the intervention group (I, IV)

Patients in the intervention group were first examined by a GP who made the diagnosis of lateral epicondylalgia according to clinical guidelines. The patient was then referred to a physiotherapist and an occupational therapist for further treatment.

The patients in the intervention group were treated three times by the same physiotherapist and occupational therapist, working in cooperation, on each occasion for half an hour. At the first session, the patients received written instructions for the home training program and written ergonomic advice for both their place of work and their home environment by the physiotherapist (Fig 6). The patients also received, when necessary, wrist supports and/or night bandages from the occupational therapist. If the patients had forearm strength higher than the mean value (women: right arm 236 N, left arm 224 N; men: right arm 433 N, left arm 393 N) [75], they were not given a night-bandage because this implement could cause stasis, which would impair the treatment. The written home training program lasted 15 minutes and consisted of eccentric and concentric training of the flexor and extensor muscles, static fitness training, and stretching to be

performed three times daily over four months. All the patients were offered a wrist bandage to use as a wrist-support in their work, but only when necessary and for the purpose of relieving the pressure on the muscles of the wrist.

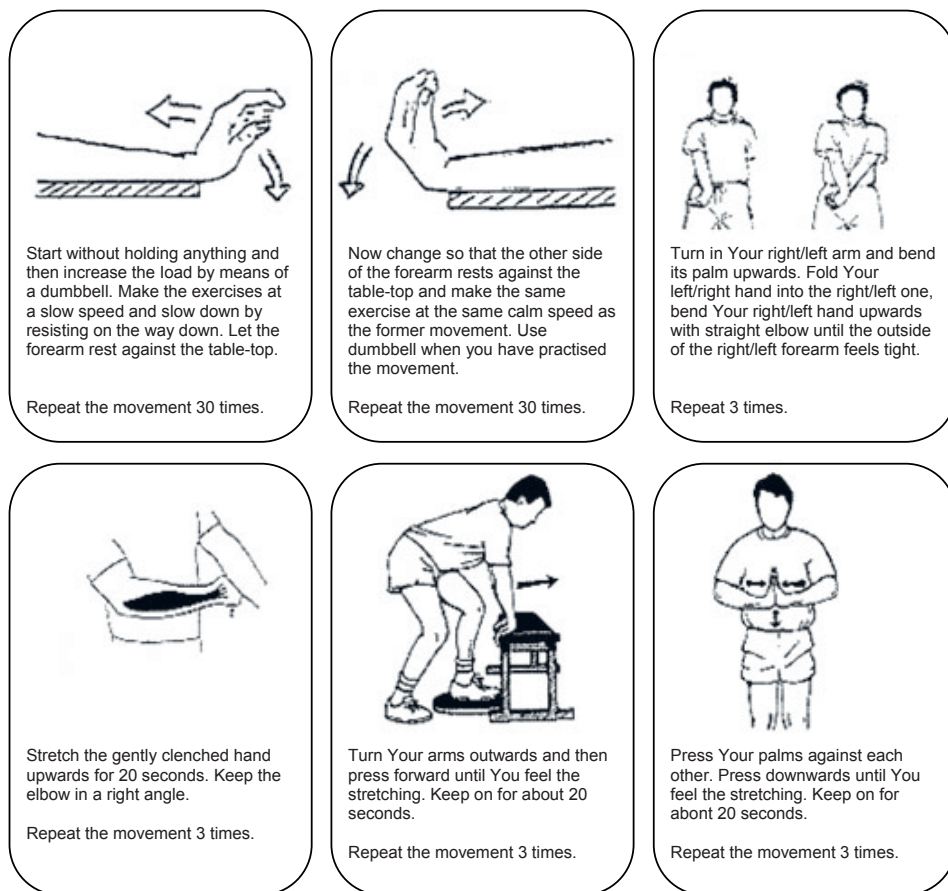


Figure 6. Home training program for the intervention group

Treatment for the control group (I, IV)

The patients in the control group did not receive any standardized program but were treated pragmatically, depending on their presented symptoms, with corticosteroid injections, anti-inflammatory drugs, gel or physical therapy according to established practice [132]. There was no guidance regarding the choice of treatment in the control group. The only guidance was the health care professional's own education. The choice depended only upon the patients' symptoms and the professionals treating them.

Data analysis

The Mann-Whitney test was used to compare the intervention group with the control group at three occasions: baseline, 4 weeks and 16 weeks in grip-strength and from the questionnaire PRFEQ concerning pain and function (I). The changes in scores in the groups were observed. To compare the dropouts with the participants in the control group (I), the Mann-Whitney test was also used, with a significance level at 0.05. This test is non-parametric and should be used when the variables have an order of rank or if the variable distribution is skewed.

The Chi-square test was used to analyze the number of people with sick-leave for lateral epicondylalgia to compare sick-leave absence between the two groups (I) during the four months of treatment and six months after treatment. The chi-square test was also used to check the frequencies of recidivism (IV). Additionally, it was used if the patients needed any more/other treatment to compare the groups with each other where the study variables were dichotomized. The chi-square test was used to compare the patients' sick-leave in this study. This test should be used with nominal data. The level of significance was set to 0.05.

Intra-class correlation coefficient was used in the test-retest reliability for the PRTEE-S (pain, function, overall score) (ICC). Variance components for the calculation of the ICC were interpreted based on the subjective categories described by Fleiss [130]. ICC s of 0.00 to 0.40 were considered to be "poor", 0.40 to 0.75 "fair to good", and greater than 0.75 "excellent".

Cronbach's alpha was used to determine the internal consistency of the questionnaire (II). When a questionnaire is used in a clinical setting, an alpha coefficient of at least 0.9 is recommended [133].

Spearman's Correlation coefficient was used to determine the criterion/construct (convergent) validity of the cross-adapted questionnaire PRTEE-S by analyzing the relationship between the PRTEE-S scores with the scores from the DASH questionnaire and the Roles & Maudsley score (II).

Cross-tab statistics was used (III) to analyze the responses to the 18 dichotomous, multiple responses and multiple choice questions in the questionnaire. Cross-tab statistics was also used to describe the study group and the drop-outs (IV).

Qualitative content analysis was used to analyze the results of the three open-ended questions (III). Quantification of these data was performed to obtain a sense of the numerical values of the perceptions [129]. Qualitative content analysis is a suitable method to use when the purpose of a study is to extract the content of a text, as it facilitates the identification and categorization of the information,

without changing its meaning. The method shows similarities and differences in the material. The analysis yielded results that were proportionately close to the written text, and the contextual coherence created the meaning. The advantage of qualitative content analysis is that it is suitable for analyzing different levels of text-like short answers to open-ended questions in a questionnaire as in the present study [129]. The three open-ended questions were analyzed in several steps. First, the responses were read by the first author (PN) several times to gain a sense of the overarching meaning [129]. Second, as the answers to each question were short, the whole answer was chosen to be the meaning unit and did not need to be condensed.

The meaning units were entered into an analysis matrix to again, get a sense of the overarching meaning. Third, the meaning units were abstracted into codes. Fourth, the codes were compared based on differences and similarities and were divided into sub-categories and categories (Table VI). The sub-categories were not pre-determined. Instead, they were derived from the text. Fifth, all codes were quantified to verify the frequency of the perceptions (Table VI). To increase trustworthiness, all the steps of this analysis were critically and carefully scrutinized and read by the multi-professional research group, first alone and then as a group. We thoroughly discussed the analysis process that was used. The analysis constantly moved between the original texts and the various levels of abstraction to ensure that no data were excluded or included under more than one category.

Student's t-test was used to compare the intervention group with the control group regarding the pain and function based on the answers in the questionnaire PRFEQ (IV) two years after intervention. This test should be used to compare parametric (in pairs) means.

Ethical considerations

The Ethics Committee of Gothenburg University, Sweden, approved study I (Ö 116-00). Permission was obtained from the operating manager of the regional Social Insurance Office for extraction of non-identifiable data from patient sick-reports with written permission from the patients. All the patients were asked by the GP and were given information regarding the study before attending the sessions. All of the patients gave their oral permission to participate. Written informed consent was gathered from the participants after the treatment period regarding sick-leave absence. The Research Ethics Committee of the Medical Faculty of Lund University (H4 197/2007) approved study II. The ethical committee was asked verbally for approval of study III, but as this study was performed to develop an organized way to treat lateral epicondylalgia, it did not require approval. The director of the health care center approved of the study. The Ethics Committee of

Lund University, Sweden, approved study IV (H4 196/2007). The patients did not give their written consent, but the questionnaires were sent out on voluntary basis, and those who chose not to answer were regarded as drop-outs.

Results

Survey with qualitative and quantitative content analysis (III)

The quantitative part of the study concerned the different treatments chosen and on what basis the participant chose treatment for acute lateral epicondylalgia. This analysis was conducted by counting and describing the treatments chosen in percents.

The two most commonly chosen treatments for the GPs and orthopedic surgeons were cortico-steroid injections and NSAIDs. Almost half of the GPs and the orthopedic surgeons (45 %) felt that there could be a risk associated with methods used when treating LE. The vast majority of GPs (73 %), orthopedic surgeons (92 %) and occupational therapists (79 %) based their treatment choices on their own experience. The occupational therapists' first-line therapy was bracelets, but the majority of all professionals used combined treatments. Notably, only 16 % thought that there could be a risk with their kind of treatment. Physiotherapists differed with regard to this response; 52 % based their choice on scientific results and 39 % on their own experience.

Almost all of the physiotherapists (87 %) were trained in acupuncture, a method which was chosen by 30 % of this group as their first-line therapy. Only 13 % thought there was any risk with their choice of treatment. The GPs and the orthopedic surgeons were the two groups that cooperated most often with physiotherapists, but physicians also cooperated with occupational therapists. The physiotherapists cooperated most often with the GPs and/or occupational therapists but had the lowest rate of cooperation. The advantages of cooperation were considered to be great and the disadvantages few (Table V).

There were three open-ended questions for which the participants could write anything connected to the question. Not all of the open questions were answered by all participants. These questions were analyzed by qualitative content analysis. The first question pertained to risks associated with treatment and was answered by 41 % of the GPs, 41 % of the orthopedic surgeons, 13% of the physiotherapists and less than 1 % of the occupational therapists. The second question, which pertained to the advantages of cooperation was answered by 77 % of the GPs, 63 % of the orthopedic surgeons, 65 % of the physiotherapists and 64 % of the occupational therapists. The third question, which pertained to the disadvantages of cooperation, was answered by less than 1 % of the GPs, none of the orthopedic surgeons, 0.5 % of the physiotherapists and less than 1 % of the occupational therapists.

Almost every individual experienced an advantage working in cooperation with another health care professional, and few individuals experienced disadvantages.

Profession	First choice of treatment for acute lateral epicondylalgia											Number who cooperates with other professions n	Yes	Number who sees advantages with cooperation n	Yes	Number who sees disadvantages with cooperation n	No
	n	Cortisone	NSAID	Acupuncture	Training program	Wrist braces incl special epicondylitis-bandage	Ergonomics	Other*	Refer to other profession	Combining different treatments							
Orthopaedic surgeon	22	6	0	0	6	1	3	1	5	16	21	19	21	18	21		
General Practitioner	108	29	26	1	15	5	12	3	17	88	106	103	105	100	104		
Physiotherapist	106	1	0	32	35	0	30	8	0	100	106	88	103	95	104		
Occupational therapist	33	0	0	0	7	13	13	0	0	33	34	32	34	34	34		
Total	269	36	26	33	63	19	58	12	22	237	267	242	263	247	263	254	

Table V. Treatment and cooperation choices for Lateral Epicondylalgia with advantages and disadvantages

*deep frictions, laser, manipulation, ultrasound, expectants

Open-ended questions (III)

The data from the qualitative content analysis of the three questions resulted in a total of five categories: right level of care; increased quality of care; decreased quality of care; side effects and inadequate treatment as well as included 13 sub-categories and 53 codes (Table VI).

Right level of care (III)

This category describes the respondents' perceptions that one advantage of interdisciplinary cooperation was that the patients had more of an opportunity to be treated at the right level of care. That meant that patients had a greater chance of being treated with extreme-competence at an adequate level of care (Tab VI).

Quality of care (III)

Increased quality of care was one of the categories, which described participants' perceptions of working as part of an interdisciplinary team included their feeling that patients could be treated with broader competence, meaning that broader spectrums of treatment methods including several different competences were available to patients, and this access increased the quality of the care. A second opinion from another profession was an opportunity to obtain secure follow-up to assess whether or not the treatment was effective, and this process resulted in secure high quality of care. This subcategory had the highest quantification rate of all categories. Decreased quality of care describes the participants' perceptions of problems that can arise due to cooperation. Lack of resources resulted in difficulties when the participant lacked the time and knowledge to appropriately cooperate. If insufficient treatment is provided by someone in the interdisciplinary team, the cooperative effort fails, and there is a decrease in the quality of care (Tab VI).

Side effects (III)

The category describes the participants' perceptions of the risks of unwanted side effects associated with different treatment options. The summative quantification pertaining to side effects was greater for corticosteroids and NSAID use (Tab VII).

Inadequate treatment (III)

This category describes the participants' perceptions pertaining to the risk of administering inappropriate treatment methods for a patient's diagnosis. Inappropriate treatments could include treatments that are administered in an inappropriate way and those that are inappropriate for the patient diagnosis (Tab VII).

Common treatments (III,IV)

In the control group (IV) the two most common treatments were corticosteroid injections, (31 %) and NSAID (35 %), which confirms the answers of study III where these two treatments also were the most common among the GPs as 27 % chose corticosteroid injections as a first choice treatment for acute lateral epicondylalgia and 24 % chose NSAID. Of the 67 patients in the control group (IV) who were treated with NSAIDs, 59 % combined this treatment with another treatment, such as a training program, wrist support, acupuncture and/or cortisone. Of the 60 patients in control group who were treated with corticosteroid injections, 47 % combined this therapy with acupuncture, training program, wrist support, heat pack, acupressure and/or NSAIDs. Other treatments that were combined were training program, wrist support, acupuncture, massage and worm therapy, which was the treatment for 10 patients in the control group.

Quotations	Code (n)	Subcategory (n)	Category (n)	
<i>Better extreme-competence by some other professions</i>	Better competence (7)	Extreme-competence (9) Adequate level of care (7)	Right level of care (16)	
<i>Better experience-area</i>	Better experience (2)			
<i>Epicondylitis should not be treated by surgery – thus not a case for an orthopedic surgeon</i>	Case for rehabilitation (7)			
<i>Good with the same methods but possible to complement each other</i>	Complementary treatments (76)	Broader competence (174)	Increased quality of care (240)	
<i>Take advantage of each professions different knowledge; what I don't know others may do better for example acupuncture</i>	Broader range of treatments (32)			
<i>To use various competences</i>	Various competences (23)			
<i>To get a good result from the treatment for the patient</i>	Good treatment effect (14)			
<i>May take care of more areas that the patient may need to get help for</i>	Holistic perspective (11)			
<i>Collected competence and in common view of the patient for successful rehabilitation</i>	Synergy (9)			
<i>More eyes and more ears see and hear more than two</i>	More eyes sees more (3)			
<i>Better information/treatment of more "power" by more professions</i>	More power to the treatment (3)			
<i>The patient get better informed and ability to understand that it takes time to get well</i>	Better information (3)			
<i>Faster caretaking optimize better progress of the rehabilitation</i>	Faster/better care (16)			Faster rehabilitation (27)
<i>Taking care of more united with different treatment possibilities means hopefully faster recovery</i>	Faster treatment effect (11)			
<i>Few options to discuss results and how to proceed</i>	Exchange of experiences (11)			Secure high quality of care (39)
<i>Always good with a second opinion</i>	Second opinion (8)			
<i>Feed-back gives faster information of effect or lack of effect of the treatment</i>	Opportunity to follow-up (8)			
<i>It is always an advantage to get another view of a case</i>	Another view of the case (4)			
<i>The same/rather like information from different occupation groups</i>	Unanimous consensus (5)	Security for the patient (3)		
<i>Security for the patient</i>	Security for the patient (3)			
<i>We have no time for telephone calls</i>	Lack of time (4)	Lack of resources (7)	Decreased quality of care (13)	
<i>Difficult to reach cooperating person</i>	Unavailability (3)			
<i>If you do not think the same and not cooperate there is a possibility of different information to the patient</i>	Contradictory treatment (5)	Insufficient treatment (6)		
<i>The knowledge of where to place the injection of cortisone may differ</i>	Insufficient competence (1)			

Table VI. Examples of the analysis process regarding advantages and disadvantages with cooperation with another health care professional

Quotations	Code (n)	Subcategory (n)	Category (n)	
Injection treatment – atrophies in skin and muscle tendons	Atrophy (27)	Side effects from treatment with cortisone (58)	Side effects (85)	
Injections of cortisone may damage	Unspecified side effects from cortisone (19)			
Multiple injections of cortisone may cause necrotic tissues	Necrosis (4)			
Increasing pain	Increasing pain (3)			
Cortisone may cause rupture	Ruptur of tendon (2)			
The patient quickly gets better and forgets the problems and the restrictions of activity	Overload (1)			
Decreasing strength in the muscle due to repeated injections of cortisone	Decreased muscle strength (1)			
Infektion from injektion	Infection from injection (1)			
NSAID have several well known severe side effects especially gastrointestinal ones	Gastrointestinal problems (8)			Side effects from treatment with NSAID (18)
Customary side effects from NSAID	Unspecified side effects from NSAID use (4)			
The patient overload if treated by NSAID	Overload (3)			
NSAID used during for a long time may give severe side effects for example damage of the kidneys	Renal damage (1)			
Risk to medicalize = over treatment	Overtreatment (1)			
Asthma by NSAID	Asthma attack (1)	Side effects from other treatments (9)		
Hematoma because of acupuncture	Hematoma (3)			
Ultra sonor may make the trouble even worse	Increasing pain (2)			
Active heavy muscle training	Overload (2)			
Weakness in muscles if treated by orthosis	Muscle weakness (1)			
Passive treatment may cause habitation to the therapist	Habitation to the therapist (1)	Wrong treatment (7)	Inadequate treatment (15)	
If cured by cortisone injections without ergonomic consideration may cause the risk for chronic recidivism of the pain	Progression to chronic disease (3)			
You have to deal with the reason to the problem	Missing the original cause (1)			
Wrong manipulation may cause damage to nerves	Nerve damage (2)			
When using orthosis you have to be aware of that there will be another movement in the shoulder	Incorrect pattern of motion (1)			
Commonly bad information of restrictions after injections of cortisone	Incorrect information (1)			
Wrong treatment when acute symptoms. A lot of patients get undertreated and are too passive during sick leave.	Undertreatment (1)			
Not adequate treatment make acute symptoms chronic	Prolonged elbow difficulties (1)			
No cure	No treatment effect (1)			
Wrong diagnose means treatment for epicondylitis even though the patient suffers from another kind of pain.	Insufficient diagnostics (1)			Wrong diagnosis (4)
If you miss another differential diagnosis. I do not use any methods which may cause side effects	Differential diagnosis (3)			

Table VII. Examples of the analysis process regarding perceptions among health care professions regarding the risks associated with the treatment of acute lateral epicondylalgia

Cross-cultural adaptation (II)

The cross-cultural adaptation was done as described by Beaton et al (Fig 7). There were no large issues to discuss during the analysis process and all of the translators agreed on the final version. The adaptation was further on pre-tested using ten healthy individuals and ten patients with no changes. Because all of the pretesters could understand the questions without having to ask for the interpretation, the face validity of the PRTEE-S was considered good (App 1).

Validity (II)

The pain sub-scale, the function sub-scale, and the overall score from the PRTEE-S each showed significant correlations with the DASH score ($p < 0.0001$). The PRTEE-S sub-scales showed significant correlation ($p < 0.0001$) with the DASH score when the DASH score was divided into symptom questions (questions 24–29) to correlate it with the pain sub-scale (questions 1–5) using Spearman's correlation factor (r) 0.79. The DASH score was then divided into a function sub-scale (questions 1–21) to correlate it with the PRTEE-S function sub-scale (questions 6–15), which was also significant in correlation ($p < 0.0001$) and $r = 0.90$. This technique had been used recently in a German cross-cultural adaptation, reliability, and validity study of the PREE (Patient-rated Elbow Evaluation) questionnaire [134], a measure which has some similarities to the PRTEE [58]. The results were significant ($p < 0.0001$), correlating DASH overall with PRTEE-S overall, $r = 0.88$. The correlations between the PRTEE-S and the Roles & Maudsley score were also significant in both the pain and the function sub-scales as well as in the overall score ($p < 0.0001$). Spearman's correlation factor strives to be 1. The best score occurred in the correlation between the DASH function section and the PRTEE-S overall ($r = 0.91$).

Reliability (II)

The test-retest reliability was calculated for all of the individual questions, for the separate pain and function sub-scales, and for the overall PRTEE-S score with all 15 questions. The intraclass correlation coefficient (ICC) was excellent for all of the individual questions. According to Fleiss [130], ICC over > 0.75 is concerned to be excellent, ICC 0.40-0.75 is "fair to good" and ICC under 0.40 is "poor". For the function sub-scale, the ICC was excellent (ICC's > 0.95), and the pain subscale also showed excellent results (ICC > 0.78). The total questionnaire ICC scores (overall pain + function) was excellent (ICC's > 0.95). This result shows the stability in the PRTEE-S questionnaire, which was excellent. The test-retest correlation showed the highest reliability for question 12 (0.99) on the function sub-scale and was the lowest for question 5 (0.88) "when the pain was worse" on the pain sub-scale. The highest intraclass correlation coefficient for the pain subscale was found for question 4, "opening a jar" (0.96), and for the function sub-scale question 12, "personal care activities" (i.e., dressing and washing) (0.99). In

the overall score, where the pain and function sub-scales are combined, the ICC was excellent (ICC's > 0.95).

The Cronbach's alpha coefficients were high for both the pain and function sub-scales (0.84 and 0.93, respectively). The coefficient for the overall PRTEE-S was excellent (0.94).

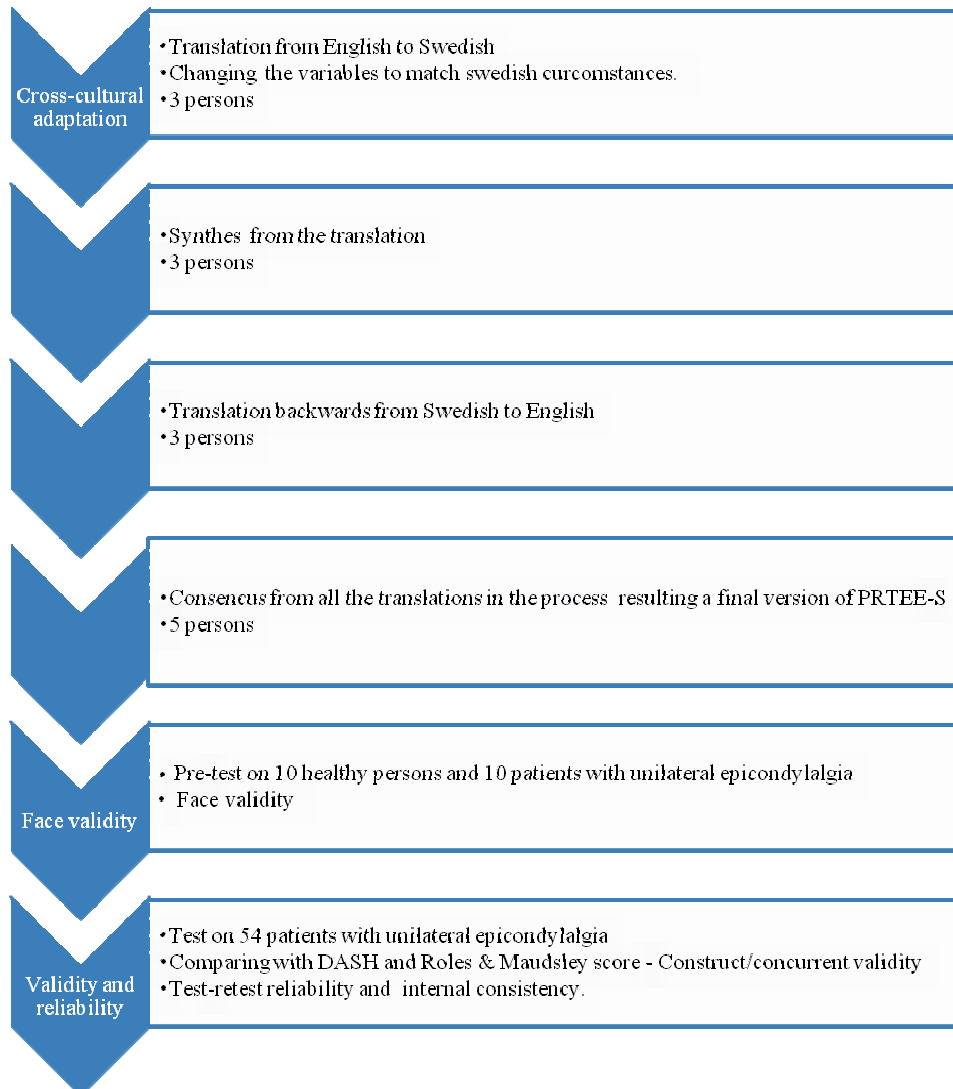


Fig 7. Cross-cultural adaptation assessing PRTEE-S
(Beaton, Bombardier, Guillemin, Ferraz, Spine 2000)

Outcome measures (I, IV)

Pain

After four weeks of treatment, the intervention group (I) had significantly less pain ($p=0.04$) than the controls. The pain decreased more in the intervention group after 16 weeks, but this decrease was not significant.

In the follow-up study (IV), 54 % of the study group still experienced pain ($n=297$) two years after the last visit to the primary health care center, but there were no significant differences comparing the intervention group with the control group concerning whether the patients had any pain at all, meaning a score greater than 1 in the questionnaire's pain section (Tab VIII). The intervention group had significantly less pain than controls ($p<0.0001$) (Tab VIII). When comparing pain scores in the intervention group with the controls that had been treated with corticosteroid injections, there was a significant difference ($p<0.0001$) (Tab IX). For those in the control group that had been treated with NSAIDs, there was also a significant difference ($p=0.048$) (Tab X).

Function

After four weeks of treatment, the intervention group (I) had significantly better function than controls, ($p=0.01$). After 16 weeks, the intervention group still had significantly better function than the control group ($p=0.02$).

In the follow-up study (IV), 55 % were still suffering from function loss after two years in the whole study group ($n=297$) meaning a score greater than one in the function part of the questionnaire (Tab VII). Patients in the intervention group experienced significantly better function than did the patients in control group ($p<0.0001$). When comparing the intervention group with those in the control group who were treated with corticosteroid injections, there was a significant difference regarding function ($p=0.002$) (Tab IX).

Student's t-test	Intervention group n=103	Control group n=194	p-value *= significant value
Pain (score 0-50)	Mean 5.4 (SD 8.95)	Mean 11.3 (SD 13.7)	<0.0001*
Function (score 0-100)	Mean 6.8 (SD14.0)	Mean 16.9 (SD 24.6)	<0.0001*
No pain (score 0)	n=53 (52 %)	n=81 (42 %)	
Pain (minimum score 1)	n=50 (48 %)	n=113 (58 %)	0.07
Full function (score 0)	n=63 (61 %)	n=98 (51 %)	
Function loss (minimum score 1)	n=40 (39 %)	n=96 (49 %)	0.05*

Table VIII. Pain and function loss for patients in the intervention and control groups two years after the first visit at the health care center for lateral epicondylalgia, evaluated with the PRFEQ (Patient-rated Forearm Evaluation Questionnaire)

Mann-Whitney test				
	n	Mean rank	Z	p-value *=significant value
<i>Pain</i>				
Intervention group	103	73	-3.51	<0.0001*
Control group	60	98		
<i>Function</i>				
Intervention group	103	74	-3.17	0.002*
Control group	60	96		

Table IX. Pain and function loss for patients in the intervention group and patients in the control group treated with corticosteroid injections, two years after the first visit at the health care center for lateral epicondylalgia, evaluated with the PRFEQ (Patient-rated Forearm Evaluation Questionnaire)

Mann-Whitney test				
	n	Mean rank	Z	p-value *=significant value
<i>Pain</i>				
Intervention group	103	81	-1.98	0.048*
Control group	69	95		
<i>Function</i>				
Intervention group	103	81	-1.78	0.075
Control group	69	94		

Table X. Pain and function loss for patients in the intervention group and patients in the control group treated with NSAID, two years after the first visit at the health care center for lateral epicondylalgia, evaluated with the PRFEQ (Patient-rated Forearm Evaluation Questionnaire)

Grip strength (I)

There were no changes in grip strength between the two groups (I). Both groups improved.

Sick-leave

After four weeks, the intervention group (I) was taking less sick-leave and therefore returned to work earlier than the control group. After 16 weeks, the intervention group was taking less sick-leave but this change was not significant. Six months after the treatment's last session, there was a difference of 19 % when comparing the two groups, but again, this difference was not significant (p=0.07). The patients in the intervention group (IV) took less sick-leave (1 %) at the time of the visit at the health care center two years prior, compared to 21 % in the control group, and had significantly fewer days on the sick list (p=0.005). Two years later, patients on sick-leave caused by lateral epicondylalgia were too few – one patient

in intervention group and eight patients in control group - to draw any conclusions regarding the number of patients on sick-leave or the length of their sick-leave time.

Recurrent rates and additional therapy (IV)

The intervention group (IV) had significantly fewer recurrence periods than did the controls ($p < 0.0001$), and this group had fewer patients that did not have any period of recurrence at all. The control group had more patients with frequent recurrent periods, meaning more than one recurrence, compared to interventions. In cases where the patients had any period of recurrence, the interventions received significantly less additional therapy than did the controls ($p < 0.005$) (Fig 8).

Main findings

Pain and function loss decreased with a structured treatment program, there were fewer recurrence periods within the intervention group and they had fewer days on sick-leave. The health care providers wanted to cooperate, and with treatment at the right level of care, the side effects would decrease. Lateral epicondylalgia could be evaluated with a reliable and valid questionnaire in Swedish for both clinical settings and in research.

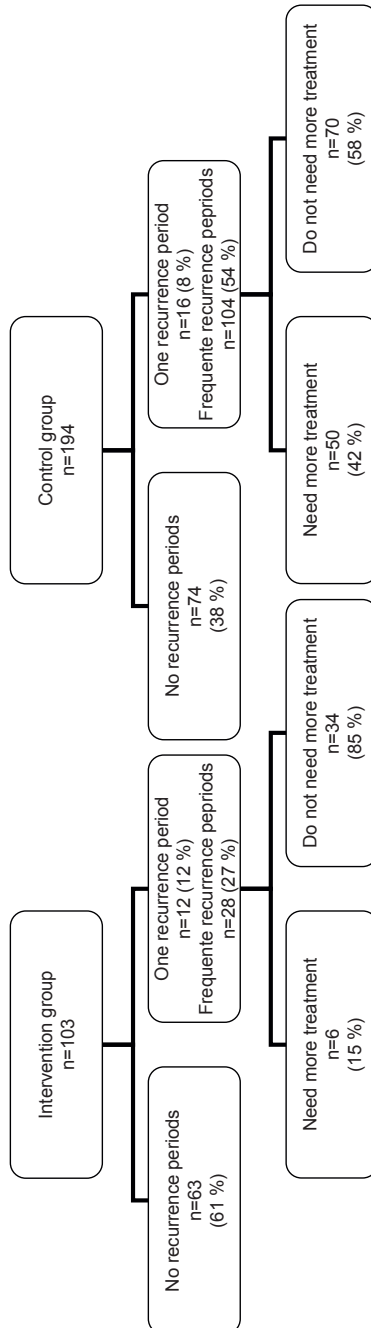


Figure 8. Recurrence periods with additional treatment for the intervention group and the control group

Discussion

Changes in the Swedish primary health care

A big part of the health and medical care takes place in the primary health care setting in which more than half of the medical examinations are conducted. When the customer's choice was introduced in Sweden in 2007, a scientific problem arose. After the patients made their choice for their health care unit, they were assumed to have entered into an agreement which meant that they should go to their own chosen healthcare unit whenever they needed treatment [135]. If patients go to another unit than that to which they belong, their original chosen unit has to pay a sum for each occasion the patient visits another unit, which could be expensive.

Larger projects of research often involve more than one health care unit. To introduce and to develop new knowledge in an organization there must be collaboration between health care centers to conduct research and development and facilitate to recruit patients from more than one health care center. This subject is not of interest in the customers' choice today in the Councils. If no solution is presented from the Swedish councils, there is a fear that this could become a big problem for researchers attempting to conduct primary health care research in Sweden.

Study population

The study population (I) was integrated into study IV. The first study started in 2004 and as the years went by, the population (IV) grew larger because the data collection went on for five years. Some of the patients in study II were also involved in study IV, but not all, because the population came from five additional health care centers where the patients were in treatment with other health care providers. The study population (IV) was almost equal with respect to gender (185 men/181 women). The mean ages in these studies were also nearly the same. The optional study should have been double blind and randomized. However, the studies were not randomly done as these patients were treated in the health care center where the author worked and at which the eligible patients were assigned. There are no double blinded components in this thesis because it is very hard to do a study with a training program and compare it in a double-blinded fashion.

All of the patients met a GP first and received a diagnosis; thus, the diagnosis could be incorrect, though there were many physicians, with many different skills, at several different health care centers involved. The reason that a GP was needed to make the diagnosis was that only a physician could give the patient a diagnosis code. It would not have been equal between the intervention and the control group if, for example, physiotherapists had included patients as the conditions

for choosing health care providers have changed during the last several years. In the first years of study I, patients needed a referral to see a physiotherapist or an occupational therapist. This procedure changed in 2001, in the county of Halland and in 2009 in Sweden, Patients no longer need to see a physician first; instead, they can go directly to the rehabilitation section.

At the baseline, there was a significant difference between the intervention group and the control group (I) in pain and function of which we were aware. The control group also consisted of 35 % more industrial workers. The results from the groups were therefore not compared to each other. Instead, the differences from baseline to the second visit and the differences from the second visit to third visit were compared to each other. The baseline for the study population in study IV was unknown, thus it is possible that the controls could be worse than the intervention group from the beginning. On the other hand, the controls came from seven different health care centers to be a comparable group.

There was a high rate for drop-outs in the control group (I). More than half of the group declined to continue the evaluations, particularly between occasion two and the last occasion. The last occasion took place four months after the first occasion; the patients might have thought this time was too long. As a result, study I was seen as a pilot study.

Regarding the population in the third study, the health care professionals working in Sweden were similar to those in the study. This was a total population study meaning that all orthopedic surgeons, GPs, occupational therapists and physiotherapists in the county of Halland had the opportunity to participate in the study. In September 2010, there were 3375 GPs working in Sweden and the mean age was 53 years. At the same time, there were 5705 physiotherapists, with the mean age of 43 years and 3745 occupational therapists, with the mean age of 44 years. The total mean age was 47 years, almost the same as in the study group, which was 48 years.

Method discussion

Treatment and cooperation survey (III)

Qualitative research methods are of great help in improving our understanding in clinical research. Rather than thinking of qualitative and quantitative strategies as incompatible, they should be seen as complementary. Although procedures for textual interpretations differ from those of statistical analysis because of the different types of data used and questions to be answered, the underlying principles have similarities [136]. The clinical behavior and clinical knowledge consist of interpretive action and interaction factors that involve communication,

opinions and experiences. The qualitative methods represent a confined access to clinical knowing because these phenomena can be measured and counted [137]. The survey that was used (III) was conducted to gather knowledge concerning which treatments were used and how the health care professionals experienced their choice of treatment. The respondents had to mark a box indicating which treatment they used as a first choice. The reason for using multiple choice questions was that the answers were precise and did not contain any attitudes for the treatments at all.

The respondent did not have to take any further action from their choice. The following question was whether they saw any risks with their treatment and was answered by almost half of the GPs and orthopedic surgeons but only by 13 % of the physiotherapists and less than 1 % of the occupational therapists. This result may show which professionals knew that their treatments involved more risks. This question also investigated the health care professionals who cooperated with the study and their experiences of the cooperation. This survey had neither been tested for validity nor reliability. The only test that was made was face validity as the survey was pretested among ten occupational therapists and physiotherapists. No changes needed to be made. The response rate was considered good as over 82 % of the health care professionals answered. All of the questions were not answered by the correspondents; the reason for this omission is unknown. The questions might be considered to be too sensitive to answer or there may have been lack of time for this kind of data collection. There is a discrepancy between the design and the conclusion in study III as the choice of treatment is not described in the conclusion. Study III is strengthened as it contained both quantitative and qualitative answers that gave the study a strong research foundation.

The qualitative part of study III – Open-ended questions

The survey was designed to outline the ways in which patients goes through the process of choosing a health care provider for lateral epicondylalgia. As it was a total population study with no exclusions, the study has a trustworthy base. The responsiveness was very good, which meant that the respondents had different basic variables, such as gender and age. Regarding transferability, the survey was thought to represent any county in Sweden because of the high responsiveness. Confirmability was thought to be good as our experience in the field tells us that the answers seem correct for the questions given. Dependability, also known as reliability, was checked as the answers were anonymous, and the authors did not have any verbal connection with the respondents, and could therefore not have provoked them in any way.

Finally, this survey's validity, the credibility of the study, was covered by describing the analyzing process with content analyses carefully. The study's

validity was also covered by the fact that all of the authors analyzed the results of the open-ended questions, first alone and then together. Graneheim and Lundman [129] offer differing deductive and inductive approaches for content analysis. The deductive approach means that the material is analyzed by a pattern that has been decided in advance. The inductive approach is an unprejudiced approach, an analysis of texts without any pre-decided theory as a ground. The analysis was made from a manifest perspective in the sense that we analyzed the experience that is actually described in the text, not the latent level that is the researchers' interpretation of the text. In other words, the categories and the sub-categories in the texts are the manifest part, and the latent part is the setting of the overarching theme of the categories.

The three open questions that were a part of the survey allowed only short answers. This feature could be a disadvantage though no follow-up questions could be made and sometimes the answers were very short. An interview could have given more information. The analysis of the three open questions (III) was conducted by all three authors, who worked as a multi-professional team. Two of the authors have treated patients with lateral epicondylalgia and had an understanding of the various treatment methods mentioned by the respondents. The third author did not work in medical care and could analyze the same questions from another point of view, a perspective which strengthened the analysis process and gave the study a higher reliability.

The trustworthiness of this project has been assessed using three main components: credibility, dependability and transferability. These themes all intersect with the study's trustworthiness [129]. With regard to credibility, the authors worked both individually and together as a multi-professional team during the various steps of the analysis process, thereby strengthening the trustworthiness of the results. The answers responded to the questions in an adequate way, and we therefore felt that the questionnaire was interpreted correctly. With regard to dependability, because the questionnaires were anonymous, and there was no connection between the respondents and the individuals who analyzed their results, the answers were thought to have been given correctly.

The short answers, which sometimes had meaning units that were too narrow at times, yielded a fragmented answer. The qualitative method that was chosen, content analysis, is a method that is highly suitable for these kinds of questions [138]. The answers were indifferent and gave rich information because of the diversity of the respondents with regard to profession, gender and other characteristics. In terms of transferability, the total eligible population had the opportunity to participate, and individuals of various ages who had differing occupations were included. Therefore, the answers were considered to reflect the reality of the population and could be generalized.

PRFEQ for pain and function (I, IV)

The questionnaire PRFEQ was used in the first study where the patients filled it out at the health care center. When the first study was conducted, there was no Swedish questionnaire which was specific to patients with problems from the lateral epicondyle. The closest questionnaire was the PRFEQ, which was translated into Swedish by the author without doing the cross-cultural adaptation. The questionnaire was easy to fill out, took approximately four minutes to mark the boxes, and was therefore easy to administer to the patients. In study IV, the same questionnaire was used as this was an on-going study with the same patients as in study I. These questionnaires were sent out by ordinary mail, with a respondent rate of 83 % in the intervention group and 80 % in the control group, which was considered to be high. This questionnaire was updated in 2007 and became “Patient-rated Tennis Elbow Evaluation questionnaire” (PRTEE) [55]. However, as the data collection had already begun with PRFEQ, we could not switch to PRTEE although this questionnaire was more up-to-date and was also the questionnaire we used to make a cross-cultural adaptation (II).

Cross-cultural adaptation (II)

The PRTEE was cross-culturally adapted and became the PRTEE-S. This change was made to give the health care provider a simple evaluation form that was easy to administer to the patients. The one that is primarily used, the DASH, is not that specific and contains different information from that of the PRTEE-S. It also contains a long list of questions and takes more time to fill out than PRTEE-S. At the time, when the cross-cultural adaptation was discussed, the PRFEQ had already become PRTEE and was already updated to be more modern and to apply to both genders. That is why the PRTEE was chosen to be cross-culturally adapted and not the PRFEQ. Beaton had a well-organized system for cross-cultural adaptation that applied well to the authors’ aims. It was easy to follow as all the steps are carefully described.

The PRTEE-S is easy to understand. It focuses on the patients’ problems and clinical experiences such that it catches the most important tasks, both in a specific way, and in general. It also concerns the patients’ spare time, a factor which is also important from both a musculoskeletal and an ergonomic perspective. Its responsiveness is good and it catches and highlights the patients’ problems to provide the best treatment for the patient. In the idiomatic purpose, there was no need for any changes in the language as it was not that specific to Swedish expressions. According to Beaton, a 12-year-old child should understand the questionnaire without a problem. This adaptation of language was done by pre-testing the questionnaire among ten healthy individuals and ten patients and resulted in that no changes were needed.

Validity (II)

Validity is a way to show that an instrument evaluates the right things. An instrument can have a good value for validity but a low value for reliability. It can never be the opposite.

Face validity is an estimate of whether a test appears to measure a certain criterion; it does not guarantee that the test actually measures phenomena in that domain. Indeed, when a test is subject to faking (malingering), low face validity might make the test more valid. The face validity was checked (II) by pre-testing the PRTEE-S on ten healthy individuals and ten patients and afterwards, discussing the questions with them. This kind of validity was used in study III for ten physiotherapists and occupational therapists to see whether the questions in the survey were understandable.

Convergent validity refers to the degree to which a measure is correlated with other measures that it is theoretically predicted to correlate with. The validity (II) was excellent, according to Fleiss [130], when determined by analyzing the relationship between its scores and the scores from DASH. The concurrent (construct) validity is the degree to which the outcomes on one test correlate with outcomes on a criterion test when both tests are given at the same time [139]. This construct was further investigated by examining the relationship between the PRTEE-S scores and the Roles & Maudsley score derived from the health care professional who had met with the patient. This score was also used by Leung et al [57]. Overend et al chose to use pain-free grip strength test to correlate with scores on the PRFEQ using Pearson product moment correlation coefficients [50]. Another way of testing the validity would have been by doing the reverse.

Discriminant validity describes the degree to which the operationalization does not correlate with other operationalizations that it theoretically should not be correlated with. This procedure was not done in this study.

Reliability (II)

A reliable measure is measuring the variables consistently.

Internal consistency assesses the consistency of the results for different items for the same construct within the measure, its homogeneity. This factor was estimated by Cronbach's Alpha, a measure which is mathematically equivalent to the average of all possible split-half estimates. The computer analyses complete the random subsets of items and compute the resulting correlations.

Test-retest reliability is estimated when the same test is administered to the same population on two different occasions. It estimates the stability in the questionnaire.

The ICC is used to measure the consistency, or conformity, of measurements made by multiple observers measuring the same quantity. This approach assumes that there is no substantial change in the construct being measured between the two occasions. The amount of time allowed between measures is critical. The shorter the time gap, the higher the correlation; the longer the time gap, the lower the correlation. This effect occurs because the two observations are related over time - the closer in time we get, the more similar the factors that contribute to error.

When administrating test-retest reliability among patients, there cannot be too long time between test administrations as there could be changes in the patient's condition which could interfere with the test-retest result. The Swedish-adapted questionnaire PRTEE-S was test-retested (II). The patients filled out the questionnaire, twice with 30 minutes between the two occasions. They did not have access to the first forms they filled out. This length of time could be too short as the patients might remember what they had answered initially. Altan et al used a two-hour gap between the occasions [59]. Silbernagel et al [140] considered a week to be too long, as there were changes in the patient's condition in that time. The positive effect (II), considering the short time gap, was that the patients filled out the questionnaires twice with no drop-outs.

Grip strength (I)

GRIPPIT was used (I) for mean grip strength. This instrument showed maximum, mean and final grip strengths under a ten-second grip where the variable for mean was used. Significant correlations between pain free grip strength score and scores on the PRFEQ was weak in the study of Overend et al, with suggestions that measuring endurance would be better [50]. The weak correlation indicated that relatively little of the variation in a patient's painfree grip strength score can be explained by the patient's score on the PRFEQ. The test and the functional activity are just too different.

In the study by Leung et al, the maximal grip strength was used but with negative correlation to the PRFEQ [57]. Some other studies have used maximum grip or pain-free grip as a variable but we chose the mean, as patients have to have endurance strength to use the elbow in some work positions that demand static positions.

Sick-leave (I, IV)

In the first study, the sick-leave was reported by the Regional Social Insurance Office after the patient's written consent. Sick-leave that did not have anything to do with lateral epicondylalgia was excluded, for example, sick-leave because of child sickness. The sick-leave was self reported and the memory of two years in the past might be flawed (IV).

Recurrence rates and additional therapy (IV)

The eventual rates of recurrence and the type of additional therapy that the patients eventually received were self-reported in the survey. This report could not be verified because we did not have the access to all of the patients' records. This confirmation would have been a significant inquiry involving the health care center's managing director and the patients' consents to allow access to their records. This omission could cause a bias in the results as the patients' memories might fail and the answers might be given incorrectly.

Follow-up periods

The treatment period (I) was four months, and the evaluation was made three times in that period. The first time was after four weeks, because the patient needed a special certificate after 29 days to the Regional Social Insurance Office, if still on sick-leave. The four month period was chosen because many studies have shown good results for other treatments, e.g., cortisone injections, but only in the short term. After four months, the effect of the other treatments may not remain as positive as in the beginning. This phenomenon is also the reason the sick-leave days are collected six months after the treatment, to see whether the positive effects of our treatment persisted. The follow-up period (IV) was chosen to be two years for two reasons. Many studies claim that there are usually recurrent periods in lateral epicondylalgia. This time period could give us a chance to see if this timeline was correct for our patients. The other reason for the time period was that many studies state that lateral epicondylalgia is a self-limited disease that does not need any treatment at all. After two years, their symptoms should be gone. We wanted to know if this spontaneous remission was present among our patients as well.

Treatment provider and author

The data collection was made by the author who was also involved in treating the patients in the intervention group. This involvement could have affected the studies (I, IV) as the patients might have answered in a way that reflected the bias of the provider of the treatment. In every session in the intervention group, the other provider of treatment, the occupational therapist was also present. She ensured that the author did not influence the patient in any way regarding the answers on the questionnaire.

Result discussion

Level of care

“Epicondylalgia should not be treated by surgery – thus not a case for an orthopedic surgeon” (Orthopedic surgeon)

Patients suffering from musculoskeletal symptoms without any specific trauma should not have to see a physician in the first place. Physiotherapists and occupational therapists are both well-trained in conducting physical examinations. If the patient should need any certification for sick-leave this need could be met in cooperation with a physician. In Sweden, the patient can be on sick-leave the first week without any certification from a physician. LEON principle (Lägsta Effektivaste Omhändertagande Nivå) describes the mission that indicates that the patient should be treated at the lowest most effective level of care [27]. This mission could also be described as the adequate level of care.

The mix of health care providers might vary from center to center. This mix is the most important variable to take into account when settling which work that should be taken care of and who should do it. Often, there are concerns regarding the displacement of examinations for lateral epicondylalgia completed by physicians. However, this group usually has longer waiting lists than the rest of the professionals. The LEON principle could more effectively outline the flow of patients. An important factor that would increase the center’s capacity to its maximum would be to make use of every health care professional. The professional must have the right competence for the task, and they must be prepared to work in an interdisciplinary manner.

“Better extreme-competence by some other profession” (GP)

Lateral epicondylalgia is a musculoskeletal disease. Providers should work not only according to the LEON-principle but also using the BEON-principle, (Bästa Effektivaste Omhändertagande Nivå), best effective level of care. It is important to not add another step into the caring process, but to use a structured program, one in which everyone in the center is aware [141]. Physiotherapists’ education involves musculoskeletal diseases from the whole body, and they are trained to palpate muscle origins and to work to restore the patient’s function. Occupational therapists and physiotherapists often become experts in identifying and treating behaviors that result in work-related injuries [113]. The physiotherapists based their first choice of treatment on science (III), where the other groups based their choice on their own knowledge. This discrepancy could mean that physiotherapists (III) were more open-minded towards the latest research and the latest interventions, both in clinic and when it comes to ergonomic adaptation of a workplace.

Quality of care

“May take care of more areas that the patient may need to get help for”
(GP)

Quality of care is an expression that assesses whether or not the care meets the expected goals [28]. The physiotherapists and the occupational therapists are solidly grounded in the theory of a holistic perspective of the patient. Physiotherapists are trained to examine more than just the elbow when it comes to lateral epicondylalgia. It is well known that the problem could originate from the neck or the shoulder [14, 142, 143]. The patient’s problem could be an incorrect working position with, for example, a long lever that could be adjusted [111]. The problem could also have to do with the patient’s home adjustment, for instance, a patient who is nursing a baby.

When more than one health care provider is involved with the patient, the spectrum of treatment gets wider. Several treatments exist and a discussion of the most suitable one with the patient could be a way to use collected competence and to work in a common view of the patient. This broader competence gives us a chance for internal education. The subcategory “broader competence” had the highest quantification data (III), an effect which shows that this question is one of importance. The synergy effect is very useful when regarding the patients’ compliance to something such as a home training program. If two people say the same thing, it usually gives the treatment more power. Studies I and IV includes a home training program where the patient has to be active and take full responsibility for doing the exercise every day.

“Faster caretaking optimize better progress of the rehabilitation”
(Physiotherapist)

An early treatment optimizes the prognosis. This fact is well known. By limiting the steps the patient must undertake to obtain the best level of care, the rehabilitation process occurs more rapidly. The quicker the patient gets the knowledge of what to do or not to do, the shorter the recovery time will be. If difficulties occur, there is a chance to get a second opinion and to achieve feedback for the treatments given. This chance could secure the quality of care and keep the standard up to an appropriate level.

“Difficult to reach cooperating person” (Orthopedic surgeon)

Not everyone involved in study III worked at the health care centers where studies I and IV are based. Some of the respondents (III), mostly physiotherapists and physicians, worked privately, a distance which could become a problem as the providers do not have the same ways to contact other professionals in the center. They might not refer patients to others as often as those working non-privately. If the knowledge of how to refer and to whom is not known, for example whether or not to refer to an orthopedic surgeon, it could take some time to obtain this knowledge. This problem might be the reason that some of these professionals do not refer the patients for further treatment. This omission might decrease the quality of care as the patient may not get the appropriate treatment.

“If you do not think the same and not cooperate there is a possibility of different information to the patient” (Occupational therapist)

As previously discussed, the treatment is more powerful if more than one person says the same. If the opposite occurs, it would surely leave the patient with doubts about the quality of care as well as the treatment. In our studies, for example, it could mean that the patient will not adjust to the work place and will not perform the home exercises. The providers must be anonymous in what they say to the patient. This condition is essential for working interdisciplinarily with a high quality of care.

Treatment choices and their side effects

“Injection treatment – atrophies in skin and muscle tendons” (GP)

In studies I and IV, the intervention group received the same treatment. The control group received other treatments and according to studies III and IV, corticosteroid injections and NSAIDs are more commonly used than other therapies, a finding also indicated by the 66 % of the control group (IV) given these treatments. These two therapies are also well known, according to study III, as leading to the most numerous and also the most severe unwanted side effects. Why choose these treatments? Perhaps they are chosen because there are no gold standard treatment and no evaluated methods for long-term treatments. It is also important to inform the patient of all risks and benefits from the treatment, as there is a spectrum of treatments to choose from for this disease. If the patient received the treatment from a provider other than a physician, the side effects could be minimized as the treatment options from physiotherapists and occupational therapists have less severe side effects.

A corticosteroid injection does not provide a clinically significant improvement in the outcome of lateral epicondylalgia and rehabilitation should be the first line of treatment in patients with a short duration of symptoms [92]. No beneficial effects were found for intermediate results [144]. The long-term effect of corticosteroids has not shown any significant results either [144]. In a study by Barr et al, the findings indicated that corticosteroid injections are effective at short-term follow-up, and physiotherapeutic interventions are effective at intermediate- and long-term follow-up, in that case 52 weeks at the longest [90]. If this treatment is first line for physicians', the second is NSAIDs according to studies III and IV.

“NSAID have several well known severe side effects especially gastrointestinal ones” (GP)

This treatment is also one with several side effects. NSAIDs are commonly used for musculoskeletal problems to stop inflammation and alleviate pain. Some support is offered for the use of topical NSAIDs, at least for the short term [145]. A Swedish survey study covering treatments for chronic lateral epicondylalgia showed that NSAIDs are commonly used despite the fact that there is no ongoing inflammation process in the tendon in this condition [146], and therefore, this treatment is not correct [34]. NSAIDs could have the effect of masking the pain so the patients over-load when training or working, a factor which also could be seen as a disadvantage. Side effects from other treatments only received nine quotations in comparison with the corticosteroids which received 58 and NSAIDs 18. Those side effects could be from acupuncture, a technique is commonly used by physiotherapists, which can cause hematomas. Bracing is another technique that can cause muscle weakness if worn all day.

“You have to deal with the reason for the problem” (Occupational therapist)

If working together in a team nothing gets passed. Symptom treatment is inadequate treatment when looking at a longer perspective. With a holistic view of the patient, this inadequate treatment could be minimized.

“Wrong treatment when acute symptoms. A lot of patients get undertreated and are too passive during sick-leave” (Physiotherapist)

The patient should be active in the rehabilitation. This activity is important to gain the motivation to go back to work and to take a responsibility for the rehabilitation. Some studies still promote rest, an incorrect treatment and one which is inadequate for this category of patients. They need to exercise the muscle to strengthen it to prevent muscle weakness.

“Wrong diagnosis means treatment for epicondylitis even though the patient suffers from another kind of pain” (Physiotherapist)

Treating the patient who suffers from conditions such as nerve entrapment as if they were a patient with lateral epicondylalgia would clearly not be effective. The wrong diagnosis will end up with an inadequate treatment. The criteria for lateral epicondylalgia should be used to diagnose the disease. The problem with diagnosing correct might be the case in studies I and IV as we have no control over the control groups in the diagnosis setting. In the intervention group, the author met all of the patients and could establish that they had obtained the right diagnosis.

PRTEE-S

PRTEE-S was cross-culturally adapted to Swedish circumstances and translated. This questionnaire is a quick evaluation form concentrating on lateral epicondylalgia. The name was taken from PRTEE with permission from the original authors for the questionnaires PRFEQ and PRTEE. Cross-cultural adaptation means that the questionnaire is placed into Swedish society to make a sense of the questions. What is natural in Canada might not be natural in Sweden. The translation involved several people, 14 in all, and then pre-tested the version using 10 healthy individuals and 10 patients. This process is time-consuming but is nevertheless worthwhile. As there existed no Swedish evaluation form for lateral epicondylalgia, this translation was necessary to complete and should have been done in the first place so that PRTEE-S could have been used for all of the studies. The final version was confirmed to be identical semantically with English version.

The test-retest reliability, where the stability of the questionnaire was tested, was 0.80 for the PREE-G (ICC) in the German study, 0.92 for the Turkish PRTEE-T [59] and 0.95 in our study for the PRTEE-S. These findings are similar.

The internal consistency, where the questionnaire's homogeneity is tested, was 0.96 for the PREE-G, 0.89 for the original PRFEQ, 0.99 for the Hongkong Chinese PRFEQ [57], 0.84 for the PRTEE-T and 0.94 for the PRTEE-S regarding the overall scores.

Regarding the validity, it has no single agreed definition but generally refers to the extent to which a concept, conclusion or measurement is well founded and corresponds accurately to the real world. The validity was excellent and was evaluated with Spearman's correlation factor as Spearman's is seen as a more reliable factor than the significance when it comes to validity. PREE-G correlated well with the DASH ($r=0.73$), the PRTEE-T ($r=0.68$), the PRTEE Canadian-French (0.93) and the PRTEE-S ($r=0.88$). The PREE-G and PRTEE-S correlated

moderately with certain clinical findings. For the PREE-G, it was mASES ($r=0.36-0.54$) and for PRTEE-S, the clinical findings correlated with Roles & Maudsley. This value, set by the health care provider, was $r=0.67-0.79$. The PRTEE Canadian-French [60] correlated with VAS ($r=0.68$). The reliability was, according to Fleiss [130], excellent with an ICC over 0.75 and the reliability also considered good. To be able to compare other outcomes, both in clinical settings and in research, it would be easier if the same evaluation questionnaire was used for lateral epicondylalgia. It is simple, shorter than the DASH and attends the most typical problems for a patient with this disease. For example, the question “lifting a cup of coffee” is also a criterion for the diagnosis of lateral epicondylalgia. On the other hand, the patient has to know the language to be able to fill it out. As the questionnaire now exists in several other languages, it will be easier to compare results in research.

Pain and function

The first five questions in the PRFEQ [50] and the PRTEE-S contain questions about pain. This variable is important for the patient. If the pain is too severe, the function will be decreased and tasks important in work may not be performed; for example, a firefighter with a pain score of 10 when lifting will be impaired. Another example is when the pain has a score of 10 at night; in this case, a night bandage has an important role.

In the first study, pain decreased after the first four weeks compared to the control group. At that time, there were not as many drop-outs as there were at the third time. After four months, there was a tendency to report less pain as compared to the controls but at the long-term follow-up, after two years, the pain was significantly decreased. The function, both in specific tasks generally, in both work and spare-time, was better in the first study and also in the follow-up. The scale is close to the VAS [147], which has been suggested to show some limitations when comparing groups, but when it comes to comparing a patient with herself over time, it is very suitable. However, the PRFEQ was recommended by Newcomer et al [54] for its sensitivity, and there is no reason why PRTEE-S should be less sensitive.

Grip-strength was measured only in study I. As this item showed no differences as compared with the control group, it might not be the best evaluation variable for research as both groups had better grip strength in that study. In the cross-cultural adaptation to Hongkong Chinese, the grip strength was not strong enough to predict or explain the PRFEQ score. Leung et al suggested that making a grip test and completing a functional task are just too different indicators from being combined [57]. Compared to a questionnaire, it is much more difficult to get the patient to make a test than to fill out a questionnaire. This variable was consequently not used in the follow-up study. Still, there is a high motivation factor

for the grip strength. The patient's compliance could increase as the number on the machine indicates whether the user has made progress. That important fact should not be over-looked. If the patient is completely in charge of the rehabilitation, the motivation must be strong. In our training program, the exercises should be done three times a day, a program which requires a good compliance by the patient. This level of compliance has only been checked verbally but the compliance was fair to good (I), meaning that the patients did their home training program at least once a day.

Sick-leave

Both in studies I and IV, the patients had less sick-leave days than controls. In Sweden, the rules for being on sick-leave have been tightened by the National Social Insurance Office since 2007, a time period that fell after study I was completed and during the study IV data collection. For lateral epicondylalgia, there is a recommendation not to exceed four weeks of sick-leave. That is a cause why the sick-leave in the long-term follow-up was unsurprisingly very little after the two years. In the health care centers from which where the intervention groups were derived, the GP knew of this structured way of treating the patient and that reason might be a factor in the difference in sick-leave days between patients and controls.

New structured program

The first study was done mainly to bring some order and routine into an area where this did not exist. The physicians did not know if or to whom they should refer the patient. One of the physicians (III) indicated "does not know who to call" in response to the question if there were any disadvantages when working in cooperation with another professional. If a clear structure was known to all health care providers in the health care center this problem would never occur. The majority of the health care providers (III) wanted to cooperate but not all of them knew how.

Interdisciplinary team-cooperation

In studies I and IV, all of the treatments were performed using the cooperation between a GP, an occupational therapist and a physiotherapist. The GP was the first health care provider the patient met and in the intervention group, the only thing that was done was that the GP diagnosed the patient according to criteria for lateral epicondylalgia, and then referred the patient to the team. In some cases, the patient got a certificate for sick-leave. The majority of the professionals wanted to cooperate (III). The GP reported some negative experience from this study, indicating that they "have not the time to get in touch with another professional". This problem could be helped out if the patient did not see any physician at all, but instead was directed instantly to the physiotherapist and/or the occupational

therapist. That change would mean one step less to pass for the patient as well as one patient less for the physician. The physiotherapist and occupational therapist are the groups that work most with musculoskeletal symptoms as well as with ergonomic situations. The occupational therapist, working in a district, is often an expert in the symptoms from the hand. The physiotherapist works with the whole body but are usually not experts in hand symptoms. These two professions are therefore highly suited to work together with a patient with elbow problems that are triggered from musculoskeletal symptoms and, in most cases, work-related. The patient would be treated at the right level of care with expert competence as referred to (III). This change would make the quality of care greater, a goal for which health care centers strive. There are advantages as well as disadvantages when working together in an interdisciplinary approach. The advantages of teamwork could be the exchange of ideas, opportunities for participatory learning, and holistic treatment. Communication problems, time-consuming meetings, and role confusion are the disadvantages [148].

Giving the patient the knowledge

Recurrence rates and additional therapy were less for the intervention groups in studies I and IV. There could be several reasons for this phenomenon. The intervention group may have been better at baseline as in study I. Of this issue, we do not know in study IV. Another reason for this finding might have been that the patient had gained the knowledge for how to treat the recurrences if any. They might also have had a better compliance to the program than did controls as they had been taught to train several times a day. In the intervention group, the patients in study IV were treated the same way as in study I, including participation in three evaluations. This high level of interaction could have been a motivational factor for them in continuing the rehabilitation.

Keeping it simple

If there was an outlined way in which the health care professionals knew to whom they should send the patient with symptoms from lateral epicondylalgia in the first place, the health care providers would know how to treat the patient. Patients could be directed to conduct the treatment at home with side effects minimized, and the effect could be evaluated in a simple and quick way; the patient would then have the knowledge of what to do if a recurrence occurs. This process could be a simple way to treat lateral epicondylalgia.

Conclusion

Conclusions of the studies

- I** The conclusion of this study was that a structured home training programme can improve function and reduce sick-leave in patients with lateral epicondylalgia.
- II** The conclusion of this study was that the PRTEE-S represents a reliable and valid instrument to evaluate the subjective outcome in Swedish speaking patients with lateral epicondylalgia and can be used in both research and clinical settings.
- III** The conclusion of this study was that interdisciplinary cooperation in the treatment of patients with acute lateral epicondylalgia benefits the patients by shortening the rehabilitation period and provides health care professionals the opportunity for an improved learning and exchanging experiences. There was a strong will to cooperate and the risks of side effects with corticosteroid injections and NSAID are well-known although they are the most common treatments. Treating the patient at the right level of care could minimize side effects. These basic conditions must be met in order to improve health care quality.
- IV** The conclusion of this study was that lateral epicondylalgia is not always a self-limiting condition and needs treatment. A structured treatment and to teach the patients how to treat themselves if the symptoms re-occur, seems to be an effective way. The patient will not need additional treatment and do not need to be on the sick list.

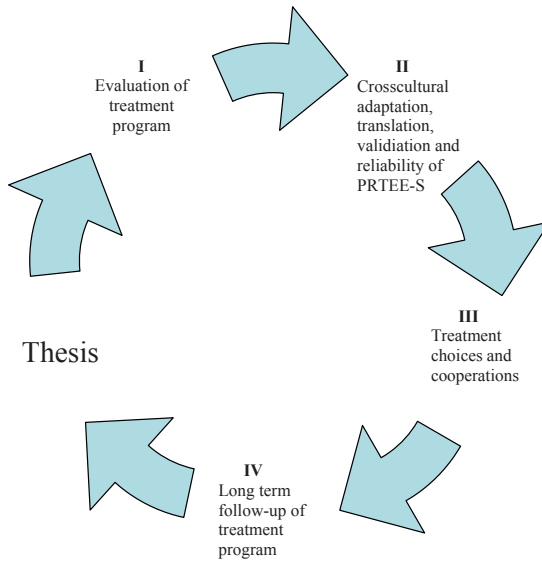


Fig 9. “The read thread”

Conclusion of the thesis

More than half of the patients in this study with lateral epicondylalgia experienced some pain and function loss two years after treatment implying that this disease is not always a self-limiting condition; the condition needs treatment and the wait-and-see policy is not enough. The patients in the intervention group, who were treated with a structured program where the physician only referred to the physiotherapist and occupational therapist, had decreased sick-leave absences as compared with the control group at the time for their first visit at the health care center when the diagnosis was set. This health care center was familiar with this specific program.

Patients that were treated with a structured home training program had less pain and function loss compared with other patients treated with other treatments. They also had fewer periods of recurrences. If a recurrence occurred, these patients needed less additional therapy than patients treated pragmatically with other treatment methods. The patients had learned how to treat themselves, a process which resulted in fewer recurrences. There was a strong will to cooperate among the health care providers, which could give the opportunity for an improved learning and exchanging of experiences. If the patients were treated from a rehabilitation view, at the best level of care, the rehabilitation period could be shortened and the side effects would be greatly minimized. The PRTEE-S is a reliable and valid instrument to evaluate subjective outcomes in Swedish-speaking patients with lateral epicondylalgia and can be used in both research and clinical settings. Using the same evaluation form makes it easier to compare results in scientific studies.

Implications

Clinical implications

This thesis revealed some facts that lateral epicondylalgia is not always a self-limiting disease. After two years patients still experiences pain and decreased function. That is why patients should not be treated with wait-and-see treatment. Patients with lateral epicondylalgia should be treated by physiotherapists and occupational therapists. The patient should be at the best level of care where the optimal treatment for the patients' disease is conducted. A structured way of treating these patients will make it easier to asses' lateral epicondylalgia. This could be time-saving for the primary health care as no physician needs to examine the patient, and the physiotherapist and occupational therapist have the extreme-competence to meet the patients' require.

A questionnaire that directs asses' complaints of elbow would be useful. Using this treatment program will minimize unwanted side effects. Treating lateral epicondylalgia with an effective way and teach the patients how to treat themselves if the symptoms re-occur, seems to be a cost-effective way for both the patient and the society. It will gain the patient as the suffering will be reduced. The patient will not need additional treatment and do not need to be on the sick list which both will reduce the costs for the society, the employer and the employee. The patient will need fewer visiting at the health care center, which is a profit for the center as it may cut down cues to the health care providers. This thesis shows an effective way that gives the patient less pain and more function compared with other treatments and with fewer side effects.

Research implications

This is a muscular-skeletal disease that is known to have recurrence periods. It is more or less usually a work-related problem but the problems are not always solved by adjusting the working place. A key component of recovery seems to be exercise. There has been discussions if the patient should train eccentric or concentric, if stretching is necessary and in what way. Different braces have been discussed in studies but evidence still lacks for the gold standard of treatment for lateral epicondylalgia. The different working places could play a role why there exists no gold standard treatment. These might differ too much for making a structured treatment for all patients with lateral epicondylalgia.

Lateral epicondylalgia is no longer lateral epicondylitis. It has been proved that there is no on-going inflammation in the tendons and therefore should not be named epicondylitis. But if there is no inflammation, why prescribe NSAID? Chronic epicondylalgia are often treated the same way as acute according to Swedish studies. This should be contra-indicated in the way that the inflammation

does not need treatment, only the pain, which could be treated in another way with fewer side effects. Comparing this structured treatment with treatments of both acute and chronic epicondylalgia could reveal new guidelines.

Interviewing health care providers of their cooperation abilities and choice of treatment might give more information and a chance to enhance the questions to a broader answer. A qualitative aspect from health care providers could give a deeper understanding of the common choice of treatments with several known side effects.

As the physicians have a higher cost for the patient visit than rehabilitation personal have, this treatment might be cost-effective as well. The studies in this thesis have not been calculated for the cost-effectiveness as that was not the interest that was focused on. Knowledge of what treatment that is the most cost-effective are of high public interest as every health care unit in Sweden bare their own costs.

A randomized controlled study is the ultimate study design which has unfortunately not been used in this thesis. A random setting where all patients came from the same health care center would be the best way to conduct next study. To random patients from another health care center seems almost impossible in Sweden since the customer's choice has been interpreted.

In this thesis the author was the same as the physiotherapist that treated the patients. This was not an optional way in a research point of view as it could cause bias. Further research is demanded to compare with other treatment providers, other regions and even other countries.

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