Lateral epicondylalgia:

Examination, differential diagnosis and treatment

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Case Report

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This case report has not been commented

and is exclusively the expression of the author's personal view.

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Abbreviations and symbols

CNFDS – Copenhagen neck functional disability scale

ECRB – Extensor carpi radialis brevis

EOR – End of range

EORP – End of range pain

LE – Lateral epicondylalgia

NPRS – Numerical pain rating scale

NSAID – Non steroidal anti-inflammatory drug

P - Pain

PPM – Passive physiological movement

PAM – Passive accessory movement

PPIVM – Passive physiological inter-vertebral movement

PAIVM – Passive accessory inter-vertebral movement

PREE – Patient rated elbow evaluation

PSFS – Patient specific functional scale

ROM – Range of movement

ULNT - Upper limb neurological test

①②③④ – numbers in the circles refers to different pain sites

1. Abstract

Background: Lateral epicondylalgia (LE) is difficult to diagnose and there is no agreement about the most effective treatment. This is probably due to the multi-factorial etiology of LE and the involvement of several anatomical structures which makes the differential diagnosis a challenge.

Purpose: The purpose of this case report is to describe an examination and treatment process of LE from a manual physiotherapy perspective, with a special consideration of the differential diagnosis.

Material and methods: A 39 years old male with lateral elbow and forearm pain, mostly with various gripping activities. The pain was provoked during examination of the superior radioulnar joint and from local musculotendinous structures. Referred pain was discarded from the cervical and thoracic spine and the neuromeningeal structures, with differential testing. Treatment consisted of mobilisation of the elbow, strengthening exercises, and correction of postural habits and ergonomics. Outcome was measured with NPRS, grip strength, PSFS, PREE and CNDFS.

Results: Decreased pain with various functional activities and increased maximal and pain free grip strength.

Discussion: In this case report a tendency is shown that a manual physiotherapy examination can differentiate local from remote structures as a source of symptoms in LE, even though some clinical uncertainty remains. ULNT seems useful as a differential diagnostic tool. However, differential diagnosis of local structures (muscle or joint) seems more problematic. Combined therapy seems to have an effect, but more studies are needed to identify the most effective diagnostic procedures and combination of treatments.

Keywords: Lateral epicondylalgia, differential diagnosis, local pain, referred pain, neurogenic pain.

2. Background

The musculoskeletal problem that is described in this case report is usually defined as pain over the lateral humeral epicondyle which often manifests with activities that involve gripping or manipulating an object. That can include for example: lifting a milk carton or a glass, dressing or doing computer work. The common term is “tennis elbow” but more recently other terms have gained popularity such as lateral epicondylagia (LE). The cardinal physical signs of the condition are pain to direct palpation over the lateral epicondyle and reproduction of pain and weakness during grip strength testing. Isometric test of the wrist extensors are usually pain provocative.

The epidemiological studies by Allander (1974 cited Labelle et al. 1992) of LE amongst 15000 residents of Sweden shows that the prevalence is about 3% in the broad community. In the study by Smidt et al. (2006) the annual incidence of tennis elbow in general practice is four to seven cases per 1000 patients and most of the patients are 35-54 years of age. LE is said to be a self-limiting condition and the average duration of a typical episode is about six months to two years, but most patients (89%) recover within one year.

The prevalence has been found to be up to 15% in populations working in industries requiring repetitive manual tasks (Chiang et al. 1993 and Ranney et al. 1995 and Shiri et al. 2006 cited Vicenzino 2003). According to Shiri et. al. (2006 cited Vicenzino 2003) in an epidemiological study of the general population in Finland, lateral epicondylitis is as common in men as in women. There are not any available information on the subject of epidemiology available in Iceland but it is not unlikely that the results would resemble other Scandinavian countries.

The etiology of LE and elbow joint injuries is not clear and when searching the literature one can see that many different suggestions have been made. The ones that are commonly repeated in the literature according to Maitland (2005a) are:

- Articular emphasis according to Shapiro and Nyland (1994 cited Maitland 2005a) where there are both intra- and extraarticular structures that can be the cause of symptoms because of their vulnarability to compressive, shearing and stretching forces. Also according to Quintart et al. (1998 cited Maitland

2005a) chondral lesions of the head of the radius are common in extension-defective elbows.

- Musculotendinosus emphasis on the extensor carpi radialis brevis muscle (ECRB) in symptoms associated with LE are common according to Kamien (1990 cited Maitland 2005a) and Alfredson et al. (2000).
- Radial nerve entrapment (Albrecht et al. 1997)
- Cervical spine and its role in the mechanism production of LE (Vicenzino 2003; Waugh et al. 2004)

The lack of agreement concerning the etiology leads to the hypothesis of a different pain mechanism behind the condition. A referred pain from the upper thoracic area possibly through the autonomic nervous system has been proposed The symptoms are usually more widespread and vague and could involve both the upper limbs and the head (McGuckin 1986).

According to Kamien (1990 cited Maitland 2005a) and Alfredson et al. (2000) the involvement of musculotendinous tissue and especially the ECRB muscle and also the peri- and intraarticular structures of the local elbow joints according to Shapiro and Nyland (1994 cited Maitland 2005a) and Quintart et al. (1998 cited Maitland 2005a) has been considered at least a part of the pain source of LE which falls under the catagory of nociceptive mechanical pain.

An inflammation of the wrist extensors have been discarded with the studies of Alfredson et al. (2000) where they demonstrated that there were no biomechanical signs of inflammation in ECRB tendons from patients with tennis elbow. However they found a higher concentration of the excitatory neurotransmitter glutamate than in normal subjects. It has been proposed that the vasculo/neural ingrowth into the ECRB tendons was the source of pain (Zeisig et al. 2006) as had been previously shown with pain in the condition of achilles tendinosis (Alfredson et al. 2003).

A mechanism of central sensitisation has also been suggested in the study of Slater et al.(2005), where bilateral hyperalgesia and deep tissue sensitisation was seen with a unilateral LE that was initiated experimentally. It is interesting to note the high level of the neurotransmitter gluatmtate in local periferal tissues as ECRB (Alfredson et al. 2000) as glutamate is a known pain mediator in the central nervous system.

Periferal neurogen pain mechanism is proposed in the hypothesis of periferal nerve entrapment of the radial nerve (Albrecht et al.1997).

Probably because of many hypotheses regarding the etiology and pain mechanism of LE, many different treatment methods have been described. Not suprisingly the evidence for the effect is lacking for most of the treatment methods and physical modalities in the management of the condition (Bisset et al. 2005; Labelle et al. 1992). This is often due to the poor methodological quality of the research. Because of the multi-factorial etiology a clearer classification is probably needed before a treatment method can be proven effective. Progressive strengthening exercise therapy has shown some effectiveness in treatment of chronic LE compared to control group (Pienimaki 1996). There are no long term studies of adequate methodological quality on manual therapy. However, there appears to be some evidence of positive initial effects in favour of elbow manipulative therapy techniques (Bisset et al. 2005)

Therefore it is not surprising that LE can be a very difficult condition to treat, especially in its chronic state, despite its rather simple appearance. This is also the author´s experience of the management of the condition and has raised his curiosity to investigate the differential diagnosis further. In the author’s opinion, the differential diagnosis is specifically important because obviously identifying the underlying cause for the development of symptoms is necessary to address the problem in the best possible way. It is therefore necessary to try to differentiate between; a) Remote structures from local structures as a source of pain such as: referred pain from the cervical/thoracic spine or nearby joints such as wrist and shoulder and neuromeningeal structures b) Local structures such as muscles, joints, ligaments and fascia.

The examination and treatment procedures described in this case report are based on the manual therapy concept of Maitland (2005a, b). Maitland described a systematic approach to the examination and treatment of the patient’s presenting signs and symptoms. That includes detailed subjective examination and building of hypothesis that are tested with the physical examination. The physical examination includes active and passive movement testing, muscle testing, soft tissue examination and other tests in order to reproduce the patient´s symptoms and differentiate between structures causing the symptoms. The passive movement testing is divided into passive physiological movements (PPM) and passive accessory movements (PAM) when referring to the peripheral joints, but passive physiological intervertebral movements (PPIVM) and passive accessory intervertebral movemens (PAIVM) when referring to the vertebral spine. The mobilisation´s techniques are graded by how far into the resistance of the joint the mobilisation is given, grade I being the most gentle technique and grade V a manipulative thrust. The techniques are also used differently when the patient´s primary problem is pain, stiffness, combination of pain and stiffness and spasm. The Maitland concept highlights the importance of reproducing the patient´s symptoms or "comparable signs" when examining movement disorders. "Comparable signs" refer to signs from the tested structures (e.g. pain, stiffness, motor response) that the examiner considers comparable with the patient´s symptoms as described in the subjective examination. The procedures that provoked the patient´s symptom or the comparable signs are frequently used as a reassessment procedure in the following sessions to monitor progression of the treatment. Since the value of the treatment technique on the presenting signs and symptoms may be assessed, the physiotherapist is left with the ability to find the most effective treatment technique. The physical and subjective examination findings contribute to the physiotherapist´s diagnosis which is most often presented in a form of a movement disorder. When stating the structure causing the patient´s problem the physiotherapist can come to the most accurate diagnosis by setting up a hypothesis and trying treatment according to it and by assessing and by reassessing the movements that provoked the patient´s symptoms or comparable signs.

Maitland (2005a) describes differential procedures where the test movement is at the point in the range of reproducing the patient´s symptoms, further movement is produced in one of the two joints or structures which at the same time, either reduces the movement in the joint or retains it at an unchanged degree of mechanical stress. This test, which increases the stress at one joint or structure and reduces it at another, will either increase or decrease the reproduced pain. In this case of lateral elbow pain these procedures are only useful once other differentiation tests have been performed. It´s important to first determine if the elbow movements are involved before discriminating between the local elbow joints. Then there is a need for special tests such as ULNT or PAIVM of the cervical joints to exclude these structures as a source of symptoms. Maitland uses the concept of segmental dysfunction where the joints of the vertebral spine can refer pain to peripheral structures. The uses of the Maitland concept is by trying to provoke the patient´s symptoms with these tests and assess the effects of trial treatments of the remote structures on the local signs and symptoms found if there are any.

In this case of lateral elbow pain the test procedure of active movements, PPIVM and PAIVM of the cervical and thoracic spine will be used to show any indication of a referred pain from these areas. Also the ULNT2b (radial nerve) will be used to investigate the contribution of the neuromeningeal structures to the problem. If these procedures do not provoke any of the patient´s symptoms the local structures are examined carefully. That includes differentiating between local structures of the elbow region, especially laterally, such as local joints and musculotendinous structures. Differentiation of local joints includes differentiation between radiohumeral, radioulnar and humeroulnar joints. When supination and pronation provokes the patient´s symptoms, it is possible to differentiate between the radiohumeral and the superior radioulnar joints in the following way according to Maitland (2005a). By adding radial or ulnar deviation to the pro/supination movement a compression/distraction component of the radial head is added to the movement and therefore it is possible to discriminate between those joints. Also by adding medial compression to the head of the radius it creates increased compression on the radioulnar joint and therefore it could suggest the involvement of that joint if the symptoms were increased. If the symptoms are provoked in flexion or extension it should not have any effect on the symptoms provoked if the radial head is moved in an anterior/posterior direction and that could be used to differentiate the humeroulnar joint from the others. An isometric testing and stretching of the wrist and finger extensors can be used to see if the musculotendinous structures are involved, but the isometric testing will also increase the compression of the joints of the elbow.

3. Purpose

The purpose of this case report is to describe an examination and treatment process, from a manual physical therapy perspective, of a patient with lateral elbow pain with a special consideration of the differential diagnosis of the problem.

4. Material and methods

Design

Prospective case report.

The patient

The patient was included in the case report after being the first patient after 15. January 2009 to fulfill the following inclusion criteria: Lateral elbow pain for at least 4 weeks duration, without any history of recent fractures of the area. No other treatment for a month prior to the inclusion. Three other patients were excluded; one had only minor symptoms after having treatment over the last year, the latest treatment being 6 months ago. The other had had their latest treatment sessions only two weeks before referral to the author´s clinic.

Pre-clinical data

The patient was referred to treatment with a history of achilles tendinitis which was addressed and the second problem, which was not mentioned in the referral note from his doctor, was lateral elbow pain. No medical imaging had been taken of the cervical spine or the elbow.

Subjective examination

The subject of the case report is a 39 years old caucasian male. He is unmarried but has been in a relationship for many years. His hobbies are rifle hunting and fly-fishing which he does a lot of with his partner. He works out five times a week, a combination of endurance and strengthening exercises with free weights and exercise-machines. He was referred to physiotherapy for treatment achilles tendinitis of the left side but complained also of LE when he arrived initially to physiotherapy. It was decided to first address the achilles tendinitis and then we started to address the lateral elbow pain.

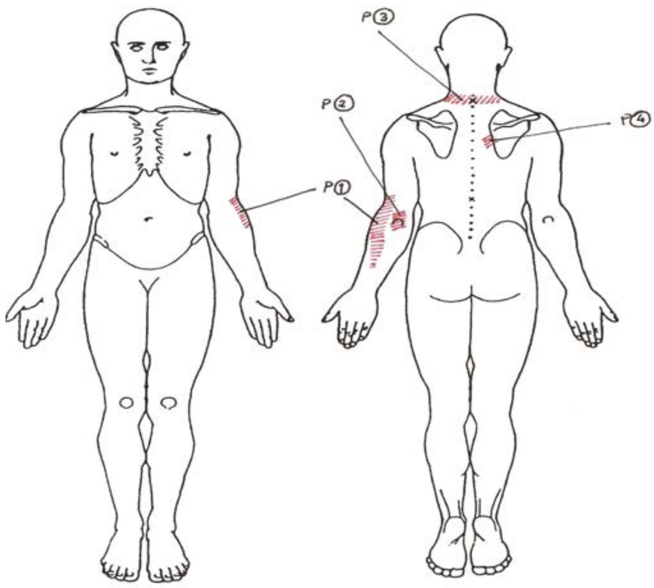

Fig. 1. The patient´s sites of symptoms.

On the initial examination of the second problem the patient complained of pain (P①) lateral on the left elbow that radiated down the radial side of the forearm (Fig. 1). The patient is left-handed. The symptoms developed gradually 6 months ago during a period of fly-fishing where the patient used his left hand to swing the rod. Prior to his fly-fishing vacation, he had been under an increased workload for a period in the hunting store where he works as a salesman and takes care of the inventory. The patient also reported a minor ache (P②) posterior over the olecranon region which he could not discriminate from P① in relation to onset or aggravating activities. The patient described P① as a constant ache/stiffness, about 0.5/10 on a numeric pain rating scale (NPRS) (Paice and Cohen 1997) that changed to a sharper pain of 8/10 with activities involving gripping, e.g. door knobs, or lifting e.g. a milk carton with the left arm and handling heavy rifles at work. The pain is provoked immediately by the first movement but if he repeats these movements the pain can linger on for 30-60 minutes. On average the patient rates the present pain about 5/10. No night pain was present but occasionally he experienced stiffness and pain with the first movements of the elbow in the morning if he had slept in an awkward position. No circadian rhythm of pain was present. The elbow pain was at its peak three months after its onset, on average 7/10, which the patient related to heavy workload at that time.

At the time of the initial visit the patient complained also of some neck stiffness (P③) with end range movements, more on the left side than the right. Also he had pain medial to the right scapula (P④) when he turned his head, more when he turned to the right than left.

The patient had not received any form of treatment for his elbow pain and was not taking any medication. He was in a good general health but is a former smoker. He did take NSAID (Voltaren rapid) for three days for pain medial of the right scapula but found no change of elbow symptoms, but got a little better of his scapular pain. No medical imaging had been taken of the elbow or the neck. The patient had a history of repeated fractures, five times, of the left metacarpal bones IV-V after fist fighting in his younger years.

No signs of psychosocial yellow flags were present at the time of the initial examination which was searched for during history taking. He had adapted his movements to his elbow pain without stopping the use of his hand. He was one of two that managed the hunting store so he didn´t feel any pressure from the workplace and was in a healthy relationship with his partner. The patient had no compensation claim going on. When scanning for red flags the patient had: a normal appetite, no change in weight, increased energy after he stopped smoking , no night pain and no change in bladder or bowel habits.

There was no previous history of similar symptoms in the left elbow but he had had similar symptoms in his right elbow many years ago. He had got a steroidal injection at that time and got completely free of his symptoms. He said though that he was not eager to get these shots now. He had a history of occasional wry neck, the last time was 7 years ago when he was working as an engineer on a trawler.

The patient’s expectations were to get better for the next fishing season after 6 months. He said though that he was very relaxed about his symptoms. His own ideas about the condition were that it was entrapment of a nerve which he had often heard of, but didn´t have a good understanding of.

Clinical reasoning following the subjective examination

When screening for red flags there do not seem to be any obvious signs of any serious underlying pathology, although he had recently stopped smoking which is a red flag according to Greenhalgh and Selfe (2006). I believe there were no yellow flags present and the patient was coping well with his condition, adjusting his activities a little without stopping them. He had no problem taking care of his work even if he experienced some symptoms. There were not seeking any compensation because of his elbow pain. In terms of predisposing factors the weightlifting could be irritating the condition but the patient claims that he is avoiding exercises that provoked the symptoms and has adjusted his exercises according to that.

Regarding pain mechanisms involved, P① seems to be a nociceptive mechanically induced pain because of its clear connection to activities such as gripping and lifting and because it is provoked immediately by the first movement. An entrapment of the radial nerve is also thought to be a possible factor in development of LE so a peripheral neurogenic pain mechanism could be involved. The patient reports a constant ache of 0.5/10 on a NPRS that could point in a direction of an inflammatory component, but studies have confirmed lack of inflammatory components in chronic LE (Alfredson et al. 2000) The patient has a history of a wry neck and complained of neck stiffness at the initial visit so a mechanism of a nociceptive referred pain cannot be rejected at this point nor a peripheral neurogenic pain mechanism from a root compression in the cervical spine although there are no obvious signs of a disc lesion present. It would also be relevant to screen for referred pain especially from the wrist and hand because of his repeated metacarpal fractures in the past. No clues were to suspect a referred pain from a visceral origin e.g. from the heart or lungs. The condition has continued over six months and is in a chronic state. Therefore a central sensitization of the central nervous system could be an issue but there is nothing other than the time factor of the problem that indicates that this type of pain mechanism is involved. There are no phychosocial signs neither in his work or personal life that could lead to that suspicion.

The onset of his symptoms was when he was fly-fishing which points in a direction of overuse of local structures of the elbow. Common structures that are thought to be involved when local structures are the source of pain include the extensor muscles of the forearm and/or peri- and intraarticular structures of the elbow joints and the radial nerve. Other structures that are not possible to reject at this point are the cervical joints and the neuromeningeal tissues. According to McGuckin (1986) the intra- and periarticular part of the facet joints of the lower neck have been shown to refer pain to the elbow region. Also an entrapment of the radial nerve is often thought to be responsible for lateral elbow pain (Albrecht et al. 1997). Referred pain from remote structures are less likely to be responsible considering the relatively vague symptoms in the patient´s neck and the lack of neurological symptoms such as dysaesthesia or sensory loss.

Plan for the physical examination

In general the plan for the examination was to try to screen for the remote structures as the source of symptoms and as suspected that the local structures of the elbow were responsible then to differentiate between the muscles, joints or the neural tissue. The screening would include the cervical and thoracic spine, shoulder, wrist and the neuromeningeal tissue. Also the plan was to look for any predisposing factors that could explain the persistency of the problem and there would the posture and analysis of movements be important.

Results measurements for the treatment

Body function level

The patients primary problem is pain with various gripping activities, e.g. as he mentioned in the subjective examination; swinging a fishing rod, handling guns and lifting things at work. The changes in pain with gripping and handling activities overall were assessed by a verbally used Numeric Pain Rating Scale (NPRS) which has been found a valid and reliable measurement of pain and a useful alternative to the Visual Analogue Scale (Paice and Cohen 1997).

Fig. 2. Grip strength with the standard positioning. (Without permission, only for evaluation)

Pain provoking motions and tests from the physical examination were noted and used to monitor the progression of the treatment. Grip strength measuring device (Baseline Hydraulic Hand Dynamometer, Irvington, New York) was used to measure maximal grip strength and pain free grip strength of the affected side. A standard positioning was used (Fig. 2).

Activity level

The most disabling activities of the patient was measured with the Patient Specific Functional Scale (PSFS) (appendix 1) developed and validated by Stratford et al. (1995) and many other studies have found the questionnaire a valid and reliable tool (Westaway et al. 1998; Chatman et al. 1997; Cleland et al. 2006). The function of the cervical spine was measured with the Copenhagen Neck Functional Disability Scale (CNFDS) (appendix 2) which was developed and validated by Jordan et al. (1998).

The Patient-rated tennis elbow evaluation (PREE) (appendix 3) questionnaire which measures changes in pain level, the difficulty performing functional tasks and usual daily activities was used. This instrument has been developed and validated by MacDermid et al. (2001) . Other studies have also found PREE valid and reliable (Angst et al. 2005; Rompe et al. 2007).

The PSFS, CNFDS and PREE were translated to Icelandic by the author.

Participation level

The patient had no problems in engaging in social activities, work, sports or leisure time. Therefore, no measures were made on that level.

Physical examination

Table 1. Physical examination findings

Posture analysis

- Standing: Sway-back posture with the weight transferred posteriorly, standing with hyperextended knees, the lumbar lordosis is decreased and he has a long thoracic kyphosis. Slightly elevated and protracted shoulders bilateral. The dorsum of the hands turn forward bilateral but slightly more on the affected side. The position of the olecranon
  Sitting: A tendency to sit in a slumped posture with a protracted shoulder, forward head posture, a decreased lumbar lordosis and an increased thoracic kyphosis.

Screening of remote structures

- Cervical spine: All active movements had full ROM and were pain free with overpressure exept left rotation provoked a known vague local pain on the left side of the lower neck (P③) and medial to the right scapula (P④) Cervical quadrant test produced no symptoms to the left arm.

- Thoracic spine: Extension with overpressure in the upper thoracic spine provoked local pain and rotation to the right provoked the patient´s known pain medial to the right scapula (P④) Flexion, lateral flexion bilaterally and rotation to the left were pain free and had a full ROM.
- Shoulders: All movements were pain free and had a full ROM.
- Wrists: Left palmar flexion with overpressure provoked local pain over the dorsum of the wrist but other movements were painfree. All movements of the wrists had a decreased ROM but equally on both sides.

Screening of neuromeningeal structures

- ULNT 2b (Fig. 3) (radial nerve): normal, slight stretching over the extensor muscles of the wrist but equally on both sides.

Screening of muscle length

- Stretching of the wrist extensors produced P①
- Bilateral shortness/stiffness of pectoralis major
- Bilateral shortness/stiffness of biceps brachi
- Bilateral shortness/stiffness of levator scapula and upper trapezius

Movement analysis of the left elbow

- Active movements:
    - Flexion: Full ROM and pain free.
    - Extension: Decreased ROM (-5°) but pain free.
    - Supination: Decreased ROM (-10°, equally on both sides), provoked at EOR the patient´s known lateral elbow pain (P①).
    - Pronation: Full ROM, provoked at EOR the patient´s known lateral elbow pain (P①).
- Passive physiological movements*:*
    - Flexion: Pain free, full ROM
    - Flexion/adduction: Pain free, full ROM
    - Flexion/abduction: Pain free, full ROM
    - Extension: Decreased ROM (-5°), pain free.
    - Extension/adduction (Fig.4): Provoked local pain around the olecranon, similar to P② (Not full extension)
    - Extension/abduction: Pain free (Not full extension)
    - Supination: Decreased ROM (-10°), EORP (P①) no change in symptom provocation with superior radioulnar compression (Fig. 5) or with radial or ulnar deviation of the wrist.
    - Pronation: Full ROM, EORP (P①), no change in symptom provocation with superior radioulnar compression (Fig. 5) or with radial or ulnar deviation of the wrist.

PAM of the elbow

- Post/ant movement on the sup. radioulnar joint in supination: produced local pain and was stiff
- Ant/post movement of sup. radioulnar joint in pronation and supination produced local pain, equally in either position and were stiff.

Isometric muscle test of the elbow

- Wrist extension: Produced the patient´s known pain (P①)
- Finger extension: Fingers II-III produced the patient´s known pain (P①)
- Supination: Provoked the patient known pain (P①)
- Pronation: Provoked the patient known pain (P①)
- Elbow flexion and extension: Pain free

PAIVM of the cervical spine

- Post/ant unilateral pressure on C5-C7 (Fig. 9) slightly stiff and painful on both sides, no referred pain produced on movement testing

- Post/ant unilateral pressure on T1-T5 (Fig. 10) painful and stiff on both sides, worse on the right than the left side but do not provoke any referred pain.

Palpation

- Extensor carpi radialis brevis and longus muscles are painful on palpation. The radial side of the olecranon fossa and the supinator muscle on the radial side of the ulna are painful on palpation: The lateral epicondyle is slightly painful on palpation. Slight pain when the annular ligament and the head of the left radius is palpated. 1st. ribs were stiff and painful on both sides with caudal movement.

Special tests:

- Maximal grip strength measurements (standard positioning)
    - Left hand: 36 kg (P① was provoked during testing)
    - Right hand: 42 kg (without symptoms in the right elbow)
- Maximal pain free grip strength (standard positioning)
    - Left hand: 18 kg before P① started

Fig. 3. ULNT2b (testing of the radial nerve).

Fig. 4. Extension/adduction of the elbow, both used in examination and treatment.

Fig. 5. Pro/sup of the elbow with compression of the superior radioulnar joint.

Reliability and validity of specific examinations methods

The upper limb neural tests (ULNT) which evaluate increased nerve mechanosensitivity have been studied for reliability and the study of Schmid et al. (2009) demonstrated that these tests have moderate to substantial reliability. Shacklock (1996), demonstrated in a case report that the ULNT was sensitive and specific in a patient with a surgically proven nerve entrapment and that it was more sensitive than routine neurological examination and ultrasound scanning for neuropathy.

Palpation is widely used among physiotherapists. The quality of the published studies on the reliability and validity of spinal palpatory procedures needs to be improved (Myburgh et al. 2008; Najm et al. 2005). Soft tissue and segmental motion tests have not been shown to be either reliable or valid although pain provocation tests are mostly reliable and demonstrate higher sensitivity (Najm et al. 2005).

The author did not find any information on the reliability or validity of specific mobilisation procedures of the elbow that is described in Maitland (2005a).

Clinical reasoning following the physical examination

The results of the physical examination points in a direction of structures provoking the lateral elbow pain. The symptoms were provoked with isometric muscle testing of the wrist and finger extensor of the left arm and also with pro- and supinaton. The extensor carpi radialis brevis and longus and the supinator were painful on palpation. Also the passive movements of pronation and supination provoked the patient´s symptoms together with the combined movement of extension/adduction but this movement provoked the patient´s posterior elbow pain more. Joint signs are most obvious from the superior radioulnar joint when accessorial movements are tested (Maitland 2005a). Both the posterior/anterior movements and anterior/posterior movements of the radial head provoke lateral elbow pain. Posterior/anterior movement provoked only symptoms in supination, but anterior/posterior movement provoked lateral elbow pain in both supination and pronation. In the radioulnar joint there was a stiffness-pain relationship, that is the stiffness came before pain in the movement testing which is relevant to notice when planning the treatment according to Maitland (2005a). These joint signs do however not totally exclude other structures such as the radial nerve as a source of symptoms, but ULNT 2b was negative which does not support the hypothesis of neuromeningael tissue as a source of symptoms. “Comparable joint signs” are found on the in the lower neck where C5-C7 and T1-T5 are slightly painful and stiff , though on both sides. This however has not provoked any referred pain to the elbow region. Stiff facet joints of the vertebral spine are thought to be a possible source of referred pain in remote regions (McGuckin 1986) and the studies of Berglund et al. (2007) have demonstrated a higher prevalence of thoracic and neck pain in patients with LE compared to a healthy control group.

Working hypothesis in relation to structures that provoke the lateral elbow pain (P①) after the physical examination are in order of priority: 1-2. Wrist extensor muscles, and the supinator muscle and the radioulnar joint. 3. Referred pain from the cervical or thoracic vertebral spine. The structures provoking the posterior elbow pain (P②) could involve the movements of the olecranon.

In relation to the predisposing factors the posture of protraction of the scapula, a medial rotated humerus and pronation of the forearm could be a factor in the chronicity of the problem (Sahrmann 2002) This positition exposes the wrist and finger extensor to a higher load if the patient is used to lifting and handling things from this position with the palm facing down. This is a matter that should be addressed with the patient and the faulty alignment corrected with exercises. The impression that the author got when interviewing the patient was that he is a person that is more likely to do too much than too little despite his pain. This is also a matter that should be addressed with the patient.

The following examination findings were used to monitor progress in treatment: pain with gripping, EORP with supination and pronation, pain with isometric wrist extension and pain with mobilisation of the radioulnar joint in posterior/anterior and anterior/posterior direction, pain with mobilisation of the elbow in extension/adduction direction and a transverse pressure on the radial side of the olecranon.

Treatment

The whole process of examination and treatment was over a period of 6 weeks. The patient received a total of 8 treatments over a five weeks period. The patient was scheduled to come twice a week but did not show up on four occasions due to the fact he could not get off work and was sick on one occasion.

Broadly the intervention consisted of local mobilisation of the elbow joint, mobilisation of the cervical and thoracic spine, strengthening exercises for the elbow and the whole upper quarter and advice and correction of faulty ergonomics and postural habits. The mobilization techniques were performed and described by Maitland (2005a). In each session the patient´s relevant objective findings were assessed and reassessed. Pain with gripping in a 90°of elbow flexion and neutral supination/pronation in supine lying was assessed by a NPRS. Also the relevant subjective information was gathered at the start of each session. The treatment sessions consisted of the following procedures (table 2).

Table 2. Description of treatment procedures

Mobilisation of the elbow:

- Mobilisation of the superior radioulnar joint in a posterior/anterior direction (Fig. 6)
- Mobilisation of the superior radioulnar joint in an anterior/posterior direction (Fig. 7)
- Mobilisation of the olecranon on the radial side (Fig. 8)
- Extension/adduction mobilisation of the elbow (Fig. 4)

Mobilisation of the cervical spine and 1.rib

- Unilateral posterior/anterior mobilisation of C5-C7 segments (Fig. 9)
- Unilateral posterior anterior mobilisation of T1-T5 (Fig. 10)
- Mobilisation of the 1. rib bilateral in a caudal direction (Maitland 2005b)

The mobilisation techniques were graded according to Maitland (2005a,b). The effect of the mobilisation was mesasured as described above by using the patient´s self-reported pain (NPRS) with gripping in 90°of elbow flexion in the start of each session and self reported present pain (NPRS). The immediate response of the mobilisation were assessed with the same measurements and also with isometric wrist extension.

The patient was given an exercise program for the upper quarter on the first day of treatment. The exercise program is described in table 3. The patient was instructed to use both concentric and eccentric muscle strength for all exercises. The patient was also given an instruction of maintaining good posture at all times while doing exercises with the special importance of a good alignment of the vertebral spine and the scapula. The resistance of the forearm exercises was adjusted so that it would not or only provoke mild pain. The patient was instructed to do 3 sets of 15 repetitions for each exercise but always to take care not to provoke more than mild pain.

Table 3. Strengthening exercises for the upper quarter.

Exercise:	*Repetitions and sets:*
Wrist extension: Sitting with the upper arm by his side with a 90° flexion of the elbow with the forearm resting on a table in a pronated position. Use dumbbell as a resistance.	3 sets of 8-12 repetitions
Wrist flexion: Sitting with the upper arm by his side with a 90° flexion of the elbow with the forearm resting on a table in a supinated position. Use dumbbell as a resistance.	3 sets of 8-12 repetitions

Wrist ulnar/radial deviation: Sitting with the arm by his side with elbow exended. Wrist in neutral position of dorsal/palmar flexion. Perform ulnar/radial deviation.	3 sets of 8-12 repetitions
Forearm pronation/supination: Sitting with the upper arm by his side with a 90° flexion of the elbow with the forearm resting on a table in a neutral position of pronation/supination. Use dumbbell as a resistance. Perform pronation and supination of the wrist.	3 sets of 8-12 repetitions
Scapular retraction/depression: Sitting in front of a pulley with two handles, pull into elbow flexion, shoulder extension and scapular retraction/depression.	3 sets of 8-12 repetitions
Biceps: Standing with upper arm slightly flexed. Perform elbow flexion/extension, use dumbbells.	3 sets of 8-12 repetitions
Triceps: Standing with upper arms slightly flexed. Pull down on a pulley into elbow extension with forearms in pronation.	3 sets of 8-12 repetitions
Shoulder press: Sitting with dumb-bells in each hand, arm by side with elbows flexed. Perform full shoulder elevation in a scapular plane and extend the elbow.	3 sets of 8-12 repetitions
Lateral rotation of the shoulder: Standing with the upper arm at his side, 90°flexion of the elbow. Perform lateral rotation from about 30°of internal rotation – 30°of lateral rotation of the shoulder. Use a pulley.	3 sets of 8-12 repetitions

The patient was given instruction of correcting postural faults and advise about ergonomics on the second visit which is outlined in table 4. He was instructed to try to be aware of his tendency to fall into the faulty posture and to correct it. It was also emphasied which exercises were supposed to correct the postural faults.

Table 4. Postural correction and advidces about ergonomics.

Postural faults:

- *Scapular protraction and elevation.* The patient was instructed to keep good vertebral alignment and “setting” the scapula where he was educated in retracting and depressing the scapula.
- *Dorsum of the hands facing forward.* The patient was made aware of the connection between the scapular position of protraction and pronation of the forearm and the position of the hand. He was instructed in trying to avoid this position and avoid pronating the forearm too much.

Ergonomic advises:

- Avoid lifting with the palm facing downwards.
- Avoid aggrevating his symptoms with lifting too heavy objects.

Treatment sessions

Fig. 6. Posterior/anterior mobilisation of the superior radioulnar joint.

Fig. 7 Anterior/posterior mobilisation of the superior radioulnar joint.

Fig. 8 Radial side pressure of the olecranon.

__Sessions 1-4:__

Joint signs of stiffness and pain in the left radioulnar joint were found with the physical examination and the mobilisation techniques that were chosen were aimed at normalising the joint movements and decreasing pain. The mobilisation of the superior radioulnar joint, both in posterior/anterior (Fig. 6) and anterior/posterior (Fig. 7) direction were in 3 sets of 30 seconds to one minute, grades IV to IV+ and pain in rhythm according to Maitland (2005a,b). The patient reported after the first treatment that his constant pain of 0.5/10 on a NPRS had changed to pain free while resting his hand. When tested the pain with isometric wrist extension did not change much but the pain with gripping was decreased after mobilisation of the radiuoulnar joint in posterior/anterior direction immediately. When tested in the beginning of the next session the pain with gripping was still decreased and the patient self reported an overall decrease in pain with various gripping activities. Mobilisation of the superior radioulnar joint in anterior/posterior direction was very tender to begin with and only decreased slightly with treatment. After mobilisation of the radioulnar joint in both anterior/posterior and posterior/anterior direction the passive movements of pronation and supination with overpressure were less painful and showed decrease in pain with every treatment session. Mobilisation in extension/adduction direction the left elbow and the transverse pressure on the radial side of the olecranon (Fig. 8) was aimed at the posterior elbow pain reported by the patient. The mobilisation was again performed with a grade IV to IV + with pain in rhythm in a set of 1-3 for about 30 seconds to 1 minute. There were no immediate effects found other than a slight increase in pain provoked by the mobilisation. However the patient reported that the vague intermittent posterior elbow pain vanished completely after two treatments, though the olecranon fossa on the radial side was still tender when palpated and there was not an obvius change in the pain provoked by the extension/adduction mobilisation. A decision was taken to proceed with the same mobilisation techniques because of the pain reduction with gripping and because of pain was still provoked with extension/adduction and with the mobilisation of the olecranon.

The patient was given an exercise program at the first treatment and could perform the exercises without much exacerbation of symptoms so they needed no adjustments.

The vague pain on the left side of the neck resolved after a mobilisation of the 1st rib and the cervical/thoracic junction in rotation to the left. The unilateral mobilisation of the cervical (Fig. 9) and thoracic (Fig. 10) apophyseal joints bilateral was continued because there was still local pain provoked with the mobilisation even though there was never any referred pain to the elbow provoked.

Fig. 9 Unilateral posterior/anterior mobilisation of the cervical spine. Used in examination and treatment.

Session 5-8

After 4 treatments the gripping was pain free when tested in the beginning of each session. On two-three occasions the pain with gripping was provoked a little with the mobilisation of the superior radioulnar joint but settled again the same day. The passive supination became pain free with overpressure after about six treatments but had shown progress since the

Fig. 10 Unilateral posterior/anterior mobilisation of the thoracic spine. Used in examination and treatment.

first treatment and the pronation with firm overpressure provoked only vague pain over the extensor muscle group. The isometric wrist extension however still provoked pain of 3/10 on a NPRS at the final visit. Extension/adduction mobilisation and mobilisation of the olecranon was still quite painful. The anterior/posterior mobilisation of the superior radioulnar joint was still quite painful. Mobilisation of the cervical and thoracic spine was continued and the unilateral pressure was still painful but the patient reported a relief of tiredness in that area at work.

5. Results

The patient received 8 treatments in a period of six weeks.

Body function level

The pain with various gripping activities in daily life reported by the patient with a NPRS decreased from a maximal score of 3/10 to 0/10 by the end of treatment. Pain with gripping had resolved in the 4^{th} treatment session when tested in the beginning of the session. The isometric wrist extension was decreased from 6/10 to a 3/10 on a NPRS. Passive supination was pain free with overpressure and slight pain with overpressure was still provoked with passive pronation. Extension/adduction mobilisation and the mobilisation of the radius produced considerable pain at the final visit. The patient rated his overall elbow pain on average 2/10 on a NPRS in comparison of 5/10 in the beginning of the treatment.

Grip strength was measured initially when the patient was first examined and then at his final visit. Both the maximal and pain free grip strength was measured. The results is demonstrated in table 5. The table shows that the maximal grip strength with the affected left side increased from 34 kg to 44 kg, a total of 10 kg. The pain free grip strength increased even more or 20 kg, from 20 kg to 40 kg. To give an estimate of normal strength of that particular patient the healthy right arm had a maximum strength of 40 kg which showed consistency from the examination to the final visit. As mentioned in the subjective examination the patient is left handed.

Table 5. Results of maximal and pain free grip strength of the affected side.

Grip strength	Initial	Final	Change (kg)	Change (%)
Maximal	34	44	10	29
Pain free	20	40	20	100

Activity level

Changes in the patients primary functional problems were measured with PSFS and the results are demonstrated in table 6.

Table 6. The patients primary functional problems rated with a PSFS

Activity	Initial score	Final score
Lifting/handle objects at work	5	2
Pcking up and handle a shot gun	5	2
Swinging a fishing rod*	6	-
Average score	5	2

* not counted because the patient did not rate it in the final score

The Patient-Rated Tennis Elbow Evaluation questionnaire was used to measure changes in pain intensity in various situations and functional disability that included various tasks. The questionnaire also included difficulties performing tasks of daily living such as personal activities, household, work and recreational or sporting activities. The results are outlined in table 7. The best score is 0 and the worst is 50.

The results were that the overall score decreased from 35 points to 14 points out of 50.

Table 7. The results of the Patient-Rated Tennis Elbow Evaluation

Categories	Initial score	Final score
Pain	19	9
Specific activities	15	4
Usual activities	16	6
Average (out of 50)	35	14

The patient also filled out the Copenhagen Neck Functional Disability Scale (CNFDS) questionnaire because of his initial complaints of vague neck stiffness and his earlier history of a wry neck. This is scale where 30 points is the worst outcome and 0 is the best. The patient only scored 1 out of 30 points at the initial and final visit.

6. Discussion

This case report describes an examination, differential diagnosis and a treatment process of a patient with LE. Local structures of the elbow were considered the source of symptoms after a referred pain from the cervical and thoracic spine and neuromeningeal structures were discarded with differential testing. The treatment consisted of 8 sessions of mobilisation of the elbow according to Maitland (2005a), strengthening exercises and correction of postural habits and ergonomics. The results were overall pain reduction and with various functional activities and increased strength of the affected side. The relatively good results make it interesting to take a closer look at the diagnostic procedures applied, the measurement methods and whether we are influencing the structures that we intend to or not.

Local or referred pain? Can we trust the diagnostic procedures?

The purpose of this report as mentioned above was differential diagnosis of lateral elbow pain. The answer to the question of we can differentiate on the one hand local structures from remote structures and on the other hand between local structures, has been sought. In this case report the hypothesis was made that the patient´s condition was primarily local to the elbow complex. The hypothesis was made on the ground that the patient´s symptoms were not provoked or any side difference noted during testing of ULNT2b and no referred pain to the elbow region was provoked with testing of the cervical and thoracic spine. But the question is whether the examination procedures of ULNT and provocative tests of the cervical and thoracic spine are reliable and valid or not. The ULNT has been found a valid diagnostic tool in a single case study made by Shacklock (1996), and in a study of Sandmark and Nissell (1995) the ULNT had a specificity of 94% and a sensitivity of 77%. However in a study of Viikari-Juntura (1987 cited Walsh 2005) inter-rater reliability has been found poor but the study of Coppiteters et al. (1999 cited Walsh 2005) showed good reliability so the results of reliability are conflicting. It is important to realize that the interpretation of a positive or negative ULNT is not clear cut and simple. Shacklock (1996) highlights the most important features in distinguishing a positive ULNT. Firstly, provocation of the patient´s known symptoms or to detect a difference in symptoms or motor responses compared to the contralateral side and to what is considered a normal response. The second important aspect of ULNT is structural differentiation, while in the test position a contralateral neck flexion can produce change in e.g. forearm and wrist symptoms. According to McLellan and Swash (1976 cited Shacklock 1996) neck movements produce movement of peripheral nerves at the elbow but not the neighbouring musculoskeletal structures. To complicate the matter even further there is always a possibility that the findings could be false negative or false positive. Shacklock (1996) comments on that matter is that the strongest indicator of an abnormal ULNT must be to provoke the patient´s known symptoms because acoording to Kenneally et al. (1988 cited Shacklock 1996) and Flanagan (1993 cited Shacklock 1996)the ULNT will produce neurogenic symptoms in a normal population.

Shacklock (2005) highlights the importance of some aspects of the ULNT to improve application of neurodynamic testing and treatment. What Schacklock mentions as important points is is threefold; a) structural differentiation where e.g. neck flexion and wrist dorsal/palmar flexion are used to differentiate between neurological and musculoskeletal structures. b) neurodynamic sequencing can also have an influence of symptoms provoked. c) reliability of the examiner, that is that the examiner is well trained to perform the test. The test is only reliable when it is performed reliably. This last point is important in this case report where the examiner is only a student in a manual therapy education. However in this case report the examiner did use the structural differentiation and provoked only mild stretching of the forearm with testing of the ULNT and the symptoms were the same on both sides. Also no difference in glenohumeral abduction ROM was noted in this case but Yaxley and Jull (1993) have demonstrated less neural tissue extensibility with LE. Due to the uncertainty of reliability and diagnostic value of ULNT presented in the literature and the author´s lack of experience in using the test, the ruling out of a nerve aspect in this case cannot be absolute.

PAIVM were used in this case report to evaluate if the cervical spine was involved in the patients LE symptoms. Piva et al. (2006) studied the reliability of various PAIVM and PPIVM of the cervical spine. The results were substantial to moderate reliability for symptom provocation during PIVM of the lower cervical segments. Berglund et. al (2008) demonstrated a higher prevalence of a positive provocation test of the cervical and thoracic spine in patients with LE compared to a control group. However the tests used by Berglund et al. are not the same tests presented in this case report. They assessed the cervical spinal pain with; palpation of the nerve trunk just beyond its exit from the vertebral foramen according to Cyriax and compression of the vertebral foramina according to Kaltenborn. These tests have been tested for validity and reliability by Strender et al. (1997 cited Berglund et al. 2008) and Sandmark and Nissel (1995). However the author of this case report was not familiar with these tests and used active movements of the cervical and thoracic spine and unilateral PAIVM for the assessment of involvement of these areas in the patients symptoms (Maitland 2005b). Berglund et al. demonstrated also that the active movements of cervical extension and flexion were significantly decreased in people with LE. The author is however not aware of any studies that demonstrate the prevalence or sensitivity of a positive PAIVM provocation test in relation to LE. The general examiner´s ability to detect a dysfunction of the spine has also been questioned. Piva et al. (2006) studied the reliability of detecting movement dysfunction with PAIVM and PPIVM of the cervical spine as was mentioned above. The results were fair for the judgement of mobility in the C2 segment and symptom reproduction during PIVM of C2 and C5. Smedmark et al. (2000), also assessed the PIVM of the cervical spine and the inter-examiner reliability was only considered to be fair to moderate. Given the lack of specific studies of cervical dysfunction in relation to LE, as well as the conflicting evidence of the reliability of tests of the cervical spine, we cannot be sure that the cervical spine is not involved in the LE experienced by the patient in this case report.

Structures involved, can we really differentiate between local structures as the source of symptoms?

Maitland´s methods of differential diagnosis were described in the background of this case report. To differentiate between different joints, and weather the symptoms originate from intra- or periarticular structures one can try to add components that either compress or distract a joint and to use isometric muscle contraction to try to avoid joint movement when testing muscles. Direct palpation of structures add to the information of structures involved. Musculoskeletal physiotherapists also use ROM and quality of movement to assess joint function. According to Abbott et al. (2009), do ninety-eight percent of manual physical therapists base treatment decisions at least in part on the results of segmental motion tests, when treating lumbar spine disorders. They found out that the content validity is dominated by concepts of segmental kinematics and the force-displacement relationship. Their results showed also that the intent of assessment varies widely between therapists. But are those methods valid and reliable? Can we really differentiate between local structures, e.g. of the elbow complex, and can we palpate accurately joint movements? As was mentioned above the author has not found any validity or inter- or intra-rater reliability studies of the PAM of the peripheral joints of the elbow. So it´s fair to say that any assessment of stiffness of joints and the movement quality is controversial. But theoretically by using joint compression and distraction, try to move one component of a joint complex like the elbow and keeping another relatively stationary, one can at least get closer to the source of the problem, but without any certainty. To get closer to differentiating between structures, Maitland suggests careful assessment of the responses during treatment and at the end of treatment and when the results are clear, then we are closer to confirming the hypothesis about the source/structures responsible for the symptoms (Maitland 2005a).

Are treatment methods valid? Are we influencing the structures that we intend to?

This question is very much related to differentiating between structures and the validity of passive joint movements. In this case report the treatment methods used were mobilisation of the elbow joints, mainly the superior radioulnar joint, strengthening exercises of the forearm muscles and the whole upper quadrant and postural and ergonomic advice.

In this case e.g. the supination and pronation movements got almost pain free but in the beginning they were painful and stiff. The results of the mobilisation points in a direction of a joint involvement supporting the hypothesis, but then again are we influencing or treating the structures that we think we are. We could be influencing other structures e.g. the interface of the radial nerve which is thought to be involved in at least some cases of LE (Albrecht 1997). However there were some immediate effects of decreased pain with gripping with posterior/anterior mobilisation of the radiohumeral joint that further supports the hypothesis of joint involvement.

Though joint involvement of the elbow pain is proposed, the author considers the musculotendinous structures are also involved. As mentioned above the hypothesis of inflammation of the wrist extensor have not been supported (Alfredson et al. 2000) so the aim of the strength training was a revascularization and collagen repair of the hypothetically pathologic tissue (Nirschl 2006).

The treatment consisted also of unilateral posterior/anterior mobilisation of the cervical and thoracic spine. In the previous history the patient had had some recurrent episodes of pain in both the cervical and thoracic area. The author thought though it was unlikely that the pain in the elbow was caused by the stiffness/and pain with unilateral posterior/anterior pressure because it did not refer any pain to the elbow region or did it show any obvious change on pain with gripping immediately after the intervention. However it´s not possible to reject or confirm the effects of this mobilisation on the elbow region as there has been reported positive effects of cervical spinal mobilisation on patients with LE by Elvey (1986 cited Vicenzino 2003) and Mulligan (1999) although the effect on the exact techniques used in this report has not been studied in relation to LE to the authors knowledge.

When using combined treatment methods as was done in this case it makes it more difficult to distinguish the effects of the individual methods. Though it´s fair to say that the immediate effects of the elbow mobilisation on pain with gripping, the decrease in pain reported with various gripping activities after the first treatment sessions and the decrease in pain with passive supination and pronation with overpressure, supports the hypothesis of a local joint involvement. The isometric contraction of the wrist and extensor muscles was decreased but still provoked pain of 3/10 with gripping on a NPRS in the end of the treatment period. It´s logical that the pain with gripping resolves sooner than isometric wrist and finger extension because biomechanically the isometric wrist and finger extension produced much higher extension load than with gripping.

Measurement methods: Are the results valid?

Are the measurement tools used in this case report measuring what they are intended to? Are the changes seen important to LE? In this case decreased grip strength was noted at the beginning of the treatment and it improved by treatment. The maximal grip strength showed increase of 39% and the pain free grip strength showed 100% increase. These finding of decreased grip strength in patients with LE are well documented in other studies, e.g. grip strength was found to be decreased in patients with LE to about 50% in the affected side compared to the healthy side with the elbow held in full extension and 69% of the healthy side in 90° of elbow flexion (Dorf et al. 2007). This difference between the strength in flexion and extension is thought to distinguish those with LE. Pain free grip strength has shown high reliability and agreement and it is relatively easy to perform, and has been shown to be associated with other measures of functional disability in patients with lateral epicondylitis (Smidt et al. 2002). The American Society of Hand Therapists suggested a standardized arm positioning for grip strength measurments because they concluded that the position of the upper extremity might influence measurements, and recommended that the patient should be seated with his shoulder adducted and neutrally rotated, elbow flexed at 90° and the forearm and wrist in neutral position (Mathiowetz et al. 1985). In this case report the standard positioning was used. The pain free grip strength was measured first followed by the maximal grip strength. The results are only made up of 2 performances of gripping instead of an average of many and that could influence the results. Though the findings of Stratford et al. (1989) suggest that the overall generalize ability can best be enhanced by averaging grip strength measurements recorded from multiple test sessions rather than by increasing the number of repetitions during a single test session.

The PSFS, CNFDS and PREE questionnaires were used in this case report to measure the effects of the treatment. However in this case they had not been translated into Icelandic and had therefore not been studied for reliability and validity on an Icelandic population. For that reason it cannot be concluded that the measurements used here are valid and reliable for this case report subject which is a native Icelander. Due to the limited time frame for this report the author has concluded to use these measurement devices. They have though all been found valid and reliable on a population in the western society though the author understands the influence of the variation between different societies.

The PSFS has been studied and validated by many authors (Stratford et al. 1995; Westaway et al. 1998; Chatman et al. 1997; Cleland et al. 2006) and found the questionnaire a valid and reliable tool. The influence of translation is not important with this questionnaire because the patient states his own functional disabilities in his own words and points at a number to assess the difficulties performing the activity that he has difficulties with. The average change of points in the PSFS were calculated and the results were 3 points change on average in this case. According to the questionnaires guidelines a minimum detectable change (90% CI) for average score are 2 points. The activity of swinging a fishing rod was not counted because the patient did not rate it when the treatments were completed for the reason of he had not done that activity lately.

The PREE has been found a valid, sensitive and reliable questionnaire for pain and function measures of chronic lateral elbow problems (MacDermid 2001; Angst et al. 2005; Rompe et al. 2007). In this case the PREE score went from 35 points to 14 points out of 50. It is suggested that PREE can become the standard primary outcome measure in research of lateral elbow pain (Rompe et al. 2007).

CNFDS was used because of the patient´s vague complains of neck pain but the results showed negligible change, because the patient experienced little disability from his neck to begin with or 1 out of 30 points on the scale. He ended the treatment process with the same 1 point. The CNFDS has been found valid and showed excellent reliability and practicality (Jordan et al. 1998).

In this case report a tendency is shown that a manual physiotherapy examination can differentiate local from remote structures as a source of symptoms in the condition of LE. However, still some clinical uncertainty remains. This report at least supports the usefulness of ULNT as a differential diagnostic tool for LE. However there is even more uncertainty about differential diagnosis of local structures (muscles or joints). Combined therapy seems to have an effect, but more studies are needed of LE to structure the most effective combination of treatment. Further studies of LE should aim at researching the multi-factorial etiology of LE, validity of differential diagnostic tools and classification so the most effective treatment modalities can be found.

7. References

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8. Appendices

Appendix 1: The patient specific functional scale

The Patient-Specific Functional Scale

This useful questionnaire can be used to quantify activity limitation and measure functional outcome for patients with any orthopaedic condition.

Clinician to read and fill in below: Complete at the end of the history and prior to physical examination.

Initial Assessment:

I am going to ask you to identify up to three important activities that you are unable to do or are having difficulty with as a result of your ________________ problem. Today, are there any activities that you are unable to do or having difficulty with because of your ________________ problem? (Clinician: show scale to patient and have the patient rate each activity).

Follow-up Assessments:

When I assessed you on (state previous assessment date), you told me that you had difficulty with (read all activities from list at a time). Today, do you still have difficulty with: (read and have patient score each item in the list)?

Patient-specific activity scoring scheme (Point to one number):

0 1 2 3 4 5 6 7 8 9 10

Unable to perform activity — Able to perform activity at the same level as before injury or problem

(Date and Score)

Activity	Initial					
1.						
2.						
3.						
4.						
5.						
Additional						
Additional						

Total score = sum of the activity scores/number of activities
Minimum detectable change (90%CI) for average score = 2 points
Minimum detectable change (90%CI) for single activity score = 3 points

PSFS developed by: Stratford, P., Gill, C., Westaway, M., & Binkley, J. (1995). Assessing disability and change on individual patients: a report of a patient specific measure. Physiotherapy Canada, 47, 258-263.

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Appendix 2: The Copenhagen neck functional disability scale.

I dette felt vurderes

NAKKE- OG ARM-SMERTER

hver for sig.

Afkryds kun ét felt i hver linje, hvor 0 svarer til slet ingen smerter og 10 svarer til værst mulige smerter.

10 svarer til de værst tænkelige smerter - som f.eks. når en fødsel er på sit højeste - og altså *ikke* (nødvendigvis) til de stærkeste *nakke*-smerter, De har oplevet.

1) NAKKESMERTER

Deres nakkesmerter **NETOP NU:**

Slet ingen smerter — værst mulige smerter

0	1	2	3	4	5	6	7	8	9	10

De **SVÆRESTE** nakkesmerter De har haft ingen for de sidste 14 dage:

0	1	2	3	4	5	6	7	8	9	10

De **GENNEMSNITLIGE** nakkesmerter de sidste 14 dage

0	1	2	3	4	5	6	7	8	9	10

2) ARMSMERTER

Deres armsmerter **NETOP NU:**

0	1	2	3	4	5	6	7	8	9	10

De **SVÆRESTE** armsmerter, De har oplevet indenfor de sidste 14 dage

0	1	2	3	4	5	6	7	8	9	10

De **GENNEMSNITLIGE** armsmerter de sidste 14 dage:

0	1	2	3	4	5	6	7	8	9	10

	ja	nej
Går armsmerterned ned i underarm eller hånd/fingre	☐	☐

DERES VURDERING AF DEN FYSISKE/PSYKISKE FORMÅEN I HVERDAGEN I DEN SIDSTE UGE

Sæt krydst på hver linje:	ja	kan give problemer	nej	ved ikke
1. Klarer De natten igennem uden forstyrrende nakkesmerter? ...	☐	☐	☐	☐
2. Klarer De daglige gøremål uden at nakkesmerterne nedsætter aktiviteten?	☐	☐	☐	☐
3. Klarer De daglige gøremål uden at nakkesmerterne nødvendiggør hjælp fra andre	☐	☐	☐	☐
4. Klarer De at klæde Dem på om morgenen uden at nakkesmerterne medfører at det tager længere tid end normalt?	☐	☐	☐	☐
5. Kan De læne Dem henover håndvasken for at børste tænder uden at få nakkesmerter?	☐	☐	☐	☐
6. Er De mere hjemme end normalt på grund af nakkesmerter?	☐	☐	☐	☐
7. Er de forhindret i at løfte lette genstande (2-4 kg) p.g.a. nakkesmerter?	☐	☐	☐	☐
8. Har De nedsat Deres læseaktivitet p.g.a. nakkesmerter?	☐	☐	☐	☐
9. Har De været generet af hovedpine i samme periode som De har lidt af nakkesmerterter? ...	☐	☐	☐	☐
10. Følger De, at Deres koncentration er nedsat på grund af nakkesmerter?	☐	☐	☐	☐
11. Er De forhindret i at udføre Deres sædvanlige fritidsaktiviteter p.g.a. nakkesmerter?	☐	☐	☐	☐
12. Opholder De Dem længere tid i sengen end normalt p.g.a. nakkesmerter?	☐	☐	☐	☐
13. Hæmmer nakkesmerterne Deres sexliv	☐	☐	☐	☐
14. Har De måttet opgive samvær /kontakt med andre mennesker de sidste 14 dage på grund af nakkesmerter?	☐	☐	☐	☐
15. Tror De, at nakkesmerterne vil få indflydelse på Deres fremtid?	☐	☐	☐	☐

Appendix 3: Patient-rated tennis elbow evaluation.

PATIENT-RATED TENNIS ELBOW EVALUATION

Name ________________________________ Date______________

The questions below will help us understand the amount of difficulty you have had with your arm in the past week. You will be describing your ***average*** *arm symptoms* ***over the past week*** *on a scale 0-10. Please provide an answer for all questions. If you did not perform an activity because of pain or because you were unable then you should circle a "10". If you are unsure please estimate to the best of your ability. Only leave items blank if you never perform that activity. Please indicate this by drawing a line completely through the question.*

1. PAIN in your affected arm	
Rate the average amount of pain in your arm ***over the past week*** *by circling the number that best describes your pain on a scale from 0-10. A* ***zero*** *(0) means that you* ***did not have any pain*** *and a* ***ten*** *(10) means that you had* ***the worst pain imaginable.***	
RATE YOUR PAIN:	No Pain — Worst Imaginable
When your are at rest	0 1 2 3 4 5 6 7 8 9 10
When doing a task with repeated arm movement	0 1 2 3 4 5 6 7 8 9 10
When carrying a plastic bag of groceries	0 1 2 3 4 5 6 7 8 9 10
When your pain was at its least	0 1 2 3 4 5 6 7 8 9 10
When your pain was at its worst	0 1 2 3 4 5 6 7 8 9 10

Please turn the page......

2. FUNCTIONAL DISABILITY

A. SPECIFIC ACTIVITIES
*Rate the **amount of difficulty** you experienced performing each of the tasks listed below, over the past week, by circling the number that best describes your difficulty on a scale of 0-10. A zero (0) means you did not experience any difficulty and a **ten (10)** means it was **so difficult you were unable to do it at all**.*
No Difficulty   **Unable** To Do

Turn a doorknob or key	0 1 2 3 4 5 6 7 8 9 10
Carry a grocery bag or briefcase by the handle	0 1 2 3 4 5 6 7 8 9 10
Lift a full coffee cup or glass of milk to your mouth	0 1 2 3 4 5 6 7 8 9 10
Open a jar	0 1 2 3 4 5 6 7 8 9 10
Pull up pants	0 1 2 3 4 5 6 7 8 9 10
Wring out a washcloth or wet towel	0 1 2 3 4 5 6 7 8 9 10

B. USUAL ACTIVITIES
*Rate the **amount of difficulty** you experienced performing your **usual** activities in each of the areas listed below, over the past week, by circling the number that best describes your difficulty on a scale of 0-10. By "usual activities", we mean the activities that you performed **before** you started having a problem with your arm. A **zero** (0) means you did not experience any difficulty and a **ten** (10) means it was so difficulty you were unable to do any of your usual activities.*

1. Personal activities (dressing, washing)	0 1 2 3 4 5 6 7 8 9 10
2. Household work (cleaning, maintenance)	0 1 2 3 4 5 6 7 8 9 10
3. Work (your job or everyday work)	0 1 2 3 4 5 6 7 8 9 10
4. Recreational or sporting activities	0 1 2 3 4 5 6 7 8 9 10

Comments: