Charles University
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Therapeutic approach to wrist pain.

Bachelor Thesis

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Abstract.

Title: *"Therapeutic approach to wrist pain"*.

Thesis Aim.

In this thesis I will discuss the "wrist pain", and then show my results after six therapeutic sessions with one patient which suffered from pain in the left wrist.

Methods.

In the general part of this thesis there will be an overview of the basic anatomy, kinematics and disorders in the wrist joint related to overuse and pressure. I have been searching many sources to progress on this challenging task. Further, we will go through the special part, where I will show how I was working with this patient for six sessions; including different examinations, treatments and finally the conclusion.

Results.

Improvements of the left wrist were detected in the final kinesiology examination. The general pain was decreased. The shortened muscles were elongated and the restricted range of motion at the wrist joint was increased. The strength of the left wrist flexors and extensors were improved.

Keywords:

- Wrist pain, overload syndrome, nerve compression.
- Weak muscles, restricted range of motion.
- Physiotherapy.

Declaration.

I hereby declare that this Bachelor Thesis has been based entirely on my own individual work and on my own practice that took place in Ustřední Vojenská Nemocnice in Prague from 04.02.2008 till 15.02.2008. All the information used for the development of this Bachelor Thesis has been taken from the list of literature that exists in the end of this Thesis.

In Prague 14.04.2008 *Jan Christian Andersson*

Jan Christian Andersson

Acknowledgement.

I would like to express my gratitude to all those who gave me the possibility to complete this thesis. I am indebted to my supervisor Mgr. Agnieszka Kaczmarska from the Charles University in Prague, whose help, stimulating suggestions and encouragement helped me in writing this thesis. I would also like to express my gratitude to the department of physiotherapy at the Charles University.

Contents.

1. Preface.

Since I was four years old and got my first pair of ski, I have been active in a lot of different sports. For three years ago I decided to apply the physiotherapist program in Prague. The time I have spent here at the Charles University has given me a great knowledge and skills about a variety of diseases, syndromes, injuries and treatment.

During this thesis I will give examples on how I used my knowledge for a general problem. We will go through a session of therapy units which includes examination, evaluation and a therapeutic plan. The general theoretical part is based on publications which helped to define different wrist disorders according to the long term overusing and compression of the soft tissues in the wrist joint.

2. General part.

2.1 Bony and joint anatomy of the forearm and the hand.

The forearm is a part of the upper limb which is situated between the elbow joint and the wrist joint. The elbow joint is a ginglymus formed by the humerus and ulna and the radius. Movements are flexion and extension. In the proximal part of the forearm, most of the major structures pass between the arm and the forearm goes through the cubital fossa, which is situated anteriorly to the elbow joint. In the distal part of the forearm, the structures go from the forearm to the hand through the carpal tunnel, which is situated on the anterior aspect. The bone framework of the forearm consists of two parallel bones, the radius and the ulna (4).

2.1.1 Radius and ulna.

In the proximal part of the forearm the radius is in a lateral position and it is small in size. In the distally part, where it forms the wrist joint with the carpal bones, it has a much larger size. The proximal end of the radius contains a head, neck and the radial tuberosity. The distal end consists of the radial styloid process, the ulnar notch, facet for articulation with the scaphoid bone and the lunate bone. In the proximal part of the forearm the ulna is placed medially, and it has a much greater size than in the distal place. The proximal end of the ulna is bigger than the the proximal part of radius and contain olecranon, the radial notch, the trochlear notch, the coronoid process and the tuberosity of ulna. The distal end consists of the ulnar styloid process and a rounded head covered by articular cartilage (4).

2.1.2 Interosseous membrane.

The interosseous membrane is a thin fibrin sheet and it connects the medial border of the radius to the lateral border of the ulna. In the anterior and posterior compartments, the membrane provides attachment for muscles. The collagen fibers in the membrane transfers forces from the radius to the ulna and therefore also transferring forces from the hand to the humerus (4).

2.1.3 Joints between the radius and ulna.

The distal radioulnar joint is situated between the articular surface of the head of the ulna, with the ulnar notch on the end of the radius, and with a fibrous articular disc, which separates the radioulnar joint from the wrist joint. The fibrous disc has a triangular shape and is attached to the ulna between the styloid process and the articular surface of the head, and to the radius between the ulnar notch and the articular surface of the carpal bones. The articular disc is a thin, oval plate of fibrocartilage and it separates the synovial cavities (4).

The midcarpal joint is the articulation between the proximal carpal row and the distal carpal row including the trapezium, trapezoid, capitate and the hamate bone (28).

2.1.4 The wrist joint.

The wrist joint is classified as a synovial joint or diarthroidal joint, and are the most common and most moveable type of joint in the body. The whole of a diarthrosis is contained by a ligamentous sac called the articular capsule. Inside this capsule there is a lubricating synovial fluid. The capsule in the wrist joint contains ligaments, palmar radiocarpal, palmar ulnocarpal and the dorsal radiocarpal (35).

Carpal bones.

The carpal bones are described as two rows. The proximal row consists of the scaphoid, lunate, triquetrum, and pisiform. The distal row consists of the hamate, capitate, trapezoid, and trapezium. The carpal bones are held together by the shape of the carpal bones and interosseous/intrinsic ligaments, as well as palmar, dorsal, radial, and ulnar extrinsic ligaments. Intrinsic ligaments originate and insert on carpal bones. Extrinsic ligaments cross between the carpal bones and the radius or the metacarpals. Additional ligaments of the wrist include components of the triangular fibrocartilage complex and the transverse carpal ligament (4).

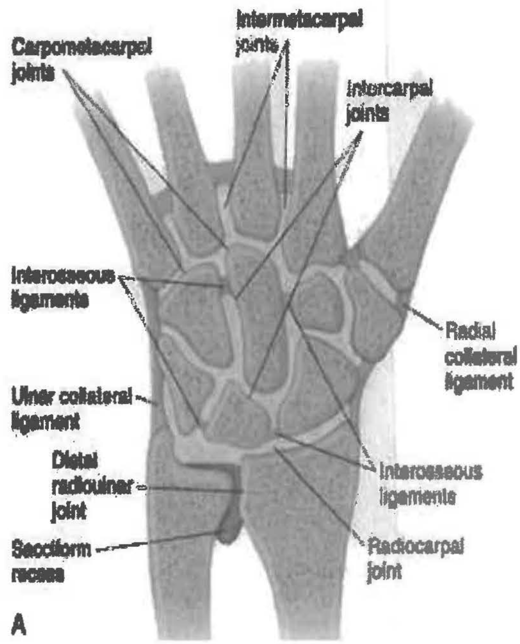


Figure 1: Ligaments of the wrist (I).

The wrist joint is made up by two joints, the radiocarpal joint and the midcarpal joint. The radiocarpal joint is formed by the articulation of the proximal carpal row (scapoid, lunate, triquetrum and pisiform) and the articular surface of the distal part of radius and the triangular fibrocartilage complex (considered as the wrist meniscus) (28). This radioulnar disk is situated proximally, and because this articular disk is located between the ulna and the proximal row of carpals, the ulna is not considered part of this joint (3). The pisiform, located in the proximal row, does not articulate with the disc because it is more anterior to the triquetrum. It is therefore not considered as a part of this joint (4).

The extensor retinaculum and the transverse carpal ligament.

The extensor retinaculum is a strong fibrous band formed as a thickening of the antebrachial deep fascia, stretching obliquely across the back of the wrist, attaching deeply to ridges on the dorsal aspect of the radius, triquetral and pisiform bones, binding down the extensor tendons of the fingers and thumb (49). The extensor retinaculum lies distal to the radial joint, spans across the carpal bones, forming a bridge over the extensor tendons (36).

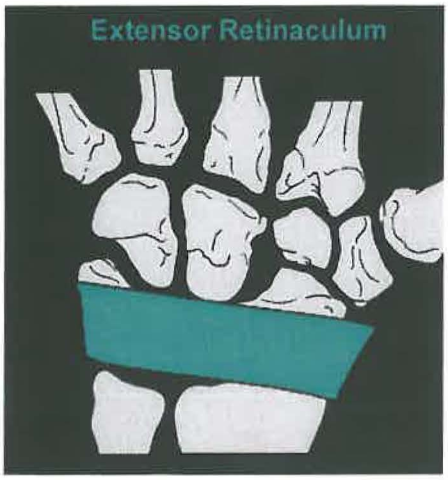


Figure 2: Extensor retinaculum (II).

The transverse carpal ligament also called the flexor retinaculum is a band of fibers which runs between the hamate and the pisiform medially to scaphoid and trapezium laterally, and forms fibrous sheath which contains carpal tunnel anteriorly within fibro-osseous tunnel (40). All the thenar and the hypothenar muscles, except the abductor minimi, originate partly from the transverse carpal ligament.

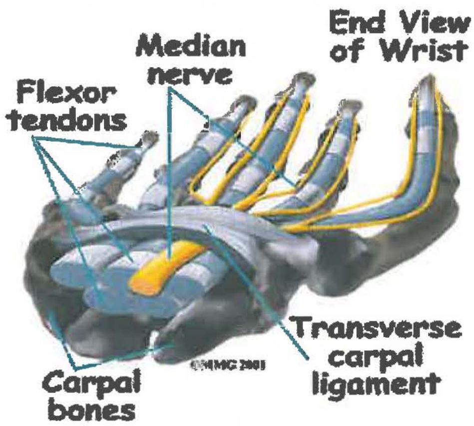


Figure 3: Transverse carpal ligament (III).

2.1.5 Hand.

Metacarpophalangeal and interphalangeal joint of thumb.

The metacarpophalangeal joint of the thumb is a condyloid joint between the distal end of the first metacarpal and the end of the proximal phalanx. The interphalangeal joint of the thumb is a ginglymus joint between the proximal and distal phalanx. Movements are flexion and extension in an ulnar and radial direction. The metacarpophalangeal joint also provides a slight abduction, adduction and rotation (14).

Carpometacarpal joint of thumb.

This is a saddle joint formed by the trapezium and the first metacarpal. Movements are flexion, extension, abduction, adduction and circumduction. It has also slight rotation as a result from the combination of basic movements. In the thumb and little finger, opposition is a combination of abduction and flexion with medial rotation of the carpometacarpal joints and flexion of the metacarpophalangeal joint (14).

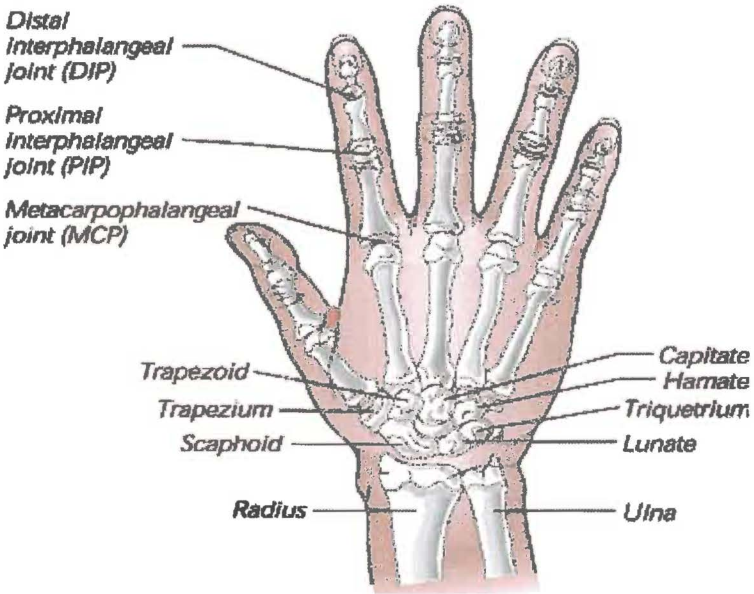


Figure 4: Hand (IV).

Carpometacarpal joints of fingers.

Between the distal row of carpal bones and the proximal end of the metacarpal bones, we find five carpometacarpal joints. The carpometacarpal joints between metacarpals two to five and the carpal bones are less mobile than the carpometacarpal joint of the thumb, because they allow only sliding movements (4).

Metacarpophalangeal joints of fingers.

They are condyloid joints formed by the uniting distal ends of the metacarpals with the adjacent ends of the proximal phalanges. Movements are flexion, extension, abduction, adduction and the combination of all these movements circumduction (14).

Interphalangeal joints of fingers.

They are ginglymus or hinge joints and are formed by uniting the phalanges. Movements are flexion and extension (14).

2.2 Muscles, nerves and fascia anatomy of the forearm and the hand.

2.2.1 Muscles.

Muscles of the forearm act on the elbow and wrist joints and on those of the digits.

Here is an overview of muscles according to movements from Kendall (14):

Dorsal flexion (figure 5):

Extensor carpi radialis longus, radial nerve.

Extensor carpi radialis brevis, radial nerve.

Extensor carpi ulnaris, radial nerve.

Extensor pollicis longus, radial nerve.

Extensor digitorum, radial nerve.

Palmar flexion (Figure 6):

Flexor carpi radialis, median nerve.

Palmaris longus, median nerve.

Flexor carpi ulnaris, ulnar nerve.

Flexor digitorum superficialis,median n.

Flexor digitorum profundus median nerve.

Abductor pollicis longus, radial nerve.

Flexor pollicis brevis, median nerve.

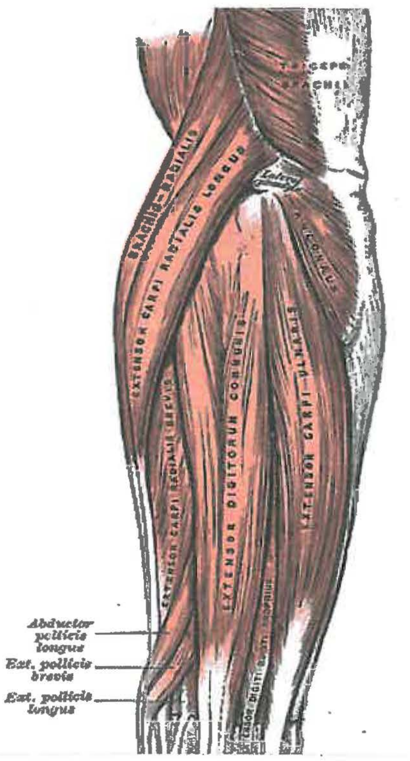


Figure 5: Posterior. Superficial muscles (V)

Figure 6: Anterior. Superficial muscles (VI).

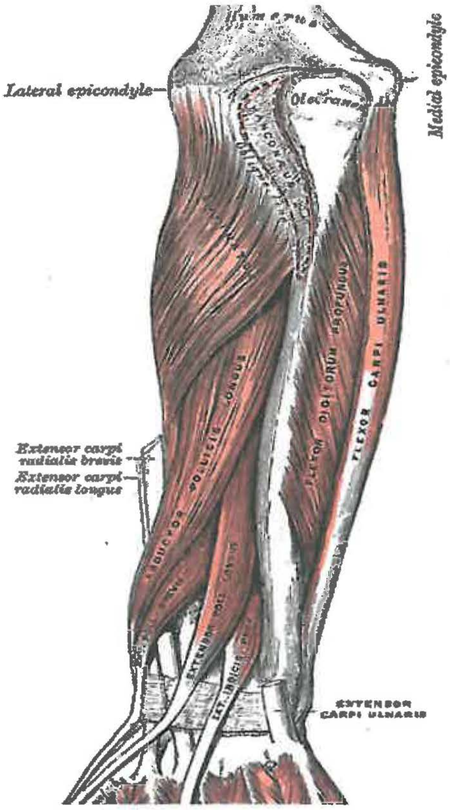


Figure 7: Posterior. Deep muscles (VII).

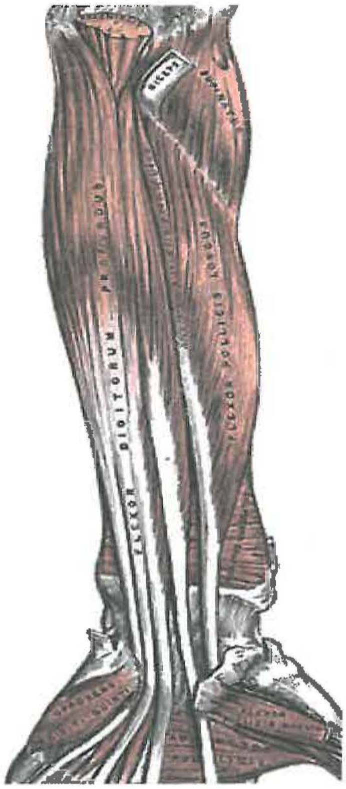


Figure 8: Anterior. Deep muscles (VIII).

Radial duction (abduction):

Abductor pollicis longus, radial nerve.

Flexor carpi radialis, median nerve.

Extensor carpi radialis longus, radial nerve.

Extensor carpi radialis brevis, radial nerve.

Ulnar duction (adduction):

Flexor carpi ulnaris, ulnar nerve.

Extensor carpi ulnaris, radial nerve.

Pronation:

Pronator teres, median nerve.

Pronator quadratus, median nerve.

Supination:

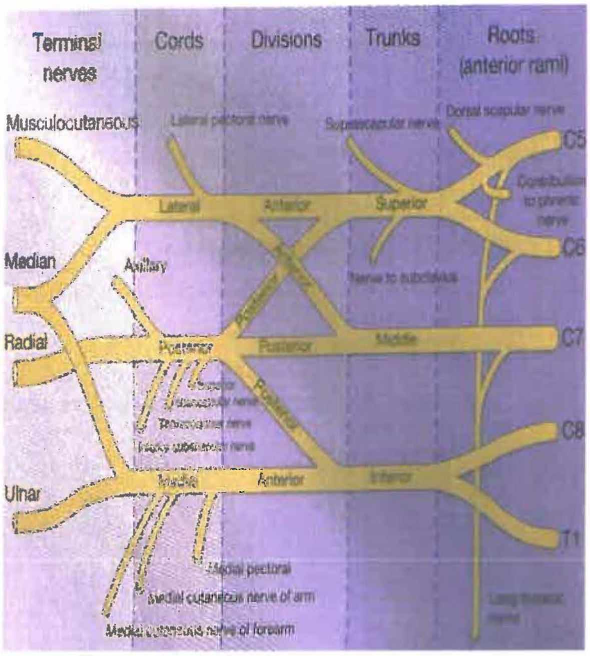
Biceps brachii, musculocutaneous nerve.

Supinator, radial nerve.

2.2.2 Nerves.

The nerves of the upper extremity originates in the spinal cord from the first cervical to the first thoracic vertebral section and are commonly classified as motor nerves, sensory nerves, or mixed nerves containing both motor and sensory capabilities (1).

Figure 9: Brachial plexus (IX).



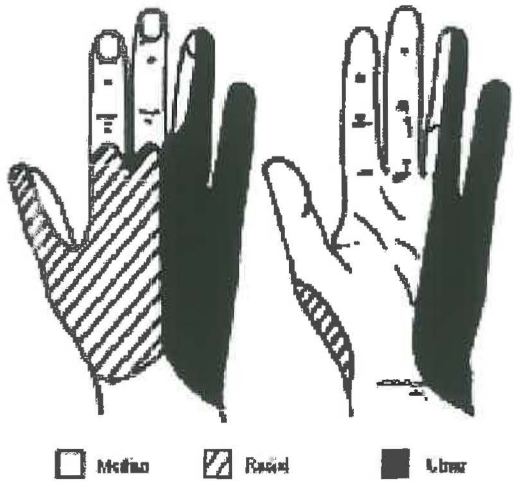
Nerves of the brachial plexus.

Spinal nerves have both anterior and posterior rami (branches or arms). The anterior rami form the brachial plexus (1)
As seen in Figure 6, it can further be dived into superior, middle and inferior trunks, followed by divisions (anterior, posterior), cords (lateral, posterior, medial), and finally the terminal nerves.

Ulnar Nerve (C7, C8, T1).

The ulnar nerve enters the forearm between the medial epicondyle and the ulnar head of the flexor carpi ulnaris. It enters the cubital tunnel and it goes between the flexor carpi ulnaris and the flexor digitorum profundus. In the distal forearm, the ulnar nerve lies on the palmar side of the pronator quadratus in the distal forearm, and it is on the palmar side of the flexor retinaculum where it crosses the wrist. The ulnar nerve gives motor function to two muscles in the forearm, the flexor carpi ulnaris and the medial portion of the flexor digitorum profundus (5).

Figure 10: Median, radial, ulnar nerve(X)



Radial Nerve (C5 – C8, T1).

The radial nerve sits superiorly and medially in the upper arm, winds around humoral shaft, and extends over the lateral epicondyle. The radial nerve goes into the forearm via the radial tunnel, which is the space between the brachioradialis and the brachialis. In the radial tunnel, the nerve divides into two branches: The deep (motor) radial nerve and the superficial (sensory) radial nerve (5).

Median Nerve (C5 – C8, T1).

The median nerve enter the palmar compartment in the antecubital fossa. The median nerve travels under the bicipital aponeurosis, a strong membranous band that reaches inferiorly across the antecubital fossa to join the deep fascia covering the flexor muscles. At the wrist joint the median nerve becomes more superficial and enters then the carpal tunnel. It innervates the pronator teres, the flexor carpi radialis, the palmaris longus, and the flexor digitorum superficialis. It supplies branches to proximal portions of the flexor pollicis longus and flexor digitorum profundus. The major branch of the median nerve is the anterior interosseous nerve. The anterior interosseous nerve innervates the flexor pollicis longus, the lateral portion of the flexor digitorum profundus, and the pronator quadratus (5).

2.2.3 Fascia.

Fascia is a thin, but very fibrous and strong connective tissue which has a number of functions, as isolating the muscles of the body and providing structural support and protection (38). Fascia plays an important role as force transmitters in human posture and movement regulation. Fascia is usually seen as having a passive role, transmitting mechanical tension which is generated by muscle activity or external forces (39). Fascial is vital for tissue form, lubrication, nutrition, stability, integrity, function and support. It is a product of mesenchyme, a type of connective tissue which develops in embryos before differentiating into numerous other structures in the body. Fascia has three layers, starting with the superficial fascia directly under the skin and ending with subserous fascia, deep inside the body (10).

The superficial fascia can be mixed with fat, and the amount depends on where it is on the body. The hands have a particularly noticeable layer of superficial fascia which connects the skin to the tissues and bone underneath it.

The deep fascia is a much denser packed and strong layer of fascia. Deep fascia covers the muscles in connective tissue aggregations which help to keep the muscles divided and protected.
The subserous fascia lies between deep fascia and major organs of the body. It is more flexible than deep fascia, and the body leaves for space around it so that the organs can move freely (38).

2.3 Movements of the forearm and the hand.

Fine motor skills are the basis of coordination skills that involve a complicated use of the small muscles controlling the hand, fingers, and thumb. The development of these skills allows one to be able to complete tasks such as writing, drawing, and buttoning (22).

2.3.1 Kinematics of forearm.

The proximal and distal joints between the radius and the ulna allow the distal end of radius to swing over the distal part of the ulna. This enables supination and pronation of the hand. In the distal radioulnar joint the radius prosupinates upon the ulna. The radius shortens and lengthens in relation to the ulna in supination and pronation (4).

At the elbow, the proximal radioulnar joint, the radial head spins on the capitulum, and at the same time, the side of the radial head slides against the radial notch of the ulna and the annular ligament of radius. At the distal radio-ulnar joint; the ulnar notch of the radius slides in an anteriorly direction over the head of the ulna. When these movements are performed the two bones are held together by the annular ligament of radius (proximal radioulnar joint), and the interosseous membrane between the radius and ulna, and the articular disc (distal radioulnar joint) (4).

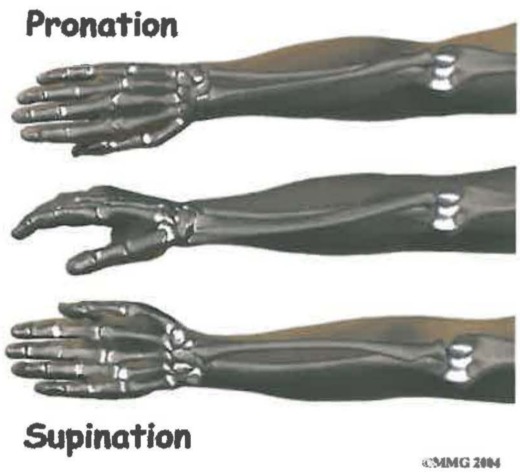


Figure 11: Pronation and supination (XI).

2.3.2 Kinematics of the wrist.

The wrist is of special importance because its mobility and stability are essential for a good hand function. Wrist mobility is a sum of all the movements of an complex made up of the radiocarpal joint, the midcarpal joint, the ulnocarpal joint and the radioulnar joint (32). The range of palmar flexion is approximately 80 degrees and dorsal flexion is approximately 70 degrees. Radial deviation (abduction) is approximately 20 degrees and ulnar deviation (adduction) is approximately 35 degrees (14).

The radiocarpal joint is a condyloid joint allowing flexion, extension, radial deviation and ulnar deviation. The combination of all these movements together is circumduction. Rotation is not present at the wrist joint (14).

The midcarparpal joint contributes to wrist motion and are nonaxial joints which provides gliding motions, which contribute to radiocarpal joint motion (13).

The wrist stability is affected especially by the bony configuration and the tension of ligaments; extrinsic- and intrinsic ligaments, anterior and posterior radiocarpal ligaments, radial- and ulnar collateral ligament, interosseous membrane and the flexor retinaculum (53). According to the wrist stability, the distal articular surface of the radius, the triangular fibrocartilage complex, and the distal ulna form the base for radiocarpal function.

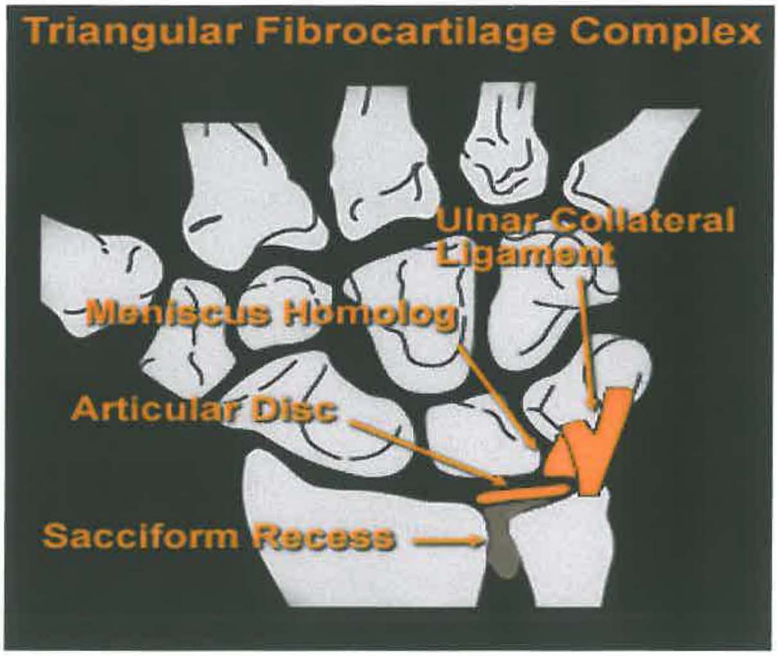


Figure 12: Triangular fibrocartilage complex (XII).

The distal row of carpal bones can be regarded as one rigid body. The proximal carpal row is a mobile adaptive and inherently unstable intercalated segment. Its relative position is determined by spatial configurations of the radius, triangular fibrocartilage and ulna proximally, and by the rigid outer carpal row distally and it is controlled by special retaining and guiding ligaments (2).

In the wrist joint the radial styloid process goes further distally then the ulna styloid process, therefore the hand has a greater movement in the ulnar duction than the radial duction (41). The radial collateral ligament in the wrist attaches from the radial styloid to the scaphoid, trapezium, and base of the first metacarpal. This ligament limits ulnar deviation of the wrist (36). The ulnar collateral ligament of the wrist attaches from the ulnar styloid process to the triquetrum, pisiform, and the articular disc. The ligament limits radial deviation.

The articular disc separates the synovial cavities. This separation of the cavity space allows for separate movements to occur in each space (37). The articular disc also permits a more even distribution of forces between the articulating surfaces of bones, increases the stability of the joint, and aids in directing the flow of synovial fluid to areas of the articular cartilage that experience the most friction (41).

Flexion and extension.

Movement of the wrist joint during flexion and extension takes place at the radiolunate and lunatecapitate joints. In the lateral axis of the radiocarpal joint we find mostly the **wrist flexion** movement. During flexion the scaphoid and lunate roll anteriorly, toward palm, and glide posteriorly, toward dorsum (42). During wrist flexion the movement at the radiocarpal joint is 40% and at the midcarpal joint 60%. During flexion, both the radiocarpal joint and the midcarpal joint flex. Active flexion is created by the combined forces of flexor carpi radialis and flexor carpi ulnaris.

Most of the **wrist extension** occurs around the lateral axis of the midcarpal joint. During extension the scaphoid and lunate roll posteriorly, toward dorsum, and glide anteriorly, toward palm (42). Wrist extension has 65% motion at the radiocarpal joint and 35% of the motion at the midcarpal joint (8). Active extension is done by the forces of extensor carpi radialis longus and brevis, and the extensor carpi ulnaris.

Rotation.

The anatomy of the distal radioulnar joint promotes both rotational and sliding movements between the radius changes (11, 23). Ulnar variance, the distance the ulnar head extends below or above the articular surface of the radius, can also effect this force distribution markedly with the latter increasing ulnar-sided forces and the former increasing radial-sided forces (26, 27). Ulnar variance changes in an above direction with the forearm pronated and grasping (6, 18). This combined forearm rotation and gripping can adversely impact ulnar-sided structures such as the triangular fibrocartilage complex, lunate and lunotriquetral ligament (11).

2.3.3 Kinematics of the carpal bones.

Motion occours not only between the carpal rows, intercarpal motion, but also within the carpal rows, intracarpal motion (28). The radiocarpal and the midcarpal joints contribute to flexion, extension, deviations on the wrist and clinically, both these joints need to be addressed when attempting to restore wrist motion (33).

Radial deviation of the hand and the distal carpus is associated with palmar flexion of the entire proximal row and ulnar deviation of the hand and distal row is associated with proximal row extension. This reciprocal motion is caused by the resulting joint reactive forces around the proximal row when the wrist is radially and ulnarly deviated (49).

Distal carpal row (Trapezium, trapezoid, capitate, and hamate).

During radial to ulnar deviation the distal carpal row changes form from palmarly to dorsally and rotates radial to ulnar. The total flexion and extension motion is divided equally between radiocarpal and midcarpal joints (43).

Proximal carpal row (Scaphoid, lunate, and triquetrum).

There is greater carpal bone motion in the proximal row versus the distal row. During radial to ulnar deviation, proximal row moves from flexion to extension, while the distal row translates palmarly to dorsally and rotates radial to ulnar. Total flexion and extension motion is divided equally between radiocarpal and midcarpal joints (43).

Radial deviation.

Radial deviation compresses the scaphotrapeziotrapezoid joint. This forces the scaphoid into flexion while trapezium comes near the radius, which then gives influence to the lunate to palmar flex, because of the attachments of the scapholunate ligament. With intact interosseous ligaments, the entire proximal row follows the scaphoid into flexion (43).

Ulnar deviation.

Ulnar deviation sends the triquetrum into its extended position against the hamate. The hamate rotates into low position, influencing triquetrum into dorsiflexion. The scaphoid becomes dorsiflexed as it is pulled into longitudinal attitude. Extension of scaphoid will tend to extend lunate (due to scaphoulnate lig). With intact ligaments, the entire proximal row now follows the triquetrum into extension (43).

The ulnar- and radial deviations happen around the axis which passes through the capitate. During ulnar deviation the scaphoid and lunate roll toward ulna and glide toward radius and in radial deviation the scaphoid and lunate roll toward radius and glide toward ulna. The muscles on the radial and ulnar sides work synergistically (42).

In **neutral deviation**, these opposing forces are dissipated if the wrist is relaxed, and they are neutralized by intact bone and ligamentous supports if the wrist is stressed. But when compressive forces are applied scaphoid normally tends to flex during compressive load, and maintain a similar influence on lunate due to ligamentous attachments. Triquetrum tends to move during compressive loading and will tend to move the lunate into extension. Therefore lunate is in a state of dynamic balance between two antagonists. When the dynamic balance is interrupted, the lunate will tend to flex with loss of ulnar support from the triquetrum or extend if there is loss of radial stability (43).

2.4 Disorders in the wrist joint related to overuse and pressure.

2.4.1 Definition and development.

Wrist pain is defined as „any pain or discomfort in the wrist"(44). A common soft tissue cause of wrist pain is the overuse syndrome. It is a form of chronic repetitive strain injury in the upper extremity and frequently presents as undiagnosed wrist pain. Any repetitive motion can stress and inflame the joints when done forcefully and for long periods of time without rest. Repetitive strain injuries cause the following symptoms in muscles, joints, tendons and nerves: Pain, inflammation and dysfunction (48).

Many repetitive injuries develop because the muscles of the hands, wrist or arm are involved in movements that are quick and involve limited movements. This quick repetitive motion blocks normal blood flow and therefore inhibits the oxygen exchange to the tissues. The lack of oxygen in the muscles, tendons or other involved tissues evokes pain and inflammation and scar formation. This results in a weakened muscle's ability to contract and increased friction and pressure develops between the injured tissues and adjacent structures. If the irritating motions are continued, chronic inflammation, muscle contractures and permanent disability will be the result. In repetitive strain injuries the synovial fluid can thicken. The tendons of the hand can have difficulties gliding in the thick synovial fluid and they can become swollen and thickened. This leads to pain and inflammation until the repetitive movements are removed (12).

Stability of the wrist is by the carpal bones and by the ligaments, which controls the movements of one bone to another. If one or more ligaments are overstretched, this will make the ulnar and the radius bones to become unstable and shift positions, and the result can then be carpal instability. Due to a trauma one of the ligaments may be torn and this will be a pain source. When the ligament injury is incomplete, the ulnar and radius can have normal alignment at rest, but during loading it can be torned. This is called dynamic instability of the wrist. The opposite is static carpal instability and it occurs when control is lost so the bones accept an abnormal alignment (45).

An increase in time and intensity of exercise and training has led to more frequent overuse problems for ligaments and tendons, accounting for up to 50% of all sports injuries. In some tests, ligaments that had been immobilized for eight weeks showed decrease in strength and measurements of load-to-failure of 35% to 45% (34).

In a chronic ligament or tendon injury, the normal healing process of connective tissue is interrupted. Connective tissue tends to become shorter and denser as it heals. The individual fibers lose the gliding capacity and mobility to each other and to their surrounding structures as joints, capsules and sheets. If ligaments are overstretched, they do not provide adequate support for a joint (34).

2.4.2 Symptoms.

The normal symptoms found during the overuse syndrome are: Pain, muscle weakness, swelling, numbness, restricted mobility of the joint and loss of function (50). Pain may also extend up to the elbow. Swelling can be present if there has been an injury. Ligament tears or sprains may not cause pain during rest, but during activity pain can be present (46). Injured ligaments do not heal quickly, sometimes taking six months to a year to heal fully. It is due to the minimal blood supply to ligaments (12). Therefore a person can feel pain for many months with a just a little relief.

2.4.3 Different causes for soft tissue disorders.

Wrist pain caused by soft tissue can arise in any anatomical structure, between the skin and the bone; skin, subcutaneous layers, peripheral nerves, blood vessels, muscles and tendons.
Lockwood described the overuse syndrome as *„an injury caused by the cumulative effect on tissues of repetitive physical stress that exceeds physiological limits"*(24).
Fry described it as *„a painful condition of the hand and arm produced by hand-use-intensity activity over long periods and use which is excessive for the individuals affected"*. He also underlined that *„it is important that overuse syndrome is differentiated from tenosynovitis which, by definition, is an inflammation of the tenosynovium"*(24).

Tenosynovitis.

It is an inflammation of the fluid-filled sheath which is around the tendon. The cause of this inflammation may be from overuse, strain, infection, injury or unknown. The wrists, hands, and feet are the areas that are commonly affected. It has generally symptoms like pain, swelling and difficulty moving the particular joint where the inflammation occurs. One condition can cause the finger to "stick" in a flexed position, and this is called stenosing tenosynovitis (47).

Dorsal impact syndrome.

The main complaint is to have pain on the dorsal side of the wrist, where there is a history of repeated forced dorsal flexion with some components of incidental weight bearing. The cause of repeated dorsiflexion compress the dorsal wrist structures, leading to capsulitis and a number of reactive changes, including localized hypertrophic synovitis (meniscoid of the wrist) and osteocartilaginous changes in the dorsal rim of the scaphoid, lunate, capitate or radius. Tenderness is found at the middorsal aspect of the wrist, specifically at the lunocapitate area (31).

Ulnar-Sided Wrist Pain.

To discover the cause of a ulnar-sided wrist pain can be difficult, because of the complexity of the anatomic and biomechanical properties of the ulnar wrist (49).

A) Ulnar midcarpal instability.

The ulnar midcarpal instability has been given more names by different authors: Palmar midcarpal instability, capitolunate instability pattern, ulnocarpal instability and midcarpal instability (49). Dysfunction of key ligaments that causes a loss of normal joint forces between the proximal and distal rows is the most likely reason for a painful midcarpal instability. These ligaments include the arcuate, triquetrohamate, and capitolunate ligaments palmarly and or the radiotriquetral ligament dorsally (4). The instability is most commonly caused by damage to the triquetrohamate ligament and the associated extrinsic structures (29). If laxity or traumatic disruption of these ligaments, the rotation of the carpus is no longer present. Instead, the proximal row stays flexed, and the distal row remains excessively palmarly translated until the extreme of ulnar deviation is reached, causing the proximal row to abruptly snap back into extension and the distal row to reduce (49).

B) Cubital tunnel syndrome.

Another example of the entrapment of the ulnar nerve in the cubital tunnel may result in numbness, pain or parasthesia of the little and ring finger and the dorsal-ulnar aspect of hand may hinder a person's ability to forceful grasping. This is due to loss of critical motor function in the little finger and hand intrinsic muscles (5).

C) Ulnar nerve entrapment, Gyons's canal syndrome.

Ulnar nerve entrapment due to compression in the Guyon canal is usually presents as a motor lesion due to isolated involvement of the deep motor branch as it courses around the hook of the hamate. Patients often have a positive Tinel sign over the Guyon canal with paresthesia in the small and ring fingers.

The Gyon's canal syndrome has also been called the cyclist palsy (30). This is because; during long distance cycling the ulnar nerve is stretched because of hyperextension and ulnar deviation of the wrist. The stress taken by the hand in cycling can be greater than the athlete's bodyweight and altered conduction velocity of the distal ulnar nerve has been showed in long distance cyclist (8). Motor and sensory symptoms are affecting the fourth and the fifth fingers, and there will be a weakness of fine finger movements and lost of strength (25).

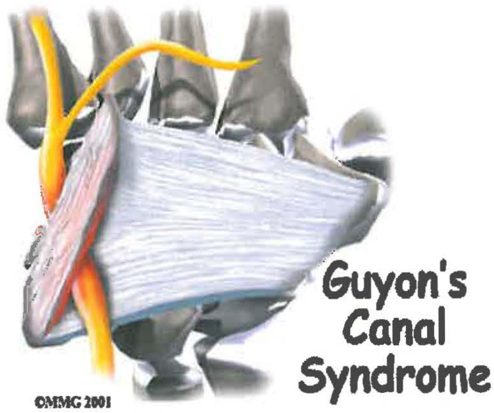


Figure 13: Guyon's canal syndrome (XIII).

D) Triangular fibrocartilage.

The Triangular fibrocartilage (TFCC) complex provides a flexible mechanism for stable rotational movements of the radiocarpal unit around the ulnar axis. It also suspends the ulnar carpus from the dorsal ulnar face of the radius, and it cushions the forces transmitted through the ulnocarpal axis. This TFCC complex improves wrist functional stability and allows six degrees of freedom at the wrist. The cases of injury can be: A fall onto pronated hyper extended wrist, or power drill injuries in which the drill binds and rotates the wrist instead of the bit, or distraction force applied to the palmar forearm or wrist (52). Other factors include the poor blood supply to the peripheral of the disc and the association of ulnar positive variance that causes compression and thinning of the triangular fibrocartilage (31).

Myofascia dysfunction.

Deep fascia is dense connective tissue that surrounds and separated deeper structures, such as muscles, tendons, joints, ligaments and bone. Because it is a stiffer structure, the deep fascia is less able to accommodate edema, which can cause problems, such as compartments syndromes. Myofascia covers muscles, and provides vital support to permit normal muscle function. It helps provide structure and form to the muscle, lubrication between muscle fibers and nutrition for the muscles. It also bears the blood and lymph vessels and nerves for the muscles. When injury or unbalanced biomechanical forces are applied to the myofascia, its ability to support normal muscle function is impaired. This can lead to pain, loss of motion and less than optimal functional performance. Dysfunction causes additional changes in the myofascia (10).

2.4.4 Physical examination.

History information should be focusing on the location, duration, and radiation of pain. Any sign of swelling or burning should be documented.

A physical examination should always begin with observation, followed by range of motion and the palpation. After this we should continue with the examination of active- and passive mobility, manual muscle testing, muscle length tests, jointplay, sensory examination and test of reflexes. In this case the pain, swelling and muscle dysfunction will affect the coordination and the fine movements of the wrist and hand.

Observation.

The examination begins with observation of the patient during the history portion of the evaluation. Observation and evaluation of anterior, posterior and side view of the wrist is necessary, in order to take the correct information. This evaluation will give us information about the positions of the various joints and muscle balance or imbalance. During observation, there should be written down if these things are present: Edema, erythema, abrasions, scars or nodules.

Range of motion.

The range of motion (ROM) of joints is necessary to be examined, to show the joint dysfunction and restrictions. ROM of the wrist should be measured for active and passive motion in dorsal- and palmar flexion, and radial- and ulnar deviation. All of the measurements should be compared to the opposite extremity. Sometimes evaluation of ROM or general examination of the hand, elbow, shoulder, and neck may be necessary, to exclude the possibility that the wrist pain is referred from a pathologic condition in either of these regions. If pain or special sounds are present in some motions, it should be noted (57).

Palpation.

The palpation examination will give information about skin barriers, connective tissue, muscle fascia and muscle mass. During palpation possible presence of hyperalgic skin zones (HAZ), tender points and trigger points, restriction of mobility of fascia, muscle spasm, hypertonicity or hypotonicity on muscles can be detected (15).

Mobility and movement against resistance.

Active mobility shows both muscular activity and joint mobility uninfluenced by the examiner. Any force applied by the examiner may be less than, equal to or greater than that used by patient; then it is concentric (resisted) movement, isometric resistance, or eccentric movement. Each technique examines muscular function (the strength of the muscle, reaction to pain provoked in the muscles, possible muscle imbalance, even coordination). Passive movement shows the degree of mobility of joints and may at the same time reveal muscular tension or spasm.

Manual muscle testing.

Fundamental components of manual muscle testing are test performance and evaluation of muscle strength and length. Examination to determine **muscle length and strength** is essential before prescribing therapeutic exercises because most of these exercises are designed either to stretch short muscles or to strengthen weak muscles (14).

Muscle length tests are done for the purpose of determining whether the range of muscle length is normal, limited, or excessive. Muscles that are excessive in length are usually weak and allow adaptive shortening of opposing muscles; muscles that are too short are usually strong, and maintain opposing muscles in a lengthened position. Muscle length testing consists of movements that increase the distance between origin and insertion, elongating muscles in directions opposite to that of the muscle actions.

Muscle strength testing is used to determine the capability of muscles or muscles groups to function in movement and their ability to provide stability and support. Weakness of muscle may be due to nerve involment, disuse atrophy, stretch weakness, pain or fatigue. It is important to remember as Kendall says, „Every muscle is a prime mover in some specific action“. Therefore will a good performed muscle testing help in distinguishing different syndromes or problems (14).

Mobility of joint.

Mobility of joint (joint play) should also be examined to determine the joint dysfunction or blockages (23). Examination of a particular joint may disclose normal, increased, or restricted mobility. This may affect functional movement as well as joint play. It is a passive movement, which cannot be carried out by the subject and comprises a sliding movement of one joint surface against the other, or even rotation and also distraction (33).

Sensory examination.

The sensory examination is almost entirely subjective and dependent on the patient cooperation and effort. Report of „dull“ following application of a sharp pin to the skin is a subjective response, whereas jumping in response to application of the pin would be an objective indication the pin was painful. Swelling can cause pinched nerve, and it is a nerve with pressure applied to it. This can further cause weakness, tenderness, prickly sensation, stabbing sensation and burning sensation (20).

Deep tendon reflexes.

- The biceps brachii reflex is obtained by tapping the distal tendon in the antecubital fossa. This reflex occurs at the C5-6 level (21).
- The brachioradialis is another C5-6 reflex that can be obtained by tapping the radial aspect of the wrist (21).
- The triceps reflex can be obtained by tapping the distal tendon at the posterior aspect of the elbow with the elbow relaxed at about 90° of flexion. This tests the C7-8 nerve roots (21).
- The pronator reflex can be helpful in differentiating C6 and C7 nerve root problems. If it is abnormal in conjunction with an abnormal triceps reflex, then the level of involvement is more likely to be C7. This reflex is performed by tapping the palmar aspect of the distal radius with the forearm in a neutral position and the elbow flexed. This results in a stretch of the pronator teres resulting in a reflex pronation (17) (21).
- Flexors of fingers reflex occurs in C7-T1 level (C8 nerve root) (21).

2.4.5 Diagnostic modalities.

Most diagnoses can be made with history taking, physical examination and radiography.

A) Radiography.

Radiography is the use of X-rays to diagnosing eventually bone damage, eg. trauma, osteoporosis. Radiography should include posteroanterior and lateral views of the wrist. The patient should sit with forearm in a neutral position, elbow flexed (90°) and the shoulder abducted to 90° (28).

B) Ultrasonography.

For the evaluation of soft tissue anatomy ultrasonography can be used. It has been useful in evaluating ganglion cysts, tendons, and tendon sheaths (6, 7).

C) Videofluoroscopy.

This examination is good for evaluating dynamic ligament instabilities, as for example in patients with a history of wrist clicking, where findings are normal on plain images. During the examination the wrist should be examined through many active and passive motions, and also with some provocative maneuvers, to try to reproduce the original symptoms. The fluoroscopic examination gives a detail study without excessive radiation exposure (6, 7).

D) Computed tomography.

CT scans can bring out a detailed articular and osseous anatomy. It can be used to detect fractures, to evaluate bone healing and to find tumors. Axial CT provides an excellent means for evaluating distal radioulnar joint deformity. CT scanning shows a better image of bony details than the radiography (6, 7).

E) Magnetic resonance imaging.

MRI gives information in the detection of soft tissue and osseous lesions, including interosseous and extrinsic ligament tears, tumors, swelling, avascular necrosis, and occult fractures (6, 7).

2.4.6 Treatment.

The treatment should always focus on treating the primary cause with main aim on the general coordination and the correction of the functional abnormal position of the segment.

In overuse syndromes it is important to avoid the factors that make them worse, and the activity should consist of rest, splinting, and a gradual resumption when the symptoms have settled. Surgery is not recommended.

Loss of range of motion according to muscle shortening can be restored with stretching of the involved muscles of the motion.

Weak muscles will affect the stability and the coordination of the wrist joint and can cause in long term an overload of the muscles and the surrounding tissues. The strengthening of the muscles, which affect the wrist joint, will give a positive approach (51).
Hypertonic or overloaded muscles can be over resistive to stretch, as in restricted movement, or in an over protective state. This will also influence the coordination. The overall effect would be to relax the muscles (54).
Swelling of the wrist is proportional to the extent of the injury. During mild ligamentous lesions swelling is not common, and increased swelling should indicate the probability of fracture or dislocation. First degree and mild second degree sprains usually treated with splinting and physical therapy. Most of the second- and third degree sprains should be referred to orthopedic specialist for complete evaluation and treatment. Many patients with chronic ligamentous wrist pain often are greatly relieved by joint play mobilization and friction massage to hypomobile carpals that are due to fibrous adhesions (9).

Impaction syndromes are as said earlier due to repetitive loading of the wrist in maximum extension. Injuries may range from localized synovitis to osteocartilaginous fractures. Treatment should focus on strengthening the wrist and the finger flexors, which is necessary to cushion the dorsiflexion of the wrist to prevent maximum dorsiflexion (9).

Joint mobilization.

Various causes can prevent normal motion. When the cause is tightness within the joint capsule, specific characteristic changes are seen in pattern of motion loss and are referred to as capsular pattern (10). A capsular pattern indicates that some of the lost motion is because of tightness within the capsule and that joint mobilization should be included in the treatment program. A non-capsular pattern indicates that structures other than the capsule are preventing normal motion and that joint mobilization will not significantly contribute to range of motion gains.

A capsular pattern in the wrist joint will be that the dorsal flexion and palmar flexion are equally limited, and the pronation and supination are mildly limited at the distal radioulnar joint (9) (10).

According to Lewit the soft tissue manipulation should include a skin stretch, connective tissue stretch, pull or pressure, shifting of fasciae, post isometric relaxation and exteroceptive stimulation. He also said there is much less awareness of the role of connective tissue and fascia, partly due to the lack of scientific knowledge (18).

Fascia release techniques.

Fascia release techniques benefits these muscles as well as normalizing the pull through the fascial planes including the periosteum that tend to intersect at joints. Restoration of balanced structural alignment promoted by these different methods is helpful in reducing muscular and fascial tension. The resulting ease of the tissues improves their condition, which contributes to minimizing localized adhesions (34).

Swelling reduces lymph drainage. A fascia release will improve surrounding tissue move ability, characteristics and therefore secondary improve the lymph drainage. Methods that restore a full and balanced joint motion on a proper axis (e.g. joint gliding technique) allow relaxation of the neighboring soft tissue, including tendons and ligaments. The soft tissue is then no longer in a need for compensating the disrupted and restricted joint motion (34).

Conservative treatment.

It is a treatment option that does not involve surgery. Physical therapy and exercise will assist in calming pain and inflammation, and improve mobility and strength. After using plaster it is normal that the involved muscles will be in hypotension as a result of the inactivity. The treatment must therefore focus on restoring the function of the fine movements and the coordination of the wrist, hand and fingers. This will again affect the activity of daily living in a positive way. The patient should in a long term perspective be able to perform all the daily activities in a normal way (28).

After treatment.

It is essential to advise the patient after the first treatment, so he knows what he may do and what he should avoid. It is important to tell him whether he should rest completely or if he should move around. He should be aware of that there may be a painful reaction during the next one or two days. If possible give him some simple exercises (18).

Methodology.

Goal:

- To improve the condition for the patient.

Clinic:

- Place: Ustřední Vojenská Nemocnice in Prague.
- Period: 04.02.2008 - 15.02.2008.
- Adviser: Alena Rihova.
- Supervisor: Mgr. Agnieszka Kaczmarska.

Patient:

- Male.
- 35 years old.
- Diagnose: M708: Other soft tissue disorders related to use, overuse and pressure.

Organization of work:

- The therapy was six sessions, Monday, Wednesday and Friday. The patient had 15 min of Hydrotherapy, 15 min Magnetotherapy and 30 min individually physiotherapy.

Work progression:

- After consultation with supervisor, I learn about diagnosis and got very good advices for treatment. I wrote daily therapy during each session, and kinesiology examination. I made short and long term plans and I was controlling eventually treatment progression on each session.

Final analysis:

- The initial kinesiology examination was compared to the final kinesiology examination, followed by conclusion.

Statement:

- The patient was informed that the examination and subsequent therapy would be included in this thesis, and has signed the Up-To-Date Agreement of 04.02.2008.

3. Special part.

3.1 Anamnesis – History

Patient: B. K. Male. 35 years old.

Diagnosis:

- ***M708: Other soft tissue disorders related to use, overuse and pressure.***

Family anamnesis:

- The mother is 62 years old and the father is 67 years old, both healthy.

Personal anamnesis:

- Childhood diseases: The typical childhood diseases.
- Operations: No operations provided.
- Allergies: None.
- Abuses: None-smoker and occasionally alcohol.

Social anamnesis:

- The patient is married, and lives in a house with his two children; a three years old son and a nine months old daughter.

Working anamnesis:

- He is running his own business, which includes a lot of afterhours work. He does not have any employees and he must do everything himself. The work tasks can variety from meeting potential investors, making agreement, economical accounting, marketing and travelling. Sometimes the work is very mentally stressful according to the patient.

Sport anamnesis:

- The patient has been an active sportsman since childhood, and he has been playing ice hockey, floor ball, bicycling and fitness.

- He has been up to now going to the gym three times per week, and the upper extremities have been trained two times per week (biceps exercises). He was at the same period of time been playing floorball and cycling.

Previous physiotherapy:

- No, this is the first time the patient attends physiotherapeutic treatment.

Treatment described by medical doctor:

3 times per week of a total 8 sessions; including:

- Hydrotherapy for 15 min.
- Joint mobilization.
- Magnetotherapy for 15min.

Status presens:

- The patient has used plaster on the left forearm for a period of six weeks, and took it of 28.01.2008. The right hand is the dominant.
- The patient feels a sticking pain in his left wrist during all movements, dorsal- palmar flexion, radial- and ulnar deviation. He feels powerless when he tries to provide a handgrip with the left hand, during palmar flexion in all fingers, but especially in the 4th and the 5th digit.
- Pain is not present during relaxation of the left arm and left wrist.
- He complains of pain while training the biceps muscles with a pronation and supination grip of the dumbbell. When using a hammer grip (neuter position of the forearm), he does not feel pain.
- He stopped to go to the gym one month after the wrist pain occur, so he did eight sessions of strength training with pain before he stopped and got plaster.
- Height: 182 cm. Weight: 83 kg. BMI: 25.1.

Differential considerations:

a) Sport.

- The patient has been very active in three types of sport at the same time; floorball, cycling and fitness. He was training the upper extremity two times per week. These activities together affect the wrist joint and stress it.

b) Dominant hand.

- Why is not the dominant right wrist joint affected? Generally the dominant hand has increased muscular power, and can therefore be able to handle heavier loading for a longer time period before secondary changes occur.

c) Long term compression overuse.

- In chronic ligamentous instabilities of the wrist, patients usually complain of a painful click and intermittent pain with particular activities. They usually can localize the area of pain. Patients may also complain of weakness as diminished grip strength.
- Hyperextension of the wrist can also lead to strained ligaments on the palmar aspect of the proximal and distal carpal rows. Patients with ligamentous injuries may have pain at end range of all wrist movements that stress the ligament.

d) Ulnar nerve compress.

- Regular activities, that require forceful or repetitive gripping over a long time period, provided many times per week for a long time period, can for example indicate ulnar sided wrist pain. Normally there is pain during palpation over the ulnar carpus, triangular fibrocartilage complex and lunotriquetral joint regions. Wrist motion is stiff and painful, and the grip strength is diminished.
- The ulnar nerve can be compressed in the Gyon canal when edema and inflammation is present.
- In bicycle riders, compressive ulnar neuropathies are very common. They usually result from continued compressive forces to the hypothenar eminence during supporting of the bodyweight, or from repetitive hyperextension of the wrist.

e) Trauma and others.

- Possible causes of pain in the wrist joint according to discomfort and inability to perform exercises can also be: Dorsal radiocarpal impingement syndrome, fractures of carpal bones, dorsal wrist capsulitis, dorsal wrist ganglion, traumatic and degenerative triangular fibrocartilage complex tears (52).
- Traumatic triangular fibrocartilage complex (wrist meniscus) tears both result in ulnar wrist pain, particularly with activities that load the wrist during pronation and supination. The pain may also be accompanied by a sensation of catching or snapping in the wrist. The degenerative triangular fibrocartilage complex is referred to as the ulnar impaction syndrome.
- Both traumatic and degenerative triangular fibrocartilage complex lesions develop of similar biomechanical alterations. The combination of forearm pronation and forceful grip makes the triangular fibrocartilage complex either to acutely tears or gradually weaken and there will be holes, because of its role in load transfer (7).

3.2 Initial kinesiology examination.

3.2.1 Anthropometry.

Wrist circumduction:	19,5 cm (left).	18 cm (right).
Forearm:	30 cm (left)	32 cm (right).
Upper arm:	36 cm (left)	36 cm (right).

Conclusion of anthropometry:

- Left wrist is 1,5 cm larger caused by swelling.
- Left forearm is 2 cm less, because of inactivity caused by plaster.

3.2.2 Goniometry.

Table 1: Active, passive movements.

Active	*Passive*	*Movement*	*Active*	*Passive*
Dx	**Dx**	**Wrist joint**	**Sin**	**Sin**
80	80	Palmar flexion	20	25
85	90	Dorsal flexion	25	30
35	35	Ulnar deviation	5	5
20	20	Radial deviation	5	5
Dx	**Dx**	**Radioulnar joint**	**Sin**	**Sin**
90	90	Pronation	30	35
90	90	Supination	30	30

Conclusion of goniometry:

- The range of motion in the left wrist joint and the radioulnar joint is restricted in all directions and in passive and active movements.
- During passive pronation of the left wrist joint the patient complains of pain in the ulnar styloid process.
- The range of motion in the right wrist joint shows hypermobility in dorsal flexion.

3.2.3 Neurological:

Table 2: Superficial sensation

Touch	Positive. Hypersensitive, dorsal aspect, left wrist joint.
Hot	Negative. same sensation in both sides
Cold	Negative. same sensation in both sides
Graphesthesia	Negative.

Table 3: Sensory compression.

	Dx	Sin
Tinel's sign (Median nerve).	Normal	Normal
Tinel's sign (Ulnar nerve).	Normal	Positive

Table 4: Tendon reflexes, upper extremity.

	Dx	Sin
Biceps brachii reflex	Negative.	Negative.
Triceps brachii reflex	Negative	Negative
Brachioradialis reflex	Negative	Negative
Pronator reflex	Negative	Negative
Flexion of fingers reflex	Negative	Negative

Table 5: Motor tests, wrist joint.

	Dx	Sin
Opposition thumb and 5th digit (Median nerve).	Normal	Normal
Abduction of digits (Ulnar nerve).	Normal	Normal
Extension of wrist and digits (Radial nerve).	Normal	Normal

Conclusion of neurology:

Superficial:

- It was discovered a much larger sensitivity on the left wrist joint and left hand.

Motor:

- There was no tingling sensation in the thumb, index, and middle fingers (median n.)
- The patient was able to perform motor movement, but with restricted range of motion and power.

Compression:

- The Tinel' sign was present in the left wrist, ulnar nerve.

3.2.4 Muscle strength test.

The muscle strength test was provided according to Kendall (14).

Table 6: Prime movers of the wrist joint and the radioulnar joint.

Dx	Movement	Muscles	Sin
5	Palmar flexion	Flexor carpi radialis	3
5		Palmaris longus	3
5		Flexor carpi ulnaris	3
5	Dorsal flexion	Extensor carpi radialis longus	3+
5		Extensor carpi radialis brevis	3+
5		Extensor carpi ulnaris	3+
5	Radial duction	Abductor pollicis longus	5
5		Extensor pollicis brevis	5
5	Ulnar duction	Flexor carpi ulnaris	3
5		Extensor carpi ulnaris	3
5	Pronation	Pronator teres	3+
5	Supination	Biceps brachii	5
5		Supinator	4

Based on (5).

Table 7: Metacarpophalangeal joints of fingers.

Movement	Finger	Dx	Sin	Movement	Dx	Sin
Flexion	1st digit	5	4	Extension	5	4
	2nd digit	5	4		5	4
	3rd digit	5	4		5	4
	4th digit	5	3-		5	3
	5th digit	5	3-		5	3-
Abduction	1 to 5	5	4			
Adduction	1 to 5	5	4			

Conclusion of muscle strength test.

- Weakness of all the muscles in the left wrist joint, except the biceps brachii, abductor pollicis longus and extensor pollicis brevis.
- The right wrist joint has normal strength.
- The patient complained of pain on the dorsal aspect of the left wrist joint when he provided dorsal flexion, palmar flexion, radial duction, pronation and supination.
- Left hand: Weak flexion 4^{th} and 5^{th} digit.

3.2.5 Palpation examination

Table 8: Palpation of muscle tonus.

Dx	Movement	Muscles	Sin
Normal	Palmar flexion	Flexor carpi radialis	Hypotonus
Normal		Palmaris longus	Hypotonus
Normal		Flexor carpi ulnaris	Hypotonus
Normal	Dorsal flexion	Extensor carpi radialis longus	Hypotonus
Normal		Extensor carpi radialis brevis	Hypotonus
Normal		Extensor carpi ulnaris	Hypotonus
Normal	Radial duction	Abductor pollicis longus	Normal
Normal		Extensor pollicis brevis	Normal
Normal	Ulnar duction	Flexor carpi ulnaris	Hypotonus
Normal		Extensor carpi ulnaris	Hypotonus
Normal	Pronation	Pronator teres	Hypotonus
Normal		Pronator quadratus	Hypotonus
Normal	Supination	Biceps brachii	Normal
Normal		Supinator	Hypotonus

Skin examination of the forearm, wrist and hand.

Left wrist joint:

- The skin is restricted over wrist joint, ventral and dorsal side.

Right wrist joint:

- Restrictions are not present.

Examination of the fascia in forearm and at the wrist.

The left wrist joint:

- There is restrictions in fascia over the wrist joint and 10cm cranially direction towards the elbow joint.

The right wrist joint:

- Restrictions are not present.

Examination of Subscapularis.

Palpation of subscapularis in prone postion:

- Palpation of the subscapularis muscle in prone position showed a normal tonus.

Subscapularis test (figure 7):
Hand to Shoulder Blade Test:

- No restriction in the right and left arm.

Figure 7: Subscapularis test.

Conclusion of palpation examination.

Left forearm, wrist and hand:

- All the muscles palpated in the left forearm as showed in Table 8 are in hypotonus, except the biceps brachii, which has a normal muscle tonus.
- Triggerpoint or hypertonus is not present in Subscapularis muscle, so there is no indication that the left wrist pain should be caused from tension in this muscle.

Right forearm, wrist and hand:

- All muscles palpated had a normal tonus.

3.2.6 Joint play examination.

The joint play examination was performed according to Prof. Lewit (18) and Mgr. Holubarova (16).

Table 9: Jointplay examination of the left upper extremity.

Elbow joint	No restriction present in latero-lateral direction.
	No restriction of the head of radius in ventral direction.
Proximal radioulnar joint	No restriction of the head of radius in rotation.
Radiocarpal joint	Restriction of proximal row in dorsal direction.
	Restriction of scaphoid in dorsal direction (radial side).
	Restriction of lunate in dorsal direction (ulnar side).
	Restriction of proximal row in radial direction.
Intercarpal joint	Restriction in dorsal and palmar direction of each carpal bone.
	Restricted and extreme painful capitate in palmar direction.
Distal radioulnar joint	No restriction present in dorsal and palmar direction.
Metacarpophalangeal joint	No restriction in dorsopalmar, laterolateral and rotation direction.
Interphalangeal joint	No restriction in dorsopalmar, laterolateral and rotation direction.

Table 10: Jointplay examination of the right upper extremity.

Elbow joint	No restriction present in latero-lateral direction.
	No restriction of the head of radius in ventral direction.
Proximal radioulnar joint	No restriction of the head of radius in rotation.
Radiocarpal joint	No restriction of proximal row in dorsal direction.
	No restriction of scaphoid in dorsal direction (radial side).
	No restriction of lunate in dorsal direction (ulnar side).
	No restriction of proximal row in radial direction.
Intercarpal joint	No restriction in dorsal and palmar direction of each carpal bone.
Distal radioulnar joint	No restriction present in dorsal and palmar direction.
Metacarpophalangeal joint	No restriction in dorsopalmar, laterolateral and rotation direction.
Interphalangeal joint	No restriction in dorsopalmar, laterolateral and rotation direction.

3.2.7 Conclusion of the initial kinesiology examination.

Physical examination, radiographic evaluation, and wrist arthroscopy are all helpful in excluding alternative causes of ulnar wrist pain (55). In this case radiographic evaluation and arthroscopy were not present.

The main complaint here is the painfulness, powerless and stiffness of the left wrist joint especially on the ulnar side. The comparison of all the separate conclusions leads me in these results:

- The range of motion in wrist joint and the radioulnar joint is restricted in all directions, both in the passive and active movements. The right wrist joint showed hypermobility in dorsal flexion.
- Further, there is present weakness and hypotonus of all the muscles in the left forearm (except the biceps brachii) affecting the wrist joint in dorsal flexion, palmar flexion, radial deviation, ulnar deviation, pronation and supination.

According to muscle length, the term **active insufficiency** (14) is precise to use in this case. It refers to lack of muscle strength, and the patient has been inactive for six weeks, so muscles have lost strength. It can look like he is hypermobile in dorsal flexion in the left wrist joint, because he has hypermobility in the right one. The right arm has greater power, so it could up to now, take the long term stress overloading. Therefore I believe that to reduce swelling, increasing muscle strength will improve the range of motion.

According to jointplay examination there were present restrictions in the radiocarpal joint (dorsal direction) and in the intercarpal joint (palmar direction). The patient had a very painful capitate during examination, and the ulnar- and radial deviation happen around the axis which passes through the capitate. During ulnar deviation the scaphoid and lunate roll toward ulna and glide toward radius and in radial deviation the scaphoid and lunate roll toward radius and glide toward ulna (8). I believe there is a connection between the painful capitate and ulna, through the ulnocapitate ligament.

Since the ulnar deviation is almost without pain in my patient, and the passive and active radial deviation causes pain on the medial (ulnar) side of the wrist, there is likely to believe that the ulnar collateral ligament of the wrist is injured.

My patient is a bicycle rider, and he is also training weightlifting and floorball. All of these activities put a lot of stress to the wrist joint and the hand. I found that he had a positive Tinel sign, and the grip strength was weak, especially in the 4^{th} and 5^{th} digit. These two fingers were shaking and he could hardly provide palmar flexion with them.
Generally all the wrist movements were weak, slow and painful for the patient. According to fine movements the coordination by the left hand was not satisfactory; he had problems when he tried to grasp a ball or a pencil. When he tried to provide quick finger tapping on the table, the performance showed slow and weak movements of each finger.

3.3 Short term and long term rehabilitation plan.

Short-term plan:

Left wrist:

- Decrease the pain and stiffness in the left wrist.
- Improve the restricted range of motion of dorsal- palmar flexion, radial- and ulnar deviation, pronation and supination.
- Restore normal joint kinematics
- Increase of muscle power of weak muscles.
- Instruction of patient how to provide correct the auto-therapy exercises.

Long-term:

Left wrist:

- Avoiding overtraining and maintaining a comprehensive strength and flexibility program for the muscles of the upper extremity.
- Improve the muscle power and coordination.
- Improving the activities of daily living.

3.4 Rehabilitation.

Day to day therapy.

<u>Week 1:</u>

Monday, 1 of 6 session. 04.02.2008.

Note:

- The initial kinesiology examination was performed in this session.
- All the treatment in this session is on the left wrist and hand.

General procedure provided for all six sessions:

- Hydrotherapy for 15 min.
- Physical therapy.
- Magnetotherapy for 15min.

Soft tissue techniques on the left wrist area:

- Fascial techniques.
- Stroking.

PIR/PFS:

- Dorsal flexor muscles of the hand, 4 repetitions.
- Plantar flexor muscles of the hand, 4 repetitions.

Mobilization of:

Radiocarpal joint:

- Proximal row in dorsal and radial direction.
- Scaphoid in dorsal direction on the radial side.
- Lunate in dorsal direction on the ulnar side.

Intercarpal joint:

- Dorsal and palmar direction of each carpal bone.
- Capitate in palmar direction.

Hand:

- Dorsal and palmar fan.

Day to day therapy.

Wednesday, 2 of 6. 06.02.2008:

Goniometry:

Table 11 : Active, passive movements.

Movement	*Active*	*Passive*
Wrist joint	**Sin**	**Sin**
Palmar flexion	30	35
Dorsal flexion	35	40
Ulnar deviation	10	10
Radial deviation	10	10
Radioulnar joint	**Sin**	**Sin**
Pronation	40	45
Supination	30	35

Palpation:

- Restricted skin and fascia.
- Painful capitate.
- Pain on the ulnar styloid process dorsal side.

Strength test of each digit:

- Left hand, digits 1, 2, 3: 4. Digit 4, 5: 3.
- Right hand: 5 (normal).

Soft tissue technique on the left wrist area:

- For fascia.
- Stroking.

PIR/PFS:

- Dorsal flexor muscles of the hand, 4 repetitions.
- Plantar flexor muscles of the hand, 4 repetitions.

Mobilization of:

Radiocarpal joint:

- Proximal row in dorsal and radial direction
- Scaphoid in dorsal direction on the radial side
- Lunate in dorsal direction on the ulnar side.

Intercarpal joint:

- Dorsal and palmar direction of each carpal bone.
- Capitate in palmar direction.

Hand:

- Dorsal and palmar fan.

Strength:

- Grasping of ball.
- Isometric contraction of dorsal flexors, palmar flexors, radial and ulnar deviation.

Day to day therapy.

Friday, 3 of 6. 08.02.2008:

Goniometry

Table 12: Active, passive movements.

Movement	*Active*	*Passive*
Wrist joint	**Sin**	**Sin**
Palmar flexion	35	40
Dorsal flexion	40	45
Ulnar deviation	15	15
Radial deviation	10	10
Radioulnar joint	**Sin**	**Sin**
Pronation	50	50
Supination	40	45

Palpation:

- Restricted skin and fascia.
- Painful capitate.
- Pain on the ulnar styloid process dorsal side.

PIR/PFS:

- Dorsal flexor muscles of the hand, 4 repetitions.
- Plantar flexor muscles of the hand, 4 repetitions.

Mobilization of:

Radiocarpal joint:

- Proximal row in dorsal and radial direction
- Scaphoid in dorsal direction on the radial side
- Lunate in dorsal direction on the ulnar side.

Intercarpal joint:

- Dorsal and palmar direction of each carpal bone.
- Capitate in palmar direction.

Hand:

- Dorsal and palmar fan.

Strength:

Isometric strengthening technique:

- Palmar- and dorsal flexor muscles.

<u>Week 2:</u>

Monday, 4 of 6. 11.02.2008.

Anthropometry.

Wrist circumduction:	18,5 cm (left).	18 cm (right).
Forearm:	31 cm (left)	32 cm (right).
Upper arm:	36 cm (left)	36 cm (right).

Goniometry:

Table 13: Active, passive movements.

Movement	***Active***	***Passive***
Wrist joint	**Sin**	**Sin**
Palmar flexion	40	45
Dorsal flexion	40	45
Ulnar deviation	10	15

Radial deviation	10	15
Radioulnar joint	**Sin**	**Sin**
Pronation	55	60
Supination	45	50

Palpation:

- Restricted skin and fascia.
- Painful capitate.
- Pain on the ulnar styloid process dorsal side.

Strength test of each digit:

- Left hand, digits 1, 2, 3: 4. Digit 4, 5: 3+
- Right hand: 5 (normal).

Soft tissue technique on the left wrist area:

- Fascial techniques.
- Stroking.

PIR/PFS:

- Dorsal flexor muscles of the hand, 4 repetitions.
- Plantar flexor muscles of the hand, 4 repetitions.

Mobilization of:

Radiocarpal joint:

- Proximal row in dorsal and radial direction
- Scaphoid in dorsal direction on the radial side
- Lunate in dorsal direction on the ulnar side.

Intercarpal joint:

- Dorsal and palmar direction of each carpal bone.
- Capitate in palmar direction.

Hand:

- Dorsal- and palmar fan.

Strength:

- Grasping of ball.
- Isometric contraction of dorsal flexors, palmar flexors, radial and ulnar deviation.

Day to day therapy

Wednesday, 5 of 6. 13.02.2008

Note:

- *Today the patient was very positive and felt less pain in the left wrist. He had performed auto therapy on himself since Monday; Stretching of DF, PF on both wrist and had slept with orthesis.*

Goniometry:

Table 14: Active, passive movements.

Movement	*Active*	*Passive*
Wrist joint	**Sin**	**Sin**
Palmar flexion	50	65
Dorsal flexion	55	60
Ulnar deviation	20	25
Radial deviation	15	15
Radioulnar joint	**Sin**	**Sin**
Pronation	70	75
Supination	60	65

Palpation:

- Small restriction of skin and fascia.
- Painful capitate.

Soft tissue technique on the left wrist area:

- Fascial techniques.
- Stroking.

PIR/PFS:

- Dorsal flexor muscles of the hand, 4 repetitions.
- Plantar flexor muscles of the hand, 4 repetitions.

Mobilization of:

Radiocarpal joint:

- Proximal row in dorsal and radial direction
- Scaphoid in dorsal direction on the radial side
- Lunate in dorsal direction on the ulnar side.

Intercarpal joint:

- Dorsal and palmar direction of each carpal bone.
- Capitate in palmar direction.

Hand:

- Dorsal and palmar fan.

Strength:

- Grasping of ball.
- Isometric contraction of dorsal flexors; palmar flexors, radial and ulnar deviation.

3.5 Final kinesiology examination.

3.5.1 Anthropometry.

Wrist circumduction:	18 cm (left).	18 cm (right).
Forearm:	31,5 cm (left).	32 cm (right).
Upper arm:	36 cm (left).	36 cm (right).

Conclusion of anthropometry:

- Left wrist circumduction has reduced swelling and has now the same as the right wrist join.
- Left forearm has decreased its circumduction with 1,5cm as a result of improved muscles function.

3.5.2 Goniometry.

Table 15: Active, passive movements.

Active	*Passive*	*Movements*	*Active*	*Passive*
Dx	**Dx**	**Wrist joint**	**Sin**	**Sin**
80	80	Palmar flexion	60	65
85	90	Dorsal flexion	65	70
35	35	Ulnar deviation	25	30
20	20	Radial deviation	15	15
Dx	**Dx**	**Radioulnar joint**	**Sin**	**Sin**
90	90	Pronation	80	85
90	90	Supination	70	75

Conclusion of goniometry:

- The range of motion in the left wrist joint and the radioulnar joint has improved in all directions in passive and active movements.

3.5.3 Neurological:

Table 16: Superficial sensation

	Dx	Sin
Touch	Negative	Negative
Hot	Negative	Negative
Cold	Negative	Negative
Graphesthesia	Negative	Negative

Table 17: Motor tests, left wrist joint.

	Dx	Sin
Opposition thumb and 5th digit (Median nerve)	Normal	Normal
Abduction of digits (Ulnar nerve).	Normal	Normal
Extension of wrist and digits (Radial nerve).	Normal	Normal

Table 18: Sensory compression.

	Dx	Sin
Tinel's sign (Median nerve).	Normal	Normal
Tinel's sign (Ulnar nerve).	Normal	Normal

Conclusion of neurology:

Superficial:

- The sensitivity is now equally (normal) on both upper limbs.
- Tinel's sign is not present.

3.5.4 Muscle strength test.

The muscle strength test was provided according to Kendall (14).

Table 19: Prime movers of the wrist joint and the radioulnar joint.

Dx	Movement	Muscles	Sin
5	Palmar flexion	Flexor carpi radialis	4
5		Palmaris longus	4
5		Flexor carpi ulnaris	4

5	Dorsal flexion	Extensor carpi radialis longus	**4+**
5		Extensor carpi radialis brevis	**4+**
5		Extensor carpi ulnaris	**4+**
5	Radial duction	Abductor pollicis longus	**5**
5		Extensor pollicis brevis	**5**
5	Ulnar duction	Flexor carpi ulnaris	**4**
5		Extensor carpi ulnaris	**4**
5	Pronation	Pronator teres	**4+**
5		Pronator quadratus	**4+**
5	Supination	Biceps brachii	5
5		Supinator	**4+**

Based on (5).

Table 20: Metacarpophalangeal joints of fingers.

Movement	Finger	Dx	Sin	Movement	Dx	Sin
Flexion	1st digit	5	**4+**	Extension	5	**4+**
	2nd digit	5	**4+**		5	**4+**
	3rd digit	5	**4+**		5	**4+**
	4th digit	5	**4-**		5	**4-**
	5th digit	5	**4-**		5	**4-**
Abduction	1 to 5	5	**4+**			
Adduction	1 to 5	5	**4+**			

Conclusion of muscle strength test.

- Improved strength of all the muscles in the left wrist joint, DF, PF, RD, UD, pronation and supination, except the normal biceps brachii.
- Also the fingers of the left hand have improved, as showed in table 18 (bold is improved).

3.5.5 Palpation examination

Table 21: Palpation of muscle tonus.

Dx	Movement	Muscles	Sin
Normal	Palmar flexion	Flexor carpi radialis	*Slight hypot.*
Normal		Palmaris longus	*Slight hypot.*
Normal		Flexor carpi ulnaris	*Slight hypot.*
Normal	Dorsal flexion	Extensor carpi radialis longus	*Normal*
Normal		Extensor carpi radialis brevis	*Normal*
Normal		Extensor carpi ulnaris	*Normal*
Normal	Radial duction	Abductor pollicis longus	Normal
Normal		Extensor pollicis brevis	Normal
Normal	Ulnar duction	Flexor carpi ulnaris	*Normal*
Normal		Extensor carpi ulnaris	*Normal*
Normal	Pronation	Pronator teres	*Normal*
Normal		Pronator quadratus	*Normal*
Normal	Supination	Biceps brachii	Normal
Normal		Supinator	*Normal*

Skin examination of the forearm, wrist and hand.

Left wrist joint:

- The skin is only slightly restricted at the wrist joint, dorsal side.

Right wrist joint:

- Restrictions are not present.

Examination of fascia of the forearm and at the wrist.

The left wrist joint:

- Slight restrictions of the fascia.

The right wrist joint:

- Restrictions are not present.

Conclusion of palpation examination.

Left forearm, wrist and hand:

- All the muscles palpated in the left forearm as showed in table 20 have improved, except the biceps brachii, Abductor pollicis longus and extensor pollicis brevis, which has had a normal muscle tonus all the time.
- It looks like capsular and ligaments problems, and this further provokes reflex changes in the surrounding muscles and edema.

Right forearm, wrist and hand:

- Normal.

3.5.6 Joint play examination.

The joint play examination was performed according to Prof. Lewit (18) and Mgr. Holubarova (16).

Table 22: Jointplay examination of the left upper extremity.

Elbow joint	No restriction present in latero-lateral direction.
	No restriction of the head of radius in ventral direction.
Proximal radioulnar joint	No restriction of the head of radius in rotation.
Radiocarpal joint	*Slight restriction of proximal row in dorsal direction.*
	No restriction of scaphoid in dorsal direction (radial side).
	No restriction of lunate in dorsal direction (ulnar side).
	Slight restriction of proximal row in radial direction.
Intercarpal joint	*Slight restriction; dorsal and palmar direction of each carpal bone.*
	Restricted, painful capitate in palmar direction.
Distal radioulnar joint	No restriction present in dorsal and palmar direction.
Metacarpophalangeal joint	No restriction in dorsopalmar, laterolateral and rotation direction.
Interphalangeal joints	No restriction in dorsopalmar, laterolateral and rotation direction.

Table 23: Jointplay examination of the right upper extremity.

Elbow joint	No restriction present in latero-lateral direction.
	No restriction of the head of radius in ventral direction.
Proximal radioulnar joint	No restriction of the head of radius in rotation.
Radiocarpal joint	No restriction of proximal row in dorsal direction.
	No restriction of scaphoid in dorsal direction (radial side).
	No restriction of lunate in dorsal direction (ulnar side).
	No restriction of proximal row in radial direction.
Intercarpal joint	No restriction in dorsal and palmar direction of each carpal bone.
Distal radioulnar joint	No restriction present in dorsal and palmar direction.
Metacarpophalangeal joint	No restriction in dorsopalmar, laterolateral and rotation direction.
Interphalangeal joints	No restriction in dorsopalmar, laterolateral and rotation direction.

3.5.7 Conclusion of the final kinesiology examination.

The therapy effect.

The final kinesiology examination shows that improvements have been gained. According to anthropometry (see 3.5.1), the left wrist circumduction is reduced from its swelling. The range of motion examination shows great improvement (see Table 1, Table 15). According to the neurological examination no neurological defects are present after the therapy (see Table 16, Table 17 and Table 18). Muscles strength have improved during this six session, as seen in Table 19 and Table 20 compared to Table 6 and Table 7. According to the palpation examination the tonus of the muscles improved as showed in Table 21 compared to Table 8. In the jointplay examination of the left forearm, wrist and hand there is positive progression, as seen in Table 22 compared to Table 9. In the short term plan (see point 3.3) my goals were to decrease the pain and stiffness in the left wrist joint, improve restricted range of motion of dorsal- palmar flexion, radial- and ulnar deviation, pronation and supination, improve muscular power and instruct the patient to provide correct auto-therapy exercises. I will say that these goals were archive according to the final kinesiology examination. The fact that the pain is reduced, swelling is reduced and the muscle strength is increase, have influenced the wrist joint to gain a greater range of motion.

Prognosis.

The prognosis of the "wrist pain" in this case is good, and if the patient will continue the auto therapy program with the same frequency and motivation, it should be expected a rehabilitation success.

More suggestion for long term plan.

I the future, when he will be able to again do sport, he must be careful to not overload the left wrist joint. Therefore he has got some new information how to improve his bicycling, floorball and weightlifting grip. Before he was using a dorsal flexion grip, but now he has changed it into a neutral grip, to prevent hyperextension and overloading of the wrist joint. He must also be careful, so he does not hold a static grip for a long period during activity. I have informed him that the total load from all these different activities must be less than before, for a long period of time; otherwise he will not become better. His strategy will be to decrease the load and focusing on correct technique when he is doing his sports. He will do the activity with less intensity, and have longer breaks during the activity while providing a static grip. It is very important that the affected area (muscles, surrounding tissues) will have time to regenerate to prevent overtraining. When the muscle power and coordination are normal and strong, he can increase the intensity gradually.

4. Conclusion.

I am very satisfied after spending two weeks of practice in the Military hospital of Prague, since I manage to fulfill the main goal of my thesis; to show that physiotherapy is an essential part of the total rehabilitation.

I was positively surprised that the effect started to show itself already during my second and third session. The restricted movements of the left wrist joint and the strength of the left handgrip improved and the pain was reduced in these parts.

The wrist improvement was a result of two main factors; my therapy and a great cooperation with the patient. I must say that this patient showed a huge willingness to work hard to improve himself. He performed auto therapy, he studied wrist anatomy and he really wanted to become better. His mood was positive and I must thank my patient for have been such a cooperative patient to work with. It made my job much easier.

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Abbreviations

DF:	Dorsal flexion.
PF:	Palmar flexion.
RD:	Radial duction.
UD:	Ulnar duction.
ROM:	Range of motion.
BMI:	Body Mass Index.
PFS:	Post Facilitation Stretching.
PIR:	Post isometric relaxation.
TFCC:	Triangular fibrocartilage complex.

Supplement

Some of the exercises in the gym for strengthening the wrist joint (56).

Wrist, palmar flexion

Preparation

- Sit and grasp bar with narrow to shoulder width underhand grip. Rest forearms on thighs with wrists just beyond knees.

Execution

- Allow the barbell to roll out of the palms down to the fingers. Grip barbell back up and flex wrists. Lower and repeat.

Comments

- Keep elbows approximately wrist height to maintain resistance through the full range of motion.

Wrist, dorsal flexors.

Preparation

- Sit and grasp bar with narrow to shoulder width overhand grip. Rest forearms on thighs with wrists just beyond knees.

Execution

- Hyperextend wrist and return until wrist are fully flexed. Repeat.

Comments

- Keep elbows approximately wrist height to maintain resistance through the full range of motion.

Pronation.

Preparation

- Grasp unilaterally loaded dumbbell with thumb next to weighted side. Lie on bench on side with weight and position arm with "half dumbbell" on bench. Bend elbow approximately 90-degrees and tucked bent elbow under body. Positi on thumb down (supinated).

Execution

- Rotate dumbbell so thumb turns upward (pronation). Return and repeat.

Comments

- Bench can be flat or slightly incline (0-30 degrees) so resistance occurs during initial range of motion. If a unilaterally loaded dumbbell, or "half dumbbell" is not available, grasp a conventional dumbbell to one side of handle with pinkie against inside surface.

Supination.

Preparation

- Lie on bench or mat. With hand of upper arm, grasp unilaterally loaded dumbbell; thumb next to side with weight. Bend elbow approximately 90-degrees and place forearm on hip, or side of waise. Position thumb downward (pronated).

Execution

- Rotate dumbbell so thumb turns upward (supination). Return and repeat.

Comments

- Pad or firm pillow may be placed between hip and arm. Elevation of elbow allows resistance during final range of motion. If a unilaterally loaded dumbbell, or "half dumbbell" is not available, grasp a conventional dumbbell to one side of handle with pinkie against inside surface.

Pictures.

Picture 1: Old grip.

Picture 2: New grip.

Picture 3: Magnetotherapy.

Picture 4: Magnetotherapy.

Picture 5: Hydrotherapy.

Muscles.

Table 23: Muscles in forearm and hand.

Muscle	Origin	Insertion	Action	Innervations
Abductor pollicis longus	middle one-third of the posterior surface of the radius, interosseous membrane, mid-portion of posterolateral ulna	radial side of the base of the first metacarpal	abducts the thumb at carpometacarpal joint	radial nerve, deep branch
Brachioradialis	upper two-thirds of the lateral supracondylar ridge of the humerus	lateral side of the base of the styloid process of the radius	flexes the elbow, assists in pronation & supination	radial nerve
Extensor carpi radialis longus	lower one-third of the lateral supracondylar ridge of the humerus	dorsum of the second metacarpal bone (base)	extends the wrist; abducts the hand	radial nerve
extensor carpi radialis brevis	Common extensor tendon (lateral epicondyle of humerus)	dorsum of the third metacarpal bone (base)	extends the wrist; abducts the hand	deep radial nerve
Extensor carpi ulnaris	Common extensor tendon. middle	medial side of the base of the 5th metacarpal	extends the wrist; adducts the hand	deep radial nerve

	1/2of the posterior border of the ulna			
Extensor digiti minimi	Common extensor tendon (lateral epicondyle of the humerus)	joins the extensor digitorum tendon to the 5th digit and inserts into the extensor expansion	extends the metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints of the 5th digit	deep radial nerve
Extensor digitorum	common extensor tendon (lateral epicondyle of the humerus)	extensor expansion of digits 2-5	extends the metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints of the 2nd-5th digits; extends wrist	deep radial nerve
extensor indicis	interosseous membrane and the posterolateral surface of the distal ulna	its tendon joins the tendon of the extensor digitorum to the second digit; both tendons insert into the extensor expansion	extends the index finger at the metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints	deep radial nerve
Extensor pollicis brevis	interosseous membrane and the posterior surface of the distal radius	base of the proximal phalanx of the thumb	extends the thumb at the metacarpophalangeal joint	deep radial nerve

Extensor pollicis longus	interosseous membrane and middle part of posterolateral surface of the ulna	base of the distal phalanx of the thumb	extends the thumb at the interphalangeal joint	deep radial nerve
Flexor carpi radialis	common flexor tendon from the medial epicondyle of the humerus	base of the second and third metacarpals	flexes the wrist, abducts the hand	median nerve
Flexorcarpi ulnaris	common flexor tendon & (ulnar head) from medial border of olecranon & upper 2/3 of the posterior border of the ulna	pisiform, hook of hamate, and base of 5th metacarpal	flexes wrist, adducts hand	ulnar nerve
flexor digitorum profundus	posterior border of the ulna, proximal two-thirds of medial border of ulna, interosseous membrane	base of the distal phalanx of digits 2-5	flexes the metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints	median nerve (radial one-half); ulnar nerve (ulnar one-half)
Flexor digitorum superficialis	humeroulnar head: common flexor tendon; radial head: middle 1/3 of radius	shafts of the middle phalanges of digits 2-5	flexes the metacarpophalangeal and proximal interphalangeal joints	median nerve
Flexor pollicis longus	anterior surface of radius and	base of the distal phalanx	flexes the metacarpophalangeal	median nerve

	interosseous membrane	of the thumb	and interphalangeal joints of the thumb	
Pronator quadratus	medial side of the anterior surface of the distal one-fourth of the ulna	anterior surface of the distal one-fourth of the radius	pronates the forearm	median nerve via the anterior interosseous nerve
Palmaris longus	medial epicondyle of humerus	distal half of flexor retinaculum and palmaris aponeurosis	flexes hand (at wrist) and tightens palmar aponeurosis	median nerve
Pronator teres	common flexor tendon and (deep or ulnar head) from medial side of coronoid process of the ulna	midpoint of the lateral side of the shaft of the radius	pronates the forearm	median nerve
Supinator	lateral epicondyle of the humerus, supinator crest & fossa of the ulna, radial collateral ligament, annular ligament	lateral side of proximal one-third of the radius	supinates the forearm	deep radial nerve
Interosseous, dorsal (hand)	four muscles, each arising from two	base of the proximal phalanx and	flex the metacarpophalangeal joint, extend the	ulnar nerve, deep branch

	adjacent metacarpal shafts	the extensor expansion on lateral side of the 2nd digit, lateral & medial sides of the 3rd digit, and medial side of the 4th digit	proximal and distal interphalangeal joints of digits 2-4, abduct digits 2-4 (abduction of digits in the hand is defined as movement away from the midline of the 3rd digit)	
Iinterosseous, palmar	four muscles, arising from the palmar surface of the shafts of metacarpals 1, 2, 4, & 5 (the 1st palmar interosseous is often fused with the adductor pollicis m.)	base of the proximal phalanx and extensor expansion of the medial side of digits 1 & 2, and lateral side of digits 4 & 5	flexes the metacarpophalangeal, extends proximal and distal interphalangeal joints and adducts digits 1, 2, 4, & 5 (adduction of the digits of the hand is in reference to the midline of the 3rd digit)	ulnar nerve, deep branch
Lumbrical (hand)	flexor digitorum profundus tendons of digits 2-5	extensor expansion on the radial side of the proximal phalanx of digits 2-5	flex the metacarpophalangeal joints, extend the proximal and distal interphalangeal joints of digits 2-5	median nerve (radial 2) via palmar digital nerves & ulnar nerve (ulnar 2) via deep branc

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Application for
Opinion of UK FTVS Ethic Committee
On the project of Bachelor Thesis including human participants

Title: "Wrist pain".

Project form: Bachelor Thesis

Author: (crucial author) JAN CHRISTIAN ANDERSSON

Supervisor (in case of student project) Mgr. A. KACZMARSKÁ

Project description
The case report of rehabilitation the patient with anamnesis ....elaborated with the vocational sight of physiotherapist in Ústřední vojenská nemocnice (Health care unit).
No one invasive procedure will be applied.

Proposal of Agreement (enclosed)

Prague 4/2-2008

Author's signature Jan Christian Andersson

Statement
UK FTVS Ethic Committee

Committee members: Ass. Prof. Staša Bartůňková, M.D., CSc.
Prof. Ing. Václav Bunc, CSc.
Prof. PhDr. Pavel Slepička, DrSc.
Ass. Prof. Jan Heller, MD., CSc.

The project was authorized by Ethic Committee UK FTVS with reference number: 0037/2008

Date: 22. 2. 2008

Ethic Committee UK FTVS evaluated submitted project and found no discrepancy to valid principles, instructions and international guidelines for biomedical research, including human participants.

Author of project fulfilled necessary conditions for the agreement of Ethic Committee.

Faculty stamp

Univerzita Karlova v Praze
Fakulta tělesné výchovy a sportu
-5-

Signature of EC chairman

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