Charles University

Faculty of Physical Education and Sport UK

Department of Physiotherapy

Fracture of Distal Radius

Bachelor Thesis

Author: Theodora Papadopoulou

Supervisor: Mgr. Agnieszka Kaczmarska, PhD

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Abstract

Title

EN: Fracture of distal radius

CZ: Zlomenina distální části rádia

Thesis Aim

The goal of the thesis is the rehabilitation after osteosynthesis of the distal radius caused by fracture. The theoretical part includes the clinical picture and the therapeutic approaches associated with distal radius fractures.

Methods

The practical part includes a female patient at age 34, approximately after one month of osteosynthesis of distal radius. During this period patient was wearing a cast and later an orthesis. In this part, examinations, therapeutic approaches and conclusions are included.

The methods used for the therapy include active and passive movements as well as mobilization techniques to increase the range of motion, soft tissue techniques to release the restriction of the scar, post-isometric relaxation techniques to relax the hypertonic muscles, and proprioceptive exercises to improve the coordination of the hand.

Results

The range of motion in the wrist joint and hand increased in all functional directions, the edema and pain were eliminated, the function of the hand improved, and the movement of the hand was well coordinated.

Conclusion

During the rehabilitation program, the patient showed a very good and satisfactory progress, and is able to return to the activities of daily living with only minimal difficulties due to an uncomfortable feeling of the hand. The prognosis for the long term rehabilitation plan is good.

Declaration

I hereby declare that this work is an individual work based on knowledge gained from books, journal and lectures I had been attending at Charles University.

I also declare that during the practical work, no invasive methods were used and the patient was entirely aware of the therapeutic procedures.

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ACKNOWLEDGEMENTS

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Theodora Papadopoulou
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1. Preface

The main goal of the therapeutic rehabilitation program for patients after osteosynthesis of the distal part of radius is to achieve the physiological joint motion, functionality, as well as muscle power and coordination of the hand, in order to return to their normal life without functional and structural problems.

More specifically, patients deal with pain and restricted joint motion in every movement of the wrist joint. Additionally, because of the immobilization there is decreased muscle power and coordination of the movements. Consequently this provokes decreased ability to handle with the activities of daily living, and therefore patients have difficulties in their normal life.

The case study was conducted in the health center “Centrum Lecby Pohyboveho Aparatu (CLPA), under the supervision of the physiotherapist called PhDr. Mahr Edwin.

2. General part

2.1 General Anatomy of wrist joint and hand

2.1.1 Bones and Articulations

The carpal bones of the wrist are arranged in two rows, a proximal and a distal row, each consisting of four bones. The proximal row of bones consists of the scaphoid, lunate, triquetrum, and pisiform, and connects the two bone of the forearm, the radius and the ulna, to the bones of the hand. The distal row of carpal bones consists of the trapezium, trapezoid, capitate, and hamate. Additionally, there are five metacarpal bones which are the bones of the hand and are related to one digit. The metacarpal I is related to the thumb, the metacarpals II to V are related to the index, middle, ring, and little fingers. Moreover, the phalanges are the bones of the digits. The thumb has a proximal and distal phalanx, and the rest of the digits have a proximal, middle, and a distal phalanx. (Drake, Vog, Mitchell & Adam, 2005)

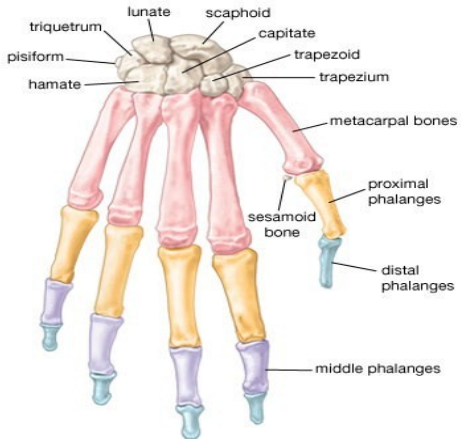

Figure 1 Bones of the wrist and hand

Additionally, the articulations include the distal radioulnar joint which is a uniaxial pivot joint and it moves back and laterally during pronation and forward and medially during supination. (Magee, 1992)

The radiocarpal joint is a condyloid joint where the radius articulates with the scaphoid, lunate, and triquetrum. The joint allows sagittal plane motions such as flexion, extension, and hyperextension, frontal plane motions such as radial and ulnar deviations, as well as circumduction. (Magee, 1992)

The carpometacapral joint of the thumb, the articulation between the trapezium and the first metacarpal, is a classic saddle joint. All carpometacarpal joints are surrounded by joint capsules, which are reinforced by the dorsal, volar and interosseus carpometacarpal ligaments. The irregular intermetacarpal joints share these joint capsules. (Luttgens &Wells, 1982)

The metacarpophalangeal joints are the condyloid joints between the rounded distal heads of the metacarpals and the concave proximal ends of the phalanges. These joints form the knuckles of the hand. Each joint is enclosed in a capsule which is reinforced by strong collateral ligaments. A dorsal ligament also merges with the metacarpophalangeal joint of the thumb. Close-pack positions of the metacarpophalangeal joints in the fingers and thumb are full flexion and opposition.

The proximal and distal interphalangeal joints of the fingers and the single interphalangeal joint of the thumb are all hinge joints. An articular capsule joined by volar and collateral ligaments surrounds each interphalangeal joint. These joints are most stable in the close-packed position of full flexion. (Luttgens &Wells, 1982)

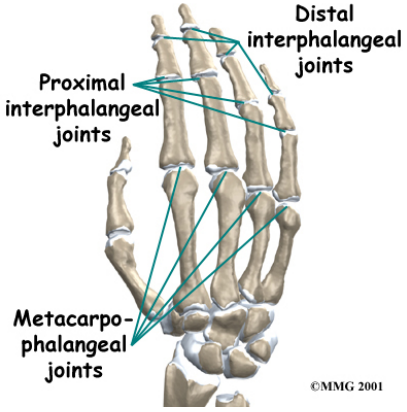

Figure 2 Hand-Dorsal view

2.1.2 Ligaments

The capsule of the wrist joint is reinforced by palmar radiocarpal, palmar ulnocarpal, and dorsal radiocarpal ligaments. In addition, radial and ulnar collateral ligaments of the wrist joint span the distance between the styloid processes of the radius and ulna and the adjacent carpal bones. These ligaments reinforce the medial and lateral sides of the wrist joint and support them during flexion and extension. (Drake, Vog, Mitchell & Adam, 2005)

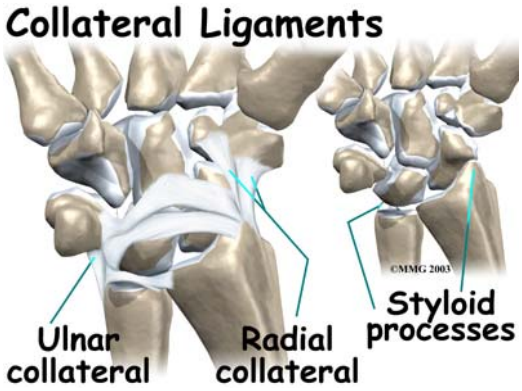

Figure 3 Ulnar and Radial Collateral Ligaments

The capsule of each metacarpophalangeal joint is reinforced by the palmar ligament and by medial and lateral collateral ligaments. (Drake, Vog, Mitchell & Adam, 2005)

Moreover, there are three deep transverse metacarpal ligaments which are thick bands of connective tissue. They are connecting the palmar ligaments of the metacarpophalangeal joints of the fingers to each other. They are important because, by linking the heads of the metacarpal bones together, they restrict the movement of these bones relative to each other. (Drake, Vog, Mitchell & Adam, 2005)

Furthermore, the interphalangeal joints of hand are reinforced by medial and lateral collateral ligaments and palmar ligaments.

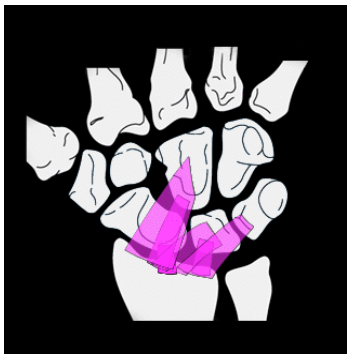

Figure 4 Palmar radiocarpal ligament

Figure 5 Dorsal radiocarpal ligament

2.1.3 Blood and nerve supply

The nerves that travel through the wrist are subject to problems. Constant bending and straightening of the wrist and fingers can lead to irritation or pressure on the nerves within their tunnels and cause problems such as pain, numbness, and weakness in the hand, fingers, and thumb. (Drake, Vog, Mitchell & Adam, 2005)

The hand is supplied by the ulnar, median, and radial nerves. All three nerves contribute to cutaneous or general sensory innervations. (Drake, Vog, Mitchell & Adam, 2005)

The ulnar nerve enters the hand lateral to the pisiform and dorsomedially to the ulnar artery. The deep branch of the ulnar nerve supplies the hypothenar muscles, the interossei, adductor pollicis, and the two medial lumbricals. As the deep branch of the ulnar nerve passes across the palm, it lies in a fibro-osseous tunnel, the Guyon's canal, between the hook of the hamate and the flexor tendons. The superficial branch of the ulnar nerve innervates the palmaris brevis muscle and supplies the skin on the palmar surface of the little finger and medial half of the ring finger. (Drake, Vog, Mitchell & Adam, 2005)

The median nerve innervates skin of the thumb, index, and middle fingers, and lateral side of the ring finger. It also innervates the thenar muscles that are responsible for the opposition of the thumb to the other digits. The median nerve enters the hand by passing through the carpal tunnel and divides into a recurrent branch and palmar digital branches. (Drake, Vog, Mitchell & Adam, 2005)

The radial nerve enters the hand by passing on the dorsolateral side of the wrist. The superficial branch of the radial nerve innervates skin over the dorsolateral aspect of the palm and the dorsal aspects of the lateral three and one-half digits distally to approximately the terminal interphalangeal joints. (Drake, Vog, Mitchell & Adam, 2005)

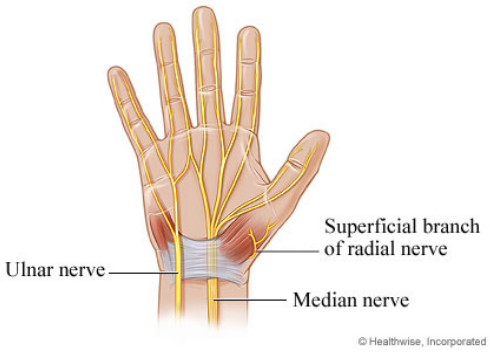

Figure 6 Ulnar, Radial and Median nerves

Blood supply to the hand is contributed by the radial and ulnar arteries. The ulnar artery enters the hand on the medial side of the wrist. The vessel lies between the Palmaris brevis and the flexor retinaculum and is lateral to the ulnar nerve and the pisiform bone. One branch of the ulnar artery in the hand is the deep palmar branch, which penetrates the origin of the hypothenar muscles. In addition, branches from the superficial palmar arch include, a palmar digital artery to the medial side of the little finger, three large common palmar digital arteries which supply the lateral side of the little finger, both sides of the ring and middle fingers, and the medial side of the index finger. (Drake, Vog, Mitchell & Adam, 2005)

The radial artery contributes to the supply of the thumb and the lateral side of the index finger. It gives rise to two vessels such as, a dorsal carpal branch which gives rise to dorsal metacarpal arteries which divide to become small dorsal digital arteries, which enter the fingers. And the first dorsal metacarpal artery, which supplies adjacent sides of the index finger and thumb. (Drake, Vog, Mitchell & Adam, 2005)

Moreover, from the radial artery arise two vessels, the princeps pollicis artery and the radialis indicis artery. The princeps pollicis artery is the major blood supply of the thumb, and the radialis indicis artery supplies the lateral side of the index finger. (Drake, Vog, Mitchell & Adam, 2005)

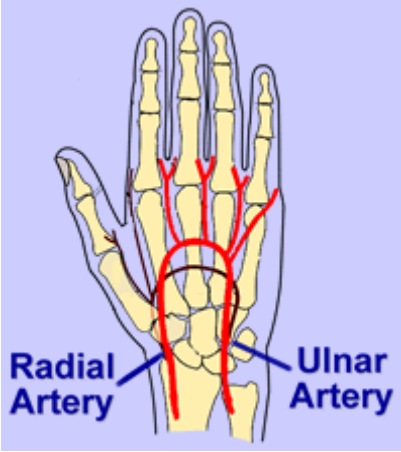

Figure 7 Radial and Ulnar Arteries

2.1.4 Muscles and Movements of the Wrist

Most of the wrist motion occurs at the radiocarpal joint which allows saggital plane motions and frontal plane motions, as well as circumduction. Movement of the wrist is 80° in flexion, 70° in extension, 30° in ulnar deviation, and 20° in radial deviation. Pronation and supination occur at the radial-ulnar articulation in the forearm and are calculated to be both 90°. (Luttgens & Wells, 1982)

Flexion

The muscles responsible for flexion at the wrist are the flexor carpi radialis and the powerful flexor carpi ulnaris. The flexor digitorum superficialis and flexor digitorum profundus can assist with flexion at the wrist when the fingers are completely extended, but when the fingers are in flexion these muscles cannot develop sufficient tension due to active insufficiency. (Luttgens & Wells, 1982)

Extension and hyperextension

Extension and hyperextension at the wrist result from contraction of the extensor carpi radialis longus, extensor carpi radialis brevis, and extensor carpi ulnaris. These muscles originate on the lateral epicondyle of humerus. The other posterior wrist muscles must also assist with extension, particularly when the fingers are in flexion.

Included in this group are the extensor pollicis longus, extensor indicis, extensor digiti minimi, and extensor digitorum. (Luttgens & Wells, 1982)

Radial and Ulnar Deviation

Cooperative action of both flexor and extensor muscles produces lateral deviation of the hand at the wrist. The flexor carpi radialis and extensor carpi radialis longus and brevis contract to produce radial deviation, and the flexor carpi ulnaris cause ulnar deviation. (Luttgens & Wells, 1982)

2.1.5 Kinesiology of the hand

The hand has multiple functions associated with the activities of daily living. The primary functions include grasping, manipulating objects, and receive sensory information from the environment. The power grip has four phases including the opening phase, finger and thumb positioning phase, approach phase, and static grip phase. (Clarkson, 2000)

Opening is an intuitive action with intent to grasp a specific object. The position of the wrist influences the fingers and thumb. For instance, wrist flexion permits full extension of the fingers to open the hand and grasp large objects. The opening phase is a dynamic phase characterized by concentric muscle contraction. If the grasped object is larger, the fingers and the thumb abduct more. (Clarkson, 2000)

In finger and thumb positioning phase, extensor digitorum muscle extends the metacarpopahalangeal joints and lumbricales create a grip position. (Clarkson, 2000)

In approach phase the movement pattern includes wrist extension, finger and thumb flexion, and adduction. As one grasps an object, wrist extension permits full flexion of the fingers. As the object is approached the fingers usually flex simultaneously and close around the object. (Clarkson, 2000)

Static grip phase is a power or stabilization phase characterized by isometric muscle contraction. The function of the hand complex is to stabilize an object so that it can be moved by the proximal limb segments. In power grip, the wrist is in neutral position or extension, the fingers are in flexion and abduction or adduction, and the volar surfaces of the fingers and portions of the palm make forceful contact with the object. The thumb may be included in the grip or not. For instance, in the hook grip such as carrying a purse or briefcase, the thumb does not contribute to the grip. In cylindrical grasp the thumb is involved and it is in opposition and fingers are adducted and flexed. In spherical grasp the thumb is in opposition as well, and the fingers are flexed and abducted, and this grasp is seen when one holds a round object such as a ball. (Rybski, 2004)

It is significant that after an injury the grip function is limited and therefore the patients deal with difficulties in activities of daily living. For example, there are difficulties in dressing, tie shoe laces, driving, writing, as well as eating. In addition, because of the immobilization and decreased movement, there might be problems in forearm and shoulder joint resulting in decreased coordination of the entire upper extremity and impaired movement quality. (Clarkson, 2000)

2.2 Causes of wrist fractures

The most common mechanism of injury to produce wrist fractures, is a fall on a hyperextended, outstretched hand. Wrist fractures are associated with sport-injury fractures and motor vehicle accidents. The palmar aspect fails in tension, and the fracture propagates dorsally, causing failure in compression and shear stresses at the dorsal surface. (Fitzgerald, Kaufer & Malkani, 2006)

The most common wrist fracture is of the distal radius. When the wrist is forced back, the carpal bones are jammed against the radius and can cause a break in the bone. The injury causes immediate pain and swelling at the back of the wrist. Deformity of an angulation of the wrist might occur with a fracture of the radius. (Gotlin, 2007)

In addition, osteoporosis plays a major role to incidences of wrist fractures especially in women. It is significant that the female to male ratio is 5:1. The incidence of wrist fractures starts to rise immediately after menopause with an incidence of about 15 percent by age 80. Wrist fractures occur as a result of moderate trauma and rapid postmenopausal bone loss. (Hudson & Northrup, 1999)

2.2.1 Physical examination of wrist injuries

Evaluation should begin with a detailed history of the incidence including the time of the injury, the onset and presentation of symptoms, and the position of the wrist at the time of the injury. In addition, it is significant to consider the amount of stress to which the wrist was subjected, and the activity the patient was participating during the injury. (Fitzgerald, Kaufer & Malkani, 2006)

Later, through inspection we can observe pain or limitation of motion by observing the patient's ability to remove a coat, or rise from a chair, or moving the hands, as well as we observe the posture of the upper extremities. Moreover, both upper extremities should be observed to assess atrophy, discoloration, and asymmetry. (Fitzgerald, Kaufer & Malkani, 2006)

In addition, palpation of the wrist is significant in order to attain a possible diagnosis. Contusion or fracture of the radial styloid may be present, if palpation on the radial styloid reveals tenderness. (Fitzgerald, Kaufer & Malkani, 2006)

Furthermore, after palpation, range of motion, consisting of flexion, extension, ulnar and radial deviation, and supination and pronation, should be carefully assessed. Active and passive movements should be always compared with the contralateral limb. (Fitzgerald, Kaufer & Malkani, 2006)

In addition, assessment of the stability of the joint is performed by placement of stress on the joint and compare it with the contralateral side. Through this assessment ligamentous injuries can be identified. (Fitzgerald, Kaufer & Malkani, 2006)

Another important aspect of the physical examination is the neurovascular status of the wrist, especially of the median nerve. It is important because median nerve praxis is common in heavily comminuted and displaced distal radius fractures. (Fitzgerald, Kaufer & Malkani, 2006)

Furthermore, it is always necessary to provide imaging methods such as X-rays, computer tomography (CT) scan, as well as magnetic resonance imaging (MRI). During radiographic examination, the examiner should note the shape and position of the bones, observe any evidence of fractures or displacement, decrease in the joint spaces and change in bone density. In addition, CT scan technique can be used to visualize bone and soft tissue. Moreover, MRI is a non-invasive technique which is useful for visualizing the soft tissues of the wrist and hand. It can show swelling of the median nerve in carpal tunnel syndrome and thickening of tendon sheaths. (Magee, 1992)

2.2.2 Types of Fractures of the Distal Radius and Diagnostics

Colle's fracture

Colle's fracture is a transverse fracture of distal radius, about 2cm from distal articular surface, which may sometimes involve fractures of ulnar styloid and sometimes have intraarticular involvement of radiocarpal joint. It is the most common fracture of the elderly people, very common in women with post-menopausal osteoporosis and almost always occurs with fall on outstretched hand. Classically appears as dinner-fork deformity. Usually there is comminution on dorsal and lateral aspects of the fracture line, while the palmar and medial aspects have clear and sharp margins. (Banerjee, 2008)

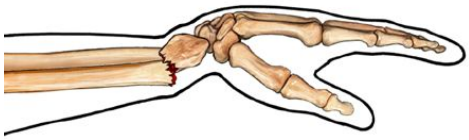

Figure 8 Colle's fracture

Radiographic appearance of Colle's fracture

X-ray appearance has a dorsal angulated fracture of distal radial metaphysis which is 2-3 cm proximal to the wrist joint, with or without associated fracture of the ulna styloid. The initial fracture line is almost always on volar side. (Pinal, 2010)

Figure 9 Colle's fracture-radiography

Smith's fracture

A Smith's fracture is a volar angulated fracture of the distal radius. It is also called reverse Colle's fracture. A type I Smith's fracture is extraarticular, a type II fracture enters the dorsal rim of the articular surface, and a type III fracture enters the middle of the radiocarpal surface. It usually occurs as a result of a fall onto the dorsum of the hand. (Brown & Neumann, 2004)

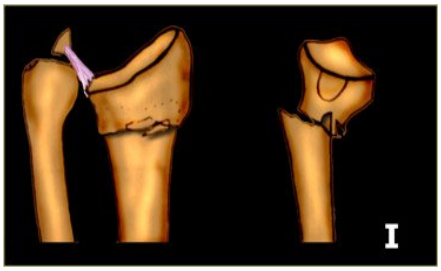

Figure 10 Smith's fracture

Radiographic appearance of Smith's fracture

The fracture extends across the lower cancellous end of the radius. The small lower fragment is bending forward, and sometimes completely transposed anteriorly. It is often comminuted, and the ulnar styloid process is usually seen to be avulsed. (Evans, 1951)

Figure 11 Before reduction

Figure 12 After reduction

Barton's fracture

A Barton's fracture is an intra-articular fracture-dislocation of the posterior margin of the radius. The fracture extends through the radiocarpal surface, with the carpus and metaphyseal fragment translating dorsally and resting on the dorsal aspect of the wrist. It is also described a similar intra-articular fracture occurring volarly. The Barton's fracture is caused by a fall on an extended and pronated wrist increasing carpal compression force on the dorsal rim. These fractures are unstable and require open reduction and internal fixation with buttress plate application because of the inability to maintain a satisfactory reduction by closed treatment methods. (Jebson & Kasdan, 2006)

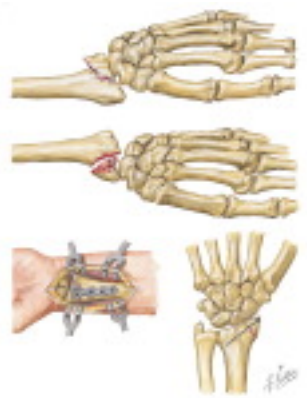

Figure 13 Barton's fracture

Radiographic appearance of Barton's fracture

We observe comminuted intraarticular fracture of the distal radius.

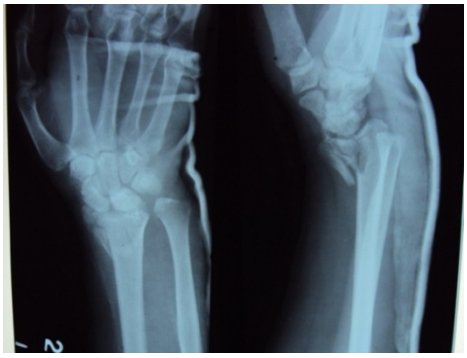

Figure 14 Volar-type barton's fracture

Figure 15 The blue arrow shows that volar rim maintains the relation with the carpus and both are displaced proximally. The yellow arrow shows the fracture of radial styloid process with loss of radial inclination s

Barton's fracture dorsal-type

We observe comminuted intraarticular fracture of the distal radius, as well as the dorsal rim and the carpus are displaced dorsally and proximally.

Figure 16 Dorsal-type Barton's fracture

Chauffeur's fracture

A Chauffeur's fracture is an intra-articular fracture of the distal radius. It is also called Hutchinson's fracture. The fracture line typically enters the joint at the junction of the scaphoid and lunate fossae. It is caused by axial compression transmitted though the scaphoid. The injury was associated with backfires resulting in the automobile starting crank striking the wrist. (Berquist, 2006)

It is caused by avulsion by the radial collateral ligament, or a direct blow. It is also associated with scapholunate ligament tears. The most frequent cause of this fracture is a fall on an outstretched hand. (Manaster, Disler, May & Sartoris, 2002)

Treatment includes cast immobilization if there is minimal displacement or percutaneous pin fixation. (Berquist, 2006)

Figure 17 Chauffeur's fracture

Radiographic appearance of Chauffeur's fracture

The dispacement of the fragment is uncommon and scapholunate ligamant injury may be associated. Moreover, in most cases the fracture is part of a comminutive intraarticular fracture. (Pinal, 2010)

Figure 18 Chauffeur's fracture

2.3 Treatment of distal radius fractures

2.3.1 Conservative treatment

A majority of fractures of the distal radius can be treated non-operatively with cast or brace immobilization. The physician by using various forms of anesthesia, manipulates the fracture fragments into proper alignment without making an incision. Conservative treatment includes reduction and immobilization using cast materials. Patients should be placed into a well padded splint. After 7-10 days, radiographs should be obtained to verify no further displacement. Long arm casts which are above the elbow, are applied for a 2 to 3 week period. Then a short arm cast which is below the elbow can be applied with the wrist in neutral position or slight extension to promote finger motion. The cast should end proximal to the metacarpal heads to allow full and early range of motion of the fingers. The thumb should also be left free of motion. In addition, functional braces have been developed to allow immediate radiocarpal motion. Moreover, immobilization should continue for 4-6 weeks followed by the use of a removable splint and active wrist exercises can begin. During the entire treatment period, metacarpophalangeal motion and digit function should be emphasized. (Obrant, 2003)

The method of closed reduction is applied in stable fractures. An intact palmar buttress resists axial compression forces which tend to collapse a fracture. In addition, traction is applied by grasping the injured hand and countertraction is applied with elbow in flexed position. Moreover, we should avoid flexion more than 30 degrees because the presence of swelling may lead to acute pressure in carpal tunnel. Furthermore, forearm should be in middle position or slight supination in order to open interosseous space between radius and ulna, as well as to relieve tension of brachioradialis which tends to pull distal fragment dorsally. The recovery in supination position helps the distal radioulnar joint to heal in proper position, as well as to achieve better radioulnar reduction and better radiographic evaluation. Finally, hematoma block with supplemental intravenous sedation can be used to provide analgesia. (Kulkarni, 2008)

2.3.2 Surgical treatment

The surgical treatment of distal radial fractures include open reduction and internal fixation, as well as external fixation.

Percutaneous pinning

It is used for fixation of distal radius fractures entering at the level of the radial styloid process. The goal is to fix the mobile fragment to the opposite cortex proximal to the fracture. Direct pinning of the fragments, through the distal ulna, adds stability to the structure. (Saffar & Cooney, 1995)

It involves the insertion of pins through the skin to hold the bones in a proper position while they heal. Wires are placed across the fracture and used to fix the fragments together. In Kapandji pinning, the wires are placed to support the distal fragment. For percutaneous pinning the reduction is closed. It is minimally invasive and relatively simple and quick to perform compared with the other surgical methods. (Handol,Vaghel & Madhok, 2008)

Figure 19 Percutaneous pinning-posteroanterior view

Intrafocal pinning

It is used for the treatment of unstable extra-articular fractures. However, it does not provide rigid fixation that is why is necessary supplemental cast or splint immobilization for 4 to 6 weeks, otherwise early wrist motion may produce pain and dystrophy. Typically K-wires are introduced through the snuffbox, where injury and irritation of the superficial radial nerve branches are common (Stern, 2001)

The K-wire is moved dorsally through the fracture site to penetrate the opposite cortex in a 45 degrees proximal direction. The K-wire because of its elastic force gives a persistent reduction and prevents redispalcement. (Saffar & Cooney, 1995)

Figure 20 Intrafocal pinning

Bone grafting

It is used when there is excessive comminution and bone loss that persists after reduction. A corticocancellous or cancellous graft prevents proximal migration of a central fragment. This migration can occur in a die-punch fracture or in elderly people with osteoporotic bone. Bone graft provides mechanical internal support of articular fragments and accelerates bone healing. (Saffar & Cooney, 1995)

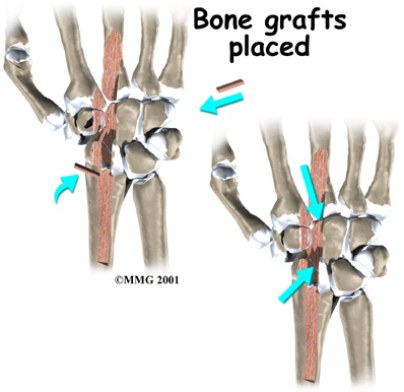

Figure 21 Bone graft is placed between each of the spaces in the wrist bones

Plate fixation

It is used for fractures with volar displacement, such as Barton's and Smith's fractures. Plate fixation provides either a buttress effect or hold the distal epiphysis by corticocancellous screws. (Saffar & Cooney, 1995)

Figure 22 Plate fixation

External fixation

It is used for the reduction of comminuted intra-articular fractures. This technique uses an external frame holding pins placed in the bone through small incisions on both sides of the fracture. Through this technique there is minimal soft tissue disruption, minimal scaring, as well as bone graft may be used to support the joint surface. (Wolf, 2007)

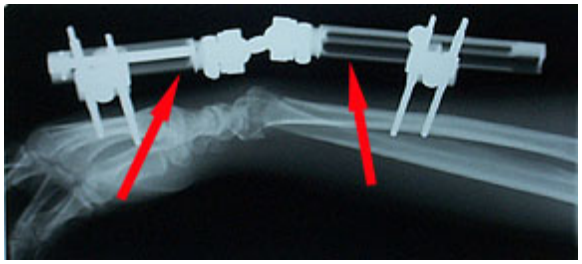

Figure 23 Wrist external fixator

Wrist arthroscopy

It can be applied to intra-articular distal radius fractures. This technique causes less post-operative pain, shorter recovery time and an earlier return on work for the patient. The volar aspect of the wrist is easily visualized with the arthroscope. Arthroscopic examination should be delayed for approximately 5 to 7 days following the injury to allow bony and soft tissue bleeding to resolve and swelling to begin to subside. During the procedure, the joint is irrigated to remove most debris, the fracture and amount of displacement are evaluated, and the scapholunate and lunotriquetral ligaments are inspected. Then K-wires can be used to fix fragments together and to the metaphysis. (Stannard, Schmidt & Kregor, 2007)

2.4 Physiotherapy

2.4.1 Physiotherapy after conservative treatment

There must be a six week period to ensure proper bone healing and bone strength. During the healing period a stable fracture is treated with a combination of casting and splinting. The plaster should be checked for tightness, looseness, softening cracks and swelling, and if any of these are found it needs to be changed immediately. In addition, the possible edema should be treated by hand elevation and retrograde massage from the fingertips to the palm. It can be used also hydrotherapy in order to reduce pain, edema and discomfort. (Ebnezar, 2003)

Moreover, in order to prevent stiffness, active range of motion exercises are encouraged to the digits, thumb, elbow and shoulder joints. It is also significant that wrist movements, such as supination and pronation should be avoided. Furthermore, isometric exercises to the hand muscles can begin. (Ebnezar, 2003)

Additionally, magnetotherapy with strong electromagnetic fields can enhance the healing of bone fractures. There is increase of peripheral blood flow which is associated with changes in fibroblast concentration, fibrin fibers, and collagen at wound sites. It also contributes to the blockage of action potentials such as those that transmit pain signals. Moreover, the therapeutic use of magnetic fields involves using pulsating magnetic fields of strengths over 10 gauss. (Frontera, 2007)

2.4.2 Physiotherapy after surgical treatment

The rehabilitation program includes active and passive motion of the digits, elbow and shoulder, as well as rotation of the forearm within 24 hours following surgery. Early motion decreases tendon adhesions and reduces soft tissue swelling. In addition, splints and casts must allow full metacarpophalangeal range of motion. If K-wire fixation was performed, a short arm cast is used for 6 to 8 weeks. Then a removable forearm-based thermoplastic wrist splint is used for another 4 weeks. (Stannard, Schmidt & Kregor, 2007)

When an external fixation is used, a soft dressing with an arm sling is sufficient, and forearm rotation is begun early with emphasis on supination.

When bone grafting with additional percutaneous pins was used, the fixator can be removed as early as 3 weeks. (Stannard, Schmidt & Kregor, 2007)

More specifically, after open reduction and internal fixation, the drain is usually removed prior to discharge on the first postoperative day. Digital motion should be encouraged immediately after surgery, and elbow and shoulder mobilization exercises are significant. (Stern, 2001)

Moreover, after external fixation, a light compressive dressing is applied around the pin sites and is changed at the first follow up visit. It is significant to perform immediate finger motion and range of motion exercises for the forearm, elbow and shoulder. In addition, stitches are removed after 10 days, and the fixator is kept in place for approximately 6 weeks. When there is setting of bone grafting or supplemental fixation, the removal can occur earlier. (Stern, 2001)

Once splints and osteosynthesis are taken out, active-assisted and active exercises are encouraged in flexion, extension, radial and ulna deviation, pronation and supination directions. The therapist may incorporate specific mobilization techniques to increase the range of motion, taking into account the status of fracture healing and the amount of joint stiffness. Moreover, it is significant that exercises for muscle control and coordination may be difficult when motion is painful. Additionally, as range of motion in the wrist increases, strengthening exercises against resistance should be included in the treatment plan. (Kauffman, 2007)

The final goal should be the restoration and maintenance of range of motion, as well as the strength of the injured wrist to physiological levels. (Kauffman, 2007)

Additionally, dynamic stabilization exercises include wrist and finger proprioceptive neuromuscular facilitation patterns, progressive resistive exercises with weights or tubing, hand dexterity tasks, eccentric work, and graded programs such as throwing and catching ball. Overhead plyometrics encourage both endurance and strength of the entire upper extremity. (Herrling & Kessler, 2006)

Closed-kinetic chain exercises may include such as floor push-ups, wall push-ups, or mini-trampoline push-ups to encourage wrist motion, general strengthening, and weight bearing. In addition, quadripod stabilization with weight bearing through the wrists and arms can be used to reestablish neuromuscular control, weight shifting, and balance. (Herrling & Kessler, 2006)

Furthermore, physical therapy modalities can be used such as hydrotherapy, electrical stimulation, heat, cold or ultrasound. (Hoppenfeld & Murthy, 2000)

Hydrotherapy may include whirlpool or therapeutic pool treatment. It is used to improve range of motion, stimulate wound healing, and improve circulation. (Hoppenfeld & Murthy, 2000)

Electrical stimulation may be provided as part of a strengthening program after a fracture has healed. High-volt galvanic, direct current stimulation may be useful to reduce muscle spasm, particularly when it is necessary to increase range of motion after cast removal. (Hoppenfeld & Murthy, 2000)

Cold is applied either by an ice pack or by the use of a vapocoolant spray that cools by evaporation, for analgesia and control of edema immediately after injury. In the later phases of rehabilitation, therapeutic cold is useful for reducing pain and muscle spasm. (Hoppenfeld & Murthy, 2000)

Superficial heat includes hot packs and radiant heat for skin and subcutaneous tissues. It provides to the patient relaxation and free mobilization of skin and scar tissue. (Hoppenfeld & Murthy, 2000)

A paraffin bath is the immersion in melted paraffin wax and glycerin that heats the skin and subcutaneous tissues as well as the small joints and muscles of the hand. Indications include pain and loss of range of motion of hand and wrist. It is important not to be used if there is edema or open wounds. (Hoppenfeld & Murthy, 2000)

It is also important to improve the functional use of the hand and set up normal grip patterns in order to increase the amount of muscle contraction required during the activities of daily living. The patient must be taught to use effectively isolated motions such as to grasp an object and repeat the movement several times. The movement sequence may reveal the limitations in the hand. It is important to achieve 20 to 40 degrees of wrist extension for positioning and stabilizing the hand, as well as for allowing maximum power for grasping when the digits flex. Functional tasks require less than 40 degrees of wrist flexion and usually wrist flexion improves more rapidly than wrist extension because wrist flexors are stronger. In addition, home exercise for progressive strengthening helps in gaining end-ranges. (Cooper, 2007)

3. Special Part

3.1 Methodology

The clinical work placement was performed at “Centrum Lecby Pohyboveho Aparatu” in Prague.
The time duration of the clinical practice was ten days between the 25th of January and the 5th of February 2010. Because the patient cancelled three therapies, the 5th session was done on 8th of February, the 6th session was done on 11th of February, the 7th session was done on 15th of February, and the final kinesiological examination was done on 18th of February.

My study was conducted under the supervision of PhDr.Edwin Mahr with whom I cooperated in all the therapeutic procedures.

The health center specializes in rehabilitation after orthopedic injuries, and the clinic provides a variety of therapeutic methods including, a big room for electrotherapy, another pool room for hydrotherapy, as well as a gym room for individual exercises.

From the first day of the therapy, the patient was informed for the approval of the project of the thesis by the Ethics Committee of the Faculty of Physical Education and Sport at Charles University in Prague.

The work has been approved by Ethics Board View at the Faculty of Physical Education and Sport, Charles University, under the approval number 072/2010.

3.2 Anamnesis

Patient's name: S.M, female

Date of Birth: 1976

Present medical diagnosis: Fracture of distal radius on the right wrist joint treated with osteosynthesis

Family anamnesis: Her grandmother has diabetes mellitus type II

Personal anamnesis: before 10 years she had knee injury on both knee joints and she had arthroscopic surgery on anterior cruciate ligaments on both knee joints.

Pharmacological anamnesis: Dolsin: painkiller, Fraxiparin: before and after surgery and antibiotics before and after surgery for 2 days.

Allergies anamnesis: None

Abuses: no smoking, occasionally alcohol

Professional anamnesis: Nurse

Social anamnesis: She is married with two small children, one 4 years old and the other 8 months.

Previous Rehabilitation: Negative

Present status: The accident occurred on 28th of November while playing with her children and fall down. She wore a cast for about 1 week and on 7th of December she had the surgery and she wore a cast. On 11th of January the cast removed and for 2 weeks she wears orthesis. At this time patient has small edema around wrist joint, fingers are in flexion position and she feels pain even with small movements. It is important to note that patient is right-handed which means she has many difficulties in the activities of daily living and to take care of her children. Additionally, patient feels pain on her right shoulder joint because she holds her 8th month child. Moreover patient has psychological problems.

Patient's height is 1.73, weight is 75 kilos and BMI is 25.8

Patient's health documentation extract: X-ray the day of the accident (28th of November), X-ray after 1 day of the operation, X-ray after 6 weeks of the operation (18th of January). The first X-ray proved the fracture of radius according to Smith Surgery which was recommended for osteosynthesis. The stlyloid process of radius was broken to ventral direction. Although we don't know the results of the surgery, we only know that there were no complications. The removal of osteosynthesis will be done only in case of unpleasant feelings.

Indication towards Rehabilitation:

- 10 x exercises under kinesiological observation and mobilization exercises in carpal area
- 10 x PIR and Soft Tissue Techniques under kinesiological observation
- 10 x hydrotherapy

Differential considerations:

- Decrease proprioception and sensation of the hand due to edema and consequently possible functional deficits
- Restriction on soft tissues
- Restricted joint play on the wrist joint, proximal interphalangeal joints, metacarpals, elbow joint and shoulder joint
- Restricted ROM on wrist and fingers due to immobilization and edema which consequently cause fine motorics and functioning problems.

- Hypotonicity of muscles and decreased power due to immobilization
- Muscle dysbalances and changes on movement patterns on the shoulder joint due to overloading of the extremity caused by the holding of the child.
- Possible difficulties in the activities of daily living such as brushing her teeth, eating, hold the plate and driving, due to weakness and decrease of fine motorics and coordination.

3.3 Initial kinesiological Examination (25.1.2010)

Standing evaluation

Standing evaluation- anterior view

Sole weight bearing	Both feet on lateral side
Patella, knee	ER bilaterally
Umbilicus	Physiological
Sternum	Middle line
Clavicles	Right is lower
Shoulder position	Protraction of shoulders
Head position	Middle line
Hand position (right)	Slightly flexion on wrist joint

Table 1- Standing evaluation-anterior view

Standing evaluation- posterior view

Achilles tendon thickness	Symmetrical
Calf	Symmetrical
Subgluteal lines	Symmetrical
Inferior scapula angles	Lower right
Shoulder position	Depression on right

Table 2- Standing evaluation-posterior view

Standing evaluation-side view

Knee joint position	Hyperextension left Hyperextension right
Lumbar part of spine	Slight hyperlordosis
Thoracic part of spine	Physiological curve
Shoulder position	Protraction, bilaterally
Cervical part of spine	Hyperlordosis, prominence of C7.
Head position	Protraction , forward-drawn position

Table 3- Standing evaluation-lateral view

Pelvis examination

Iliac crests	Symmetrical
Anterior superior iliac spines	Symmetrical
Posterior superior iliac spines	Symmetrical

Table 4- Examination of pelvis

Note: We provide pelvic examination in order to see if there is changed postural pattern and because the result is physiological, we will concentrate on the upper extremity.

Palpation examination

Brachioradialis muscle	Hypertonic on right-painful
Extensor muscles of the right forearm	Hypertonic
Flexor muscles of the right forearm	Slightly hypertonic
Biceps brachii muscle	Hypertonic on right
Trapezius muscle upper part	Hypertonic on both sides, more on the right
Pectoralis minor and major muscles	Hypertonic on both sides, more on the right

Table 5- Palpation examination

Note: Muscles on the left upper extremity are physiological

Scar examination

Aspection	Slight redness No edema Small in size Not deep
Palpation	Restricted on distal part

Table 6- Scar examination

Soft tissue examination

	Right	Left
Clavipectoral fascia	Restricted	Physiological
Arm according to rotational direction	Restricted on ventral side	Physiological
Forearm according to rotational direction	Restricted on posterolateral side	Physiological
Cervicothoracic fascia	Restricted on cranial direction	Restricted on cranial direction

Table 7- Soft tissue examination

Anthropometric measurements

	Right	Left
Circumference of wrist joint	18 cm	16 cm
Circumference of metacarpals	18 cm	18 cm
Circumference of metacarpophalangeal joints	18 cm	18 cm

Table 8-Anthropometric measurements

ROM examination

Wrist joint - passive movement

F	25˚
E	10˚
Radial duction	5˚
Ulnar duction	10˚

Table 9- Passive movement of wrist joint

Radioulnar joint - passive movement

S	5˚
P	10˚

Table 10- Passive movement of radioulnar joint

Note: Patient couldn't provide active movements due to extreme feeling of pain.

Interphalangeal joints of fingers:

Proximal interphalangeal joints are in flexion position of about 60-70 degrees and distal are as well in flexion position of about 55 degrees.

Metacarpophalangeal joints: they are in flexion position of about 60 degrees.

Shoulder joint-active:

	Right	Left
F	175˚	180˚
E	45˚	45˚
ABD	180˚	180˚
ADD	0˚	0˚
ER	85˚	90˚
IR	70˚	70˚

Table 11- Active movement of shoulder joint

Joint play examination on the right upper extremity

Wrist joint	Palmar direction restricted Radial duction restricted
Interphalangeal joints (proximal-distal)	Palmar direction restricted in all fingers Thumb physiological
Metacarpophalangeal joints	Palmar direction restricted in all fingers Thumb physiological
Shoulder joint	Caudal direction physiological

	Ventral direction physiological Dorsal direction physiological Lateral direction physiological
Elbow joint	Lateral direction: physiological Ulnar direction: physiological

Table- 12 Joint play examination

Note: We couldn't provide joint play examination on distal radioulnar joint because of the osteosynthesis.

Manual muscle testing

	Right	Left
Supraspinatus muscle	4-	4+
Deltoid (anterior,posterior,middle fibers)	4	4+
Petoralis major-upper	4	4+
Pectoralis major-lower	4	4+
Pectoralis minor	5	5
Shoulder external rotators	4+	5
Shoulder internal rotators	4+	5
Teres major-subscapularis	4+	5
Latissimus dorsi	4	4+
Rhomboids	4	4+
Trapezius-upper	5	5
Trapezius-middle	4	4+
Trapezius-lower	4	4
Serratus anterior	4-	4
Biceps brachii and	4	5

Brachiallis		
Brachioradialis	4	5
Triceps brachii (long head, lateral head, medial head)	4-	4

Table 13- Manual muscle testing

Note: We couldn't provide manual muscle testing on hand and forearm muscles because of limited movement of the hand as well as pain feeling.
Additionally, during testing of fine motorics, there was decreased coordination of the hand. Patient was unable to provide simple tasks used in activities of daily living such as, grasping, holding a spoon or plate, as well as driving.

Neurological examination

Superficial sensation

- Two-point discrimination test: physiological
- Graph aesthesia test: physiological
- Stereognosis test: physiological

Deep sensation

- Position sensation: physiological
- Movement sensation: physiological

Tendon reflexes on upper extremities

	Right	Left
Bicipital reflex	Physiological	Physiological
Brachioradial reflex	Hypereflexia	Physiological
Tricipital reflex	Physiological	Physiological
Flexor digitorum reflex	Hyporeflexia	Physiological

Table 14- Examination of tendon reflexes

3.4 Conclusion of initial kinesiological examination

After the initial kinesiological examination we conclude the following:

By aspection we observe that there is edema on the right hand. There is restriction on the distal part of scar whereas the proximal part is more movable.

Additionally, brachioradialis muscle on the right side is hypertonic and patient feels pain during palpation. Moreover, both trapezii, right pectoralis minor, right biceps brachii are hypertonic and probably this is the reason for the pain in the shoulder.

Additionally, it was found restriction on clavipectoral fascia and cervicothoracic fascia on the right side which maybe also the causal factor of shoulder pain.

Moreover, in the circumference measurements of wrist joints, it was found and quantified that the right wrist joint is 18cm in comparison to the left one which is 16cm.

Furthermore, in ROM examination, patient couldn't provide active movements at all because of extreme feeling of pain. So, we provided only passive movements in flexion, extension, supination, pronation, radial and ulnar ductions, and all of them were restricted with the worse pain feeling on supination and pronation movements.

Additionally, proximal interphalangeal joints are in flexion position of about 60-70 degrees and distal are as well in flexion position of about 55 degrees.

Metacarpophalangeal joints are in flexion position of about 60 degrees.

ROM of the shoulder joint in flexion, extension, abduction, adduction, external rotation, internal rotation is physiological in both sides.

Furthermore, joint play on the right wrist joint was restricted in palmar direction and in radial duction. Also, proximal and distal interphalangeal joints were restricted on palmar direction and metacarpophalangeal joints were restricted as well in palmar direction.

The joint play in the shoulder joint was physiological in all directions.

Moreover, manual muscle testing of shoulder and upper extremity muscles indicates that muscles are strengthen in a range of -4 to 5 degrees.

Additionally, all neurological examinations were found physiological except a hyporeflexia on flexor digitorum reflex and a hypereflexia on brachioradial reflex on the right side.

3.5 Short term and Long-term Physiotherapy Plan

Short-term rehabilitation plan: It includes decrease of edema and pain, improvement of ROM in both passive and active movements, as well as improvement of joint play.

Long-term rehabilitation plan: It includes improvement of proprioception and muscle power as well as muscle coordination and centration of the whole upper extremity together with cervical and thoracic part.

3.6 Rehabilitation Sessions

First session – 25.01.2010

Subjective findings: patient feels pain and numbness of fingers while she is moving her hand as well as pain on her shoulder. Additionally, patient is not able to brush her teeth, eat and hold the plate, as well as to drive.

Goal of today's therapy unit:

- Reduce edema and pain
- Release restriction of the distal part of scar
- Release the restriction of arm and forearm fascias in the area of biceps brachii and brachioradialis muscles
- Increase ROM of the wrist joint, IP1-IP2 joints in all functional directions

Procedure:

- Hydrotherapy for 15min.with temperature 35˚C for elimination of edema and improvement of ROM
- Soft tissue techniques in order to release the distal part of the scar
- Soft tissue techniques so as to release the arm and forearm fascias

- Passive movements in wrist joint to F, E, S, P, radial and ulnar ductions as well as in IP1-IP2 joints to E

Results:

- Slight improvement of the mobility of the scar
- There was slight release of arm and forearm fascias
- Wrist joint: F (25˚), E (10˚), S (5˚), P (10˚), radial duction (5˚), ulnar duction (10˚), which means there was no improvement after therapy.
- Passive: We could reach passively F as following: IP1 joints: F (55˚), IP2 joints: F (50˚), MP joints: F (50˚)

Note: I provided only passive movements because the patient wasn't able to provide actively the movements due to painful barrier.

Second session – 27.01.2010

Subjective findings: patient feels pain on the wrist joint and shoulder joint while she is moving. The numbness of fingers is slightly better but is getting worse in the evening while she is performing a task.

Goal of today's therapy unit:

- Reduce edema and pain
- Release restriction of the distal part of scar
- Release the restriction of arm and forearm fascias in the area of biceps brachii and brachioradialis muscles
- Improve joint play on wrist joint, IP1-IP2 joints and MP joints in palmar direction.
- Increase ROM of the wrist joint, IP1 and IP2 joints

Procedure:

- Hydrotherapy for 15min.with temperature 35˚C for elimination of edema and improvement of ROM
- Soft tissue techniques in order to release the distal part of the scar
- Soft tissue techniques so as to release the arm and forearm fascias
- Mobilization of wrist joint, IP1-IP2 joints and MP joints in palmar direction
- Active and passive movements in wrist joint to F, E, S, P, radial and ulnar ductions as well as in IP1 and IP2 joints to E

Results:

- Slight improvement of the mobility of the scar
- There was slight release of arm and forearm fascias
- No improvement of joint play
- Wrist joint-active: F (25˚), E (10˚), S (5˚), P (10˚), radial duction (5˚), ulnar duction (10˚).
- Wrist joint-passive: F (30˚), E (15˚), S (10˚), P (15˚), radial duction (5˚), ulnar duction (10˚).

- Active: Patient could decrease F as following: IP1 joints: F (45˚), IP2 joints: F (30˚), MP joints: F (25˚)
- Passive: We could reach passively F as following: IP1 joints: F (40˚), IP2 joints: F (25˚), MP joints: F (20˚)

Third session – 29.01.2010

Subjective findings: patient feels less pain on the wrist joint. In the shoulder joint she feels more pain because she is carrying her 8th month child. The numbness of fingers is better but is still getting worse in the evening while she is performing a task.

Objective findings: There is still hypertonicity of extensors, supinators, flexors, pronators, as well as of the right biceps brachii muscle.

Goal of today's therapy unit:

- Reduce edema and pain
- Release restriction of the distal part of scar
- Release the restriction of arm and forearm fascias in the area of biceps brachii and brachioradialis muscles, as well as of the cervicothoracic and clavipectoral fascias.
- Relaxation of extensors, supinators, flexors and pronators of the forearm, as well as of the right biceps brachii muscle.
- Improve joint play on wrist joint, IP1-IP2 joints and MP joints in palmar direction.
- Increase ROM of the wrist joint, IP1 and IP2 joints

Procedure:

- Hydrotherapy for 15min.with temperature 35˚C for elimination of edema and improvement of ROM
- Soft tissue techniques in order to release the distal part of the scar
- Soft tissue techniques so as to release the arm and forearm fascias, as well cervicothoracic and clavipectoral fascias.
- PIR techniques in order to relax extensors, supinators, flexors and pronators of the forearm, as well as biceps brachii muscle.
- Mobilization of wrist joint, IP1-IP2 joints and MP joints in palmar direction

- Active and passive movements in wrist joint to F, E, S, P, radial and ulnar ductions as well as in IP1 and IP2 joints to E

Results:

- Edema seems better
- More improvement of the mobility of the scar
- Arm and forearm fascias are more released. Cervicothoracic and clavipectoral fascias are slightly better.
- There is slight relaxation of the hypertonic muscles but the patient still feels pain on the brachioradialis muscle during palpation.
- There is still restriction of joint play of wrist joint in palmar direction. There is only slight improvement of joint play on IP1-IP2 joints and MP joints on palmar direction
- Wrist joint-active: F (25˚), E (10˚), S (5˚), P (10˚), radial duction (5˚), ulnar duction (10˚) – same as previous therapy
- Wrist joint-passive: F (30˚), E (15˚), S (10˚), P (15˚), radial duction (5˚), ulnar duction (10˚) – same as previous therapy
- Active: Patient could decrease F as following: IP1 joints: F (35˚), IP2 joints: F (25˚), MP joints: F (20˚)
- Passive: We could reach passively F as following: IP1 joints: F (30˚), IP2 joints: F (20˚), MP joints: F (15˚)

Self therapy: PIR for extensors, supinators, flexors and pronators of the forearm. Additionally, stretching exercises for proximal and distal interphalangeal joints into E.

Fourth session – 01.02.2010

Subjective findings: pain on the wrist joint is better but on the shoulder joint is the same as before because patient doesn't rest at all. Numbness of fingers is completely disappeared.

Objective findings: Arm and forearm fascias are released.

Goal of today's therapy unit:

- Reduce edema and pain
- Release restriction of the distal part of scar
- Release the restriction of the cervicothoracic and clavipectoral fascias
- Relaxation of extensors, supinators, flexors and pronators of the forearm, as well as of the right biceps brachii muscle, trapezii muscles (right and left) as well as right and left pectoral minor and major muscles.
- Improve joint play on wrist joint, IP1-IP2 joints and MP joints in palmar direction.
- Increase ROM of the wrist joint, IP1 and IP2 joints.
- Improve proprioception of the hand

Procedure:

- Hydrotherapy for 15min.with temperature 35˚C for elimination of edema and improvement of ROM
- Soft tissue techniques in order to release the distal part of the scar
- Soft tissue techniques so as to release cervicothoracic and clavipectoral fascias.
- PIR techniques in order to relax extensors, supinators, flexors and pronators of the forearm, as well as biceps brachii muscle, both trapezii muscles and both pectoral minor and major muscles.
- Mobilization of wrist joint, IP1-IP2 joints and MP joints in palmar direction

- Active and passive movements in wrist joint to F, E, S, P, radial and ulnar ductions as well as in IP1 and IP2 joints to E
- Proprioceptive exercises with small soft balls and small stones

Results:

- Edema decreased a lot
- More improvement of the mobility of the scar
- Cervicothoracic and clavipectoral fascias are more released
- There is slight relaxation of the hypertonic muscles and the patient feels more movable and relaxed
- There is slight improvement of joint play on wrist joint , on IP1-IP2 joints and MP joints on palmar direction
- Wrist joint-active: F (30˚), E (15˚), S (10˚), P (15˚), radial duction (5˚), ulnar duction (15˚)
- Wrist joint-passive: F (35˚), E (20˚), S (15˚), P (20˚), radial duction (10˚), ulnar duction (15˚)
- Active: Patient could decrease F as following: IP1 joints: F (30˚), IP2 joints: F (20˚), MP joints: F (20˚)
- Passive: We could reach passively F as following: IP1 joints: F (25˚), IP2 joints: F (15˚), MP joints: F (15˚)
- During the proprioceptive exercises, patient was feeling pain and slightly numbness in her fingers. Also, while she is performing functional tasks, there is synkinesis of shoulder joint.

Self therapy:

PIR for extensors, supinators, flexors and pronators of the forearm, PIR for right and left upper trapezii muscles as well as for minor and major pectoral muscles.

Additionally, stretching exercises for proximal and distal interphalangeal joints into E.

Fifth session – 08.02.2010

Subjective findings: pain on the wrist joint and shoulder joint is better. Additionally, patient is able now to brush her teeth, eating and hold the plate with index and thumb fingers, as well as she is able to drive with only small difficulties.

Goal of today's therapy unit:

- Reduce edema and pain
- Release restriction of the distal part of scar
- Release the restriction of the cervicothoracic and clavipectoral fascias
- Relaxation of extensors, supinators, flexors and pronators of the forearm, as well as of the right biceps brachii muscle, trapezii muscles (right and left) as well as right and left pectoral minor and major muscles.
- Improve joint play on wrist joint, IP1-IP2 joints and MP joints in palmar direction.
- Increase ROM of the wrist joint, IP1 and IP2 joints.
- Improve proprioception of the hand

Procedure:

- Hydrotherapy for 15min.with temperature 35˚C for elimination of edema and improvement of ROM
- Soft tissue techniques in order to release the distal part of the scar
- Soft tissue techniques so as to release cervicothoracic and clavipectoral fascias.
- PIR techniques in order to relax extensors, supinators, flexors and pronators of the forearm, as well as biceps brachii muscle, both trapezii muscles and both pectoral minor and major muscles.
- Mobilization of wrist joint, IP1-IP2 joints and MP joints in palmar direction
- Active and passive movements in wrist joint to F, E, S, P, radial and ulnar ductions as well as in IP1 and IP2 joints to E

- Proprioceptive exercises with small soft balls and small stones

Results:

- Edema decreased a lot
- More improvement of the mobility of the scar
- Cervicothoracic and clavipectoral fascias are released
- There is relaxation of the hypertonic muscles and the patient feels more movable and relaxed
- There is slight improvement of joint play on wrist joint , on IP1-IP2 joints and MP joints on palmar direction
- Wrist joint-active: F (35˚), E (20˚), S (15˚), P (20˚), radial duction (10˚), ulnar duction (20˚)
- Wrist joint-passive: F (40˚), E (25˚), S (20˚), P (25˚), radial duction (10˚)-same as active because there was painful barrier, ulnar duction (20˚)
- Active: Patient decreased F as following: IP1 joints: F (25˚), IP2 joints: F (15˚), MP joints: (15˚)
- Passive: We could reach passively F as following: IP1 joints: F (20˚), IP2 joints: F (10˚), MP joints: F (10˚)
- During the proprioceptive exercises, patient was feeling pain and slightly numbness in her fingers. The synkinesis of the shoulder joint is better.

Self therapy:

PIR for extensors, supinators, flexors and pronators of the forearm. PIR for right and left upper trapezii muscles as well as for minor and major pectoral muscles.

Additionally, stretching exercises for proximal and distal interphalangeal joints into E.

Sixth session – 11.02.2010

Subjective findings: Pain on the wrist joint and shoulder joint is better. Patient is feeling more relaxed and movable.

Objective findings: cervicothoracic and clavipectoral fascias are released.

Goal of today's therapy unit:

- Reduce edema and pain
- Release restriction of the distal part of scar
- Relaxation of extensors, supinators, flexors and pronators of the forearm, as well as of the right biceps brachii muscle, trapezii muscles (right and left) as well as right and left pectoral minor and major muscles.
- Improve joint play on wrist joint, IP1-IP2 joints and MP joints in palmar direction.
- Increase ROM of the wrist joint, IP1 and IP2 joints.
- Improve proprioception of the hand

Procedure:

- Hydrotherapy for 15min.with temperature 35˚C for elimination of edema and improvement of ROM
- Soft tissue techniques in order to release the distal part of the scar
- PIR techniques in order to relax extensors, supinators, flexors and pronators of the forearm, as well as biceps brachii muscle, both trapezii muscles and both pectoral minor and major muscles.
- Mobilization of wrist joint, IP1-IP2 joints and MP joints in palmar direction
- Active and passive movements in wrist joint to F, E, S, P, radial and ulnar ductions as well as in IP1 and IP2 joints to E
- Proprioceptive exercises with small soft balls and small stones

Results:

- Edema is almost disappeared
- More improvement of the mobility of the scar
- Hypertonic muscles are relaxed a lot
- There is improvement of joint play on wrist joint , and more improvement on IP1-IP2 joints and MP joints on palmar direction
- Wrist joint-active: F (40˚), E (25˚), S (20˚), P (25˚), radial duction (15˚), ulnar duction (25˚)
- Wrist joint-passive: F (45˚), E (30˚), S (25˚), P (30˚), radial duction (15˚)-same as active because there was painful barrier, ulnar duction (30˚)
- Active: Patient decreased F as following: IP1 joints: F (15˚), IP2 joints: F (10˚), MP joints: F (10˚)
- Passive: We could reach passively F as following: IP1 joints: F (10˚), IP2 joints: F (5˚), MP joints: F (5˚)-there was great improvement
- Proprioceptive exercises were performed very good without numbness of fingers and without shoulder synkinesis, there was only slightly pain feeling.

Self therapy:

PIR for extensors, supinators, flexors and pronators of the forearm. PIR for right and left upper trapezii muscles as well as for minor and major pectoral muscles.

Additionally, stretching exercises for proximal and distal interphalangeal joints into E.

Seventh session – 15.02.2010

Subjective findings: Patient feels much better, relaxed and movable, and she can drive without difficulties. Pain on the shoulder decreased a lot and she feels only slight pain on the wrist joint.

Objective feelings: hypertonic muscles are relaxed a lot and IP1-IP2 and MP joints are almost on 0˚ of extension.

Goal of today's therapy unit:

- Reduce edema and pain
- Release restriction of the distal part of scar
- Improve joint play on wrist joint, IP1-IP2 joints and MP joints in palmar direction.
- Increase ROM of the wrist joint, IP1 and IP2 joints.
- Improve proprioception of the hand

Procedure:

- Hydrotherapy for 15min.with temperature 35˚C for elimination of edema and improvement of ROM
- Soft tissue techniques in order to release the distal part of the scar
- Mobilization of wrist joint, IP1-IP2 joints and MP joints in palmar direction
- Active and passive movements in wrist joint to F, E, S, P, radial and ulnar ductions as well as in IP1 and IP2 joints to E
- Proprioceptive exercises with small soft balls and small stones

Results:

- Edema seems to be disappeared
- Great improvement of the mobility of the scar
- There is improvement of joint play on wrist joint, and great improvement on IP1-IP2 joints and MP joints on palmar direction

- Wrist joint-active: F (45˚), E (30˚), S (25˚), P (30˚), radial duction (15˚)-same as last therapy, ulnar duction (30˚)
- Wrist joint-passive: F (50˚), E (35˚), S (30˚), P (35˚), radial duction (20˚), ulnar duction (35˚)
- Active: Patient decreased F as following: IP1 joints: F (5˚), IP2 joints: F (5˚), MP joints: F (5˚)
- Passive: We could decrease passively F as following: IP1 joints: E (0˚), IP2 joints: E (0˚), MP joints: E (0˚)-there was great improvement
- Proprioceptive exercises were performed very good without pain and numbness of fingers

Self therapy:

PIR for extensors, supinators, flexors and pronators of the forearm. PIR for right and left upper trapezii muscles as well as for minor and major pectoral muscles.

Additionally, stretching exercises for proximal and distal interphalangeal joints into E.

3.7 Final kinesiological examination – 18.02.2010

Palpation examination

Brachioradialis muscle	Normal tone
Extensor muscles of the right forearm	Slight hypertonic
Flexor muscles of the right forearm	Normal tone
Biceps brachii muscle	Normal tone
Trapezius muscle upper part	Left: normal tone Right: slight hypertonic
Pectoralis minor and major muscles	Normal tone on both sides

Table 15- Palpation examination

Scar examination

Aspection	No redness
Palpation	Released on distal part

Table 16- Scar examination

Soft tissue examination

Clavipectoral fascia	Physiological on right side
Arm according to rotational direction	Physiological on right side
Forearm according to rotational direction	Physiological on right side
Cervicothoracic fascia	Physiological on both sides

Table 17- Soft tissue examination

Anthropometric measurements

	Right	Left
Circumference of wrist joint	16cm	16cm
Circumference of metacarpals	18cm	18cm
Circumference of metacarpophalangeal joints	18cm	18cm

Table 18- Anthropometric measurements

ROM examination

Wrist joint

	Active	Passive
Flexion	45˚	60˚
Extension	30˚	50˚
Radial duction	20˚	25˚
Ulnar duction	30˚	35˚

Table 19- Active and passive movements on right wrist joint

Radioulnar joint

	Active	Passive
Supination	30˚	40˚
Pronation	50˚	60˚

Table 20- Active and passive movements on right radioulnar joint

Proximal-distal interphalangeal joints and metacarpophalangeal joints

	Active	Passive
Proximal interphalangeal joints	E – 0˚ F - 90°	E – 0˚ F - 95°
Distal interphalangeal joints	E – 0˚ F - 80°	E – 0˚ F - 80°
Metacarpophalangeal joints	E – 0˚ F - 80°	E – 0˚ F - 90°

Table 21- Active-passive movements on right proximal-distal interphalangeal joints and metacarpophalangeal joints in flexion and extension movements

Note 1: ROM examination on the left wrist and hand is physiological in all movements.

Note 2: During active movements patient did not feel pain at all, only some uncomfortable feeling.

Joint play examination on the right wrist and hand

Wrist joint	Palmar direction improved
Interphalangeal joints (proximal-distal)	No restriction on palmar direction in all fingers
Metacarpophalangeal joints	No restriction on palmar direction in all fingers

Table 22- Joint play examination

Manual Muscle Testing

In the initial kinesiological examination we couldn't provide manual muscle testing on forearm muscles because of the extreme pain barrier and restricted joint motion.

In the final kinesiological examination, patient was able to grasp objects without difficulties, and generally there was good coordination of fine motorics. In addition, patient was able to provide active movements against resistance with satisfactory results.

	Right	Left
Flexor carpi radialis	4	5
Flexor carpi ulnaris	4	5
Flexor digitorum superficialis	4	5
Flexor digitorum profundus	4	5
Extensor carpi radialis longus and brevis	4-	5
Extensor carpi ulnaris	4-	5

Table 23- Manual muscle testing on forearm muscles

3.8 Conclusion of final kinesiology examination

From the final kinesiological examination we conclude the following:
The edema on the wrist joint disappeared (both wrists have circumference 16cm), the scar gained its mobility as well as the fascias and the hypertonic muscles released.

Additionally, range of motion on wrist, radioulnar, metacarpophalangeal, proximal and distal interphalangeal joints improved considerably.

Moreover, joint play on wrist joint improved a lot as well as there is no more restriction on proximal-distal interphalangeal joints and metacarpophalangeal joints on palmar direction.

Furthermore, manual muscle testing on forearm muscles gave satisfactory results with grades normal.

3.9 Therapy effect evaluation

Anthropometric measurements

	Right 25.01.2010	Right 18.02.2010	Left 25.01.2010	Left 18.02.2010
Circumference of wrist joint	18 cm	16 cm	16 cm	16 cm

Table 24- Comparison of anthropometric measurements

Soft tissue examination

	Right 25.01.2010	Right 18.02.2010
Clavipectoral fascia	Restricted	Released
Arm according to rotational direction	Restricted on ventral side	Released
Forearm according to rotational direction	Restricted on posterolateral side	Released
Cervicothoracic fascia	Restricted on cranial direction	Released

Table 25- Comparison of soft tissue examinations

Range of motion

Wrist joint and radioulnar joint

	Active 25.01.2010	Active 18.02.2010	Passive 25.01.2010	Passive 18.02.2010
Flexion	-	45˚	25˚	50˚
Extension	-	30˚	10˚	50˚
Radial duction	-	20˚	5˚	25˚
Ulnar duction	-	30˚	10˚	35˚
Supination	-	30˚	5˚	40˚
Pronation	-	50˚	10˚	60˚

Table 26- Comparison of range of motion on wrist and radioulnar joints

Note: we don't have active movements in initial kinesiological examination because patient wasn't able to provide them because of pain.

Proximal-distal interphalangeal joints and metacarpophalangeal joints

	Initial position 25.01.2010	Active 18.02.2010	Passive 25.01.2010	Passive 18.02.2010
Proximal interphalangeal joints	Flexion 60˚	Extension 0˚	Flexion decreased to 55˚	Extension 0˚
Distal interphalangeal joints	Flexion 55˚	Extension 0˚	Flexion decreased to 50˚	Extension 0˚
Metacarpophalangeal joints	Flexion 60˚	Extension 0˚	Flexion decreased to 50˚	Extension 0˚

Table 27- Comparison of initial and final positions of proximal-distal interphalangeal joints and metacarpophalangeal joint

The function of the hand has improved and the patient is able to grasp and manipulate objects with only minimal difficulties. She is now able to return to the activities of daily living including eating, dressing, writing, driving and take care of her children. In addition, there is good coordination and muscle power of the whole upper extremity.

4. Conclusion

The bachelor thesis study was performed at “Centrum Lecby Pohyboveho Aparatu”, in Prague as a part of the third year of studies in physical therapy. It was consisted of 80 hours of work during the time period of 25th of January 2010 until 5th of February 2010.

The main subject of this study is a patient with osteosynthesis of distal radius. Patient was in a state of pain, edema on the dorsal side of the wrist, restricted range of motion on wrist and digital movements, inability to provide activities of daily living, as well as psychological problems due to family issues.

The short term rehabilitation plan was to reduce pain and edema, as well as to improve the range of motion.

The proposal of the long term rehabilitation plan was the improvement of propioception, muscle power and muscle coordination of the whole upper extremity.

After the final kinesiological examination we obtained the following results: pain and edema were eliminated, range of motion improved considerably, and the patient was able to return to the activities of daily living.

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6. Supplements

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Table 27: Comparison of initial and final positions of proximal-distal interphalangeal joints and metacarpophalangeal joints

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6.3 List of abbreviations

F: Flexion

E: Extension

P: Pronation

S: Supination

IP1: Proximal interphalangeal joints

IP2: Distal interphalangeal joints

MP: Metacarpophalangeal joints

ABD: Abduction

ADD: Adduction

ER: External rotation

IR: Internal rotation

ROM: Range of motion

6.4 Application for ethics board review

INFORMOVANÝ SOUHLAS

V souladu se Zákonem o péči o zdraví lidu (§ 23 odst. 2 zákona č.20/1966 Sb.) a Úmluvou o lidských právech a biomedicíně č. 96/2001, Vás žádám o souhlas k vyšetření a následné terapii. Dále Vás žádám o souhlas k nahlížení do Vaší dokumentace osobou získávající způsobilost k výkonu zdravotnického povolání v rámci praktické výuky a s uveřejněním výsledků terapie v rámci bakalářské práce na FTVS UK. Osobní data v této studii nebudou uvedena.

Dnešního dne jsem byla odborným pracovníkem poučena o plánovaném vyšetření a následné terapii. Prohlašuji a svým dále uvedeným vlastnoručním podpisem potvrzuji, že odborný pracovník, který mi poskytl poučení, mi osobně vysvětlil vše, co je obsahem tohoto písemného informovaného souhlasu, a měla jsem možnost klást mu otázky, na které mi řádně odpověděl.

Prohlašuji, že jsem shora uvedenému poučení plně porozuměla a výslovně souhlasím s provedením vyšetření a následnou terapií.

Souhlasím s nahlížením níže jmenované osoby do mé dokumentace a s uveřejněním výsledků terapie v rámci studie.

Datum:……

Osoba, která provedla poučení:……

Podpis osoby, která provedla poučení:……

Vlastnoruční podpis pacienta /tky:…….