CHARLES UNIVERSITY IN PRAGUE

Faculty of Physical Education and Sport

Bachelor thesis

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Case study of physiotherapy treatment of a patient with poly trauma of the right upper extremity

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Table of contents

Contents

Declaration

In this thesis I present a body of research assembled from books, journals and articles, knowledge obtained during lectures at FTVS and learning during clinical practice.

Whenever contributions are involved, attention is made in order to illustrate this clearly, due to the reference of the literature and acknowledgement of collaborative research and discussions.

I also declare that no invasive methods were used during the treatment sessions and the patient was fully aware of the procedures at any given time.

The work was performed and completed under the guidance of Mgr. Kateřina Maršáková, and under the supervision of Mgr. Ilona Kučerová and Bc. Tomáš Modlinger, physiotherapists at Oblastní Nemocnice Kladno.

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Dedication

I would like to express my gratitude and love towards my family who was supporting and encouraging me in very beginning during the whole time that I was far from them and to all the people who were supporting me and showed their love during my stay in Czech Republic.

Abstract

Careful preoperative evaluation, surgical timing, selected strategies of surgeries and early prolonged rehabilitation are one of the great importance in the influence of producing the most positive outcome for this type of traumatic injury.

In this thesis there are the theoretical and practical aspects of a case study of physiotherapy treatment of a patient with poly trauma of the right upper extremity and surgical repair of multiple fractures and dislocations of the right upper limb.

The injuries include the fracture of the proximal humerus with dislocation, fracture of the olecranon process, communited fracture of the distal end of radius. The case study is based on clinical work performed at Oblastní Nemocnice Kladno during the time period of 26.01.21 – 22.02.21. The subject of study is a 64-year-old man who is hospitalized after having the surgery of right upper extremities due to the poly trauma due to the limited range of motions in his whole right upper extremity. Thesis is separated in to the two parts. First is general part which includes the anatomy, kinesiology, biomechanics of the whole upper extremities then the different kinds of the fractures and surgical approaches are being explained in the patient case. At the end there are some statics and information about the epidemiology of the trauma. The second part which is called special part, will start with the anamnesis of the patient complete information about the patient his chief complains, then it will be continued to the initial examinations by the therapist which has neurological, postural and muscular, joint, fascia and active of daily living examinations which started on the 04.02.2021 and 05.02.2021. Also, in these two days therapies were applied for the patient. Therapies were mostly emphasizing on the strengthening of the weakened muscles and decrease limitation of the fascia, muscle and the joints to increase the range of the motions of the right upper extremity. The methods used in the therapy for this case study was mainly manual techniques, active exercising and electro therapy. No invasive methods were used. There was a positive outcome of the applied therapy program. Both active and passive joint range of motion as well as muscle strength grades significantly increased at the affected shoulder, elbow and wrist joint, on the other hand the enhancement in the supination and pronation was observed but it was less prominent than other motions in the joints of the right upper extremity.

Key words: Trauma, fracture, range of motions, shoulder, elbow, wrist, supination, pronation, upper extremity, ligament, tendon, muscle, joint.

1.Introduction

This thesis includes theoretical and practical aspects of a case study of physiotherapy treatment. This thesis is based on clinical work placement at Kladno hospital from 026.01.2021 to 17.02.2021. The case study concerns a 64 years old man who is after multiple fracture of right upper extremity which occurred on 10.10.2021 as a result of car accident patient's main complains are excessive decreased range of motions of the whole right upper extremity with pain during doing the movements. The thesis is divided into two main parts. A theoretical part and a special part. The theoretical part which is general part is composed of the anatomy, kinesiology and biomechanics of the whole upper extremities. Then it will explain the different kinds of fractures and surgical approaches with epidemiology of the right upper extremity poly traumas with rehabilitation and treatment approaches which could be used in this kind of diagnosis. The special part deals with evaluation and examinations and treatment of the patient. It includes anamnesis, initial examination of the patient-, short- and long-term plans, day by day therapy, final examinations, and evaluation of therapy effects.

1. Theoretical part

2.1 Anatomy

2.1.1 The glenohumeral joint

The glenohumeral joint is suitable for the huge mobility and it's made of large humeral head and glenoid cavity of the scapula bone.

In human bodies, only 25- 30% of the humeral bone head is in contact with the glenoid cavity, during most of the arc motion, normal shoulder joint, humeral head press 1- 2mm of the center of the glenoid cavity which is center of the rotation, this pressure will result in static and dynamic muscle forces. Articular surfaces, capsular ligaments will have stabilizing effect, and this will be increased by muscular force and will make a concavity compression effect toward the center of the glenoid cavity.

Any biomechanics dysfunction, injury to the bony and muscle structure or trauma will result in deficit of the constrain of the center of the rotation and lack of the stability (Terry & Chopp, 2000).

2.1.2 The proximal humerus

The proximal humerus is consisting of four parts which are: humeral head, lesser and greater trochanters and proximal humerus shaft, the inclination angel of the neck shaft is approximately 145 degrees (Netter, 2018).

2.1.3 Olecranon process of the humerus

On the posterior surface of the distal end of the humerus, superior to the trochlea there is a depression which is called olecranon process, during the elbow extension the top of the olecranon process enter to this fossa (Netter, 2018).

2.1.4 Muscles of the shoulder joint

The movements around the shoulder joint are mostly occurring by scapulohumeral and thoracobrachial muscles including deltoid, pectoralis major, latissimus dorsi and coracobrachialis muscles (Lambart, 2016).

2.1.5 The rotator cuff muscles

This group muscle is made of 4 muscles: subscapularis, supraspinatus, infraspinatus and teres minor, which has a dynamic steering mechanism role for the head of the humerus (Terry & Chopp, 2000) (Fig1). See the figure 1.

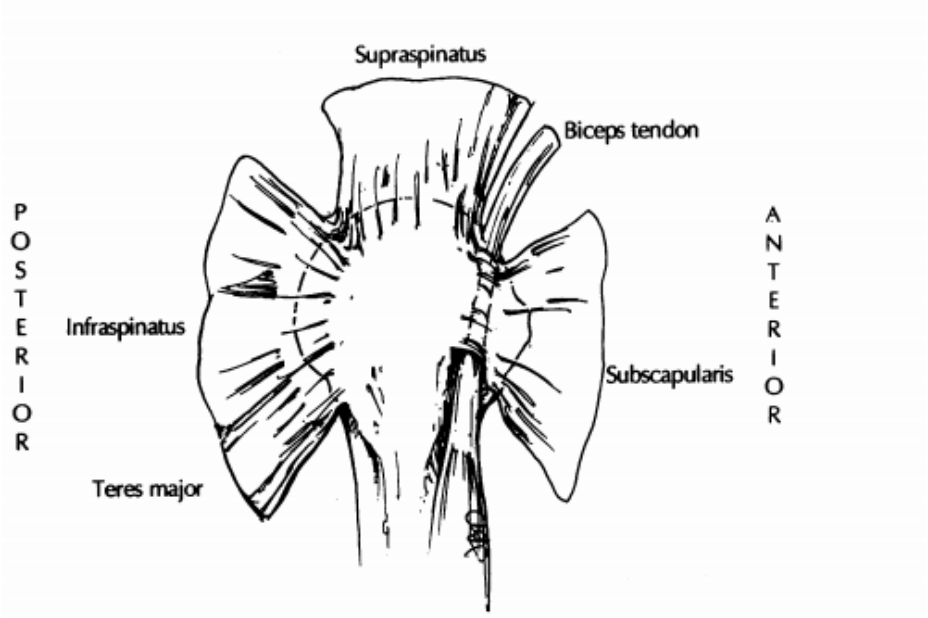

Fig1. The rotator cuff muscles (Terry & Chopp, 2000).

Rotations of the humeral head are the result of the dynamic interplay between the muscles comprising the rotator cuff and the static stabilizers. Rotator cuff activation results in humeral head rotation and depression in positions of abduction. As a group, the rotator cuff muscles are smaller in cross-sectional area and size when compared with the larger, more superficial muscles such as the deltoid, pectoralis major, latissimus dorsi, and trapezius. Also, because they lie much closer to the center of rotation on which they act, their lever arm is shorter, and a smaller generated force result. Given this anatomical location, the rotator cuff is very well situated to provide stability to a dynamic fulcrum during glenohumeral abduction. The

dynamic interaction between the rotator calf muscles and the static stabilizers will result in to the medial and external rotation of the head of humerus bone. When this group muscle is activated the head of the humerus will be in rotation, depression and abduction positions. As this group muscles are smaller than the muscles which are locating superficially like deltoid, pectoralis major, latissimus dorsi and trapezius plus they locate closer to the center of the rotation, their lever arm is shorter so they can produce smaller force than others. During abduction of the shoulder, the rotator cuff muscles have perfect situation to provide stability as a dynamic fulcrum (Fig2) (Terry & Chopp, 2000). See the figure 2.

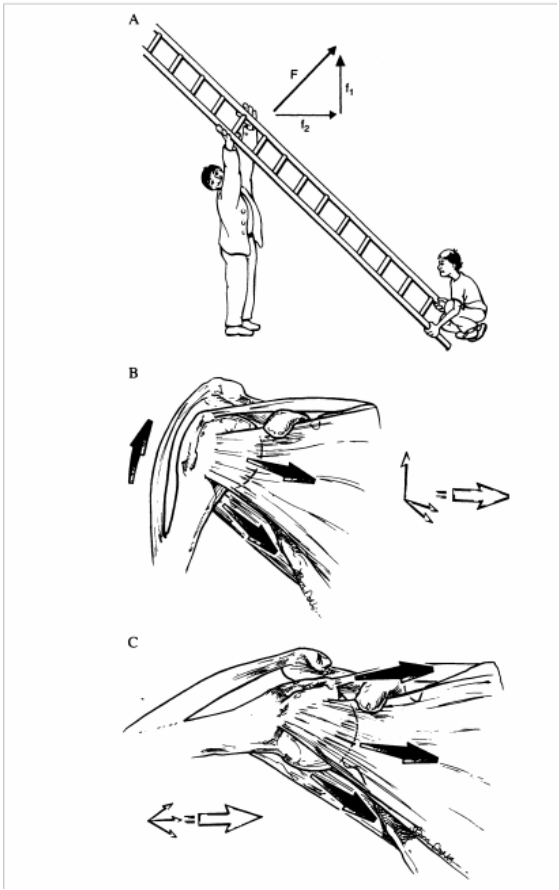

Fig2. Rotator cuff muscles act as fulcrum (Terry and Chopp, 2000).

2.2 The elbow joints

2.2.1 Anatomy of the elbow joint

The elbow is a hinged joint made up of three bones, the humerus, ulna, and radius. The ends of the bones are covered with cartilage. Cartilage has a rubbery consistency that allows the joints to slide easily against one another and absorb shock. The bones are held together with ligaments that form the joint capsule. The joint capsule is a fluid filled sac that surrounds and lubricates the joint (Netter, 2018).

2.2.2 Muscles of the elbow joint

The primary muscles of the elbow are those that pass the elbow and attach on the forearm with no attachment across the wrist. These muscles are the biceps brachii, brachialis, brachioradialis, pronator teres, triceps brachii, anconeus, and supinator. The fundamental concept for these muscles acting on elbow joint is that the muscles attach distally on the radius may supinate or pronate the forearm besides flexor or extensor action (Oatis, 2013; Neumann, 2017).

2.2.3 The wrist joint

The wrist joint is made of radius and connecting with scaphoid, lunate and triquetrum. Flexion is the movement which take place in the anterior direction of the forearm and extension is done in the posterior surface. Fingers are tending to go in to the flexion while wrist is in to the extension and they go in to the extension while wrist is in flexion (Kendall et al., 2005).

2.2.4 Muscles of the wrist joint

The wrist joint has muscles which are the flexor pollicis longus, flexor digitorum superficialis, flexor carpi ulnaris, flexor carpi radialis, extensor digitorum communis, extensor carpi ulnaris and the extensor carpi radialis muscles which allows the wrist to the flexion, extension, ulnar and radial duction (Netter, 2018).

2.3. Fascia

Fascia is divided in to the superficial and deep, superficial fascia which is covering the deep one is more elastic and adoptable than superficial fascia. Superficial fascia of the upper limb is very thin and it's not easy to separate the subcutaneous and the superficial fascia from each other. And it becomes thinner from proximal arm to the distal forearm also it's thicker in posterior side of the upper limb comparing to anterior side (Stecco et al., 2009).

2.3.1 Deep fascia

In the upper limb, deep fascia is aponeurotic that covers all around the muscles. It's consisted of laminar shape layers of connective tissues which are covering the muscles, they are collagen fibers that placed in different directions and they can be easily recognized withing the fascia. Brachial fascia surround around the arm muscles, on the other hand, the antebrachial fascia covers those of the forearm (Stecco et al., 2009).

2.4 Skin

The range of the motion of the shoulder is affected by the mobility of the skin, same as the fascia, skin around the posterior side of the upper limb is thicker than the anterior side which are hold with underlying fibers (Lambert, 2016).

2.4.1 Dermatomes

Dermatomes are area of the skin which are innervated of nerves all of these areas are carrying sensory information from its spinal root. Distribution of the nerves to the skin of the upper extremity which is mainly enveloped by C5 to T2; although C3 and C4 dermatomes only covers a small area of the pectoral area.

C5 mostly covers the outer part arm, shoulder and elbow, combining with C6 which covers the outer part of the forearm. C7 and C8 are covering the inner and ulnar side of the arm. T1 innervates the medial side of the forearm plus T2 envelopes the medial distance between elbow to upper arm (Patel, 2015).

2.5 Kinesiology and biomechanics

2.5.1 Shoulder joint stability

The shoulder capability for doing numerous motions is depended on the interplay between the different structures that respond to mechanical stimuli and modify appropriately.

The discrepancy between the articulating surface of the proximal humerus and the glenoid cavity causes insufficiency of the stability of the bony structure of the shoulder. The exitance of the fibrocartilaginous labrum, constrained capsule and ligaments will make the shoulder joint more stable. But these can be named as the static stabilizer structures which are supported by dynamic structures which are the muscles. Specially the rotator cuff muscles which are locating around glenohumeral joint.

The static and dynamic stabilizer responds to the forces which are applied to the glenohumeral joint. The scapulothoracic joint provides the additional degree of motion and stability for the shoulder joint (Lugo et al., 2008).

2.5.2 Movement of the glenohumeral joint

Shoulder joint by having three degrees of freedom, which allows the upper limb to move in three transverse horizontal, frontal and sagittal planes and axes.

Flexion, extension is performed in sagittal plane and abduction and adduction are occurring in frontal plane, also abduction to 90 degree is performed in horizontal plane. The circumduction runs about all the three axes (Kapandji, 2019).

2.5.3 Elbow joint complex

The elbow joint complex is made of humeroulnar, humeroradial and proximal radioulnar joints. The humeroradial articulation is made of hemisphere shaped capitulum and on the anterolateral and superior surface of the distal humerus and superior aspect of the disc shaped head of humerus. Since the capitulum locates on the anterior aspect of the distal humerus, the radius articulates with only small section of the capitulum during extension but during flexion this contact increases. The primary movement that takes place at the humeroulnar and humeroradial joints are flexion and extension which passes through the center of the trochlea

and capitulum and can be approximated by a line through the lateral and medial epicondyles of the humerus (Lockard, 2006).

2.5.4 Function of the elbow joint complex

The elbow joint is consisting of a mechanical link between the upper limb and forearm. It permits the forearm to have any position in the space by the movement of the shoulder in any distance from the body. Flexion and supination of the elbow allows the human to put food in to the mouth, extension puts the forearm in pronation (Kapandji, 2019).

2.5.5 Limitations of flexions and extensions

The extension of the elbow is affected by three factors which are the impact of the olecranon process to olecranon fossa also the tension from the anterior ligament of the elbow joint and the resistance which has been made by flexors muscles which are biceps brachii, brachialis and supinator If extension proceeds any further, rupture of one of these limiting structures must occur:

While the extension increases more than the optimal range of motion could result in the fracture of the olecranon, ligament and capsule torn with dislocation of the elbow.

Limitation of the flexion depends on whether the flexion is active or passive.

Active flexion, the first factor is the contraction of the anterior muscles of the forearm and arm which would prevent the active flexion more than 145 degree. The second one is the impact of bony surface and tension of the capsular ligament, are insignificant.

In passive flexion, the muscles get flatten to it will allows the joint to be flexed more than 145 in this stage, the impact of the head of the radius against fossa of the radius and the coronoid process against coronoid fossa. Also tension of the posterior capsular ligament; tension which is made passively in triceps. Flexion can reach more than 160 degree (Kapandji, 2019).

2.5.6 The articular complex of the wrist

There are two degrees of freedom in the articular complex of the wrist joint, combination of the supination and pronation around its long axis, allows the hand to grasp and hold an object.

The movements of the wrist which are flexion, extension, ulnar and radial duction occurs around two axis, transverse and antero-posterior axis (Kapandji, 2019).

2.6 Upper extremity fractures

2.6.1 Epidemiology

The most common type of traumatic injuries is orthopedic injuries which presents as fractures of the limbs, pelvis and vertebrae the lesion in soft tissue, muscles, ligaments and tendons. The upper limb fractures mostly locate on the distal and proximal radius, ulna, metacarpals, fingers, carpal bones, scapula, proximal, diaphysis, humerus, clavicle (Ameri et al., 2016).

According to the statistics, the most persistent fracture occurs in distal radius and then respectively in proximal femur, metacarpals, phalanges, and ankles (Brown & Caesar, 2006).

In a study in US in 2009 from 87 million Americans, 590,193 fractures of the upper extremity were determined, therefore the annual incidence of fractures of upper extremities was 67.6 fractures per 10,000 persons. Distal radius fractures are one of the most prevalent fractures with the rate of about 25% of fractures in the pediatrics and around 18% of all fractures in the elderly. In another study the incidence of distal radius and ulna fractures were the most common upper extremity fractures (16.2 fractures per 10,000) (Karl et al., 2015).

2.6.2 Proximal humerus fracture

The proximal humerus fracture has been classified according to Neer, based on the existence of displacement of one on or more major segment such as humeral shaft, humeral head, lesser and greater tuberosity. It has been investigated on the 6 group which can be summarized in to the: group one includes no dislocations regardless to the number of fracture line, group two includes dislocation of the anatomical without separation of the tuberosities, group three, which is the fracture of the surgical neck that the neck is dislocated more than 1cm or angulated for more than 35 degree it has variations such as impacted and angulated the surgical neck, separated surgical fracture or comminuted fracture of the surgical neck. In general group two and three can be named as the two-part fractures.

Group four included the fracture of the greater tuberosity and can be named as two-, three- and four-part fractures. Group is the fracture and displacement of the lesser tuberosity. Group

six which is dislocation of the proximal humerus with anterior and posterior dislocations that may happen in two, three and four parts fracturs (Biberthaler et al., 2015).

2.6.2 Comminuted fracture

A comminuted fracture could be open fracture or closed fracture. An open comminuted fracture may lead to a complication. By effecting the internal body tissues, it will result in infection which is usually followed by this kind of injury, which is one of the common complications. A minor bone can have this kind of fracture if it receives a pressure of around 9-13 pounds. A slightly bigger bone just as the one like femur are much stronger than others. They can sustain much pressure but are fractured under 160 pressures (Gordon, 2020).

2.6.3 Olecranon fracture

Olecranon fractures consist of 10% of all fractures including around elbow and there is numerous treatment option to manage and solve this kind of trauma.

Olecranon fractures could be comminuted, unstable or straightforward transverse fractures. To perfectly manage these fractures, the surgeon needs to have a reliable knowledge about anatomy, treatment options and potential complication (Lervick, 2015).

2.7 Surgical approaches

2.7.1 Surgical approach for fracture of proximal humerus

The goal is with approaching a proximal humerus fracture with a short humeral nail is to enter the humeral head at the lateral articular margin. It has been preferred to sacrifice a bit of superior lateral humeral head articular cartilage in an effort to avoid complicating or potentiating rotator cuff disease and tears and to avoid potential sources of residual shoulder pain after fracture treatment. With a more medial starting point, the supraspinatus muscle is more likely to be violated rather than the tendon and therefore has a greater potential to heal. Rotator cuff muscle violation occurs with every shoulder arthroscopy, and it seems most likely that placing nails the size of cannulas through muscle makes practical sense. In an effort to achieve the more medial starting point, one may perform a standard deltoid-splitting approach at the raphe between the anterior and middle thirds of the deltoid. Frequently,

depending on the medial-lateral size of the acromion or its projection, a more medial insertion site can be difficult to initiate and achieve. With slight shoulder extension, the more medial starting point can be easily accessed anterolateral to the acromion without sacrificing the coracoacromial ligament (Dilisio et al., 2015).

Regardless of the approach, the surgeon must remain cognizant of the course of the axillary nerve. Whereas axillary nerve anatomy is relatively predictable, it remains at risk during placement of the proximal interlocking screws (Sung et al., 2013).

2.7.2 Inferomedial screws

It has been suggested that obliquely positioned inferomedial screws as an additive support tool. A calcar screw reduces the risk of a varus collapse with subsequent screw perforation by counteracting the varus deforming forces acting on the humeral head. This results in a significantly higher reposition stability after 6 and 12 months, and increases the failure load (Erhard et al., 2012). With new minimally invasive techniques, the need for calcar screws often has been questioned. However, the positive clinical impact of calcar screws in terms of complication rate, fracture reduction, and constant score has been repeatedly shown, especially for more complex fractures. In order not to affect the axillary nerve in minimal invasive plate osteosynthesis, the insertion of calcar screws should only be performed under direct vision. The insertion of calcar screws does not enhance the risk of humeral head necrosis by compromising the medial periosteal blood supply. Insertion of more than one calcar screw does not provide additional torsional or axial stability. A proximal screw perforation is seen in 6–8% of patients treated with calcar screws (Katthagen et al., 2014).

2.7.3 Nail height

Subacromial nail height can be deceiving as well. One must be constantly cognizant of the trajectory of the x-ray beam, shoulder rotation and its potential change through the procedure, and patient position. Changes in any of these can significantly change subacromial nail height. Nail height in the humeral head can also affect the proximity of humeral head interlocking screws. Particularly with lateral-medial screws, one must always be cognizant of the axillary nerve. Knife blades should be used for skin only, with blunt dissection being performed through deltoid muscle to bone. From the lateral edge of the acromion, the average distance to the axillary nerve or its branches is 58 mm (38-70 mm) (Sung et al., 2013). More

deeply placed nails carry a higher risk of nerve damage with lateral-medial interlocking screws. Oblique screws into the head also place the nerve and its branches at risk. Posterolateral screws do not have minor risk of nerve damage, nor do distal locking screws for short nails (Dilisio et al., 2015).

2.7.4 Surgical approaches of olecranon fracture

2.7.5 Tension Band Wiring

In this kind of surgical approach, general anesthesia or brachial block will be used. Mid arm tourniquet will be applied with the patient in supine or in lateral position. Exposure of the olecranon will be done by Campbell's posterolateral approach. A vertical incision will be taken over the posterior aspect of the elbow about 2.5cms proximal to olecranon, curving distally along the lateral aspect of olecranon reaching the subcutaneous border of the ulna and extending distally for about 7.5 cm distal to olecranon. Fascia will be incised along the line of skin incision and fracture site will be expose. Fracture hematoma will be cleared off and the fracture site will gently curettage. Accurate anatomical hairline reduction will be achieved and held with either reduction clamp or long towel clip. 2 K-wires is introduced parallel from the tip of the olecranon i.e., the proximal fragment across the fracture site to the distal fragment. Periosteum will be stripped from the shaft of ulna distal to fracture site and a transverse hole will be drilled approximately 3 to 5 cm distal to fracture site. A No. 18 stainless steel malleable wire will be passed through this transverse hole and crossed over the posterior surface of olecranon in a figure-of-eight manner and then passed around the protruding. Kirschner wires and tightened using AO tensioner and then secured with a twist. Bend the proximal ends of the Kirschner wires 1800 and tap the cut ends back into the proximal fragment. Accuracy of reduction will be checked and stability will be tested by moving the joint. Wound closed in layers and sterile dressing applied (Basha et al., 2017).

2.7.6 Surgical Procedure- Olecranon Hook Plate

For comminuted olecranon fracture, Exposure of the olecranon will be done by Campbell's posterolateral approach. A vertical incision will be taken over the posterior aspect of the elbow about 2.5 cm proximal to olecranon, curving distally along the lateral aspect of olecranon reaching the subcutaneous border of the ulna and extending distally for about 7.5

cm distal to olecranon. Fascia will be incised along the line of skin incision and fracture site will be exposed. Fracture hematoma will be cleared off and the fracture site will be gently curettage. Accurate anatomical hairline reduction will be achieved and held with either reduction clamp olecranon hook plate will be applied on the posterior surface with cortical screws after drilling and tapping, through wash will be given, wound closed in layers and sterile dressing will be applied (Basha et al., 2017).

2.9 Rehabilitation approach

2.9.1 Rehabilitation

Rehabilitation for the patient with fractures have to be initiated shortly right after treatment (repositioning and stabilization after fractures) (Kolar et al., 2013).

2.9.2 Rehabilitation during healing

Healing stage can be named as acute stage which the goals include: pain control, decrease edema and maintaining the range of motions in the surrounding segments, rehabilitations depend on whether the extremity is immobilized in the cast or orthosis or it's not immobilized (Kolar et al., 2013).

2.9.3 Rehabilitation for the immobilized fracture

In this situation, an isometric muscle contraction can be performed also with relaxation of the muscles which are in spasmatic situation due to the injury. Then for maintaining the range of motions for unaffected segments the open kinematic chain exercises has to be performed with proprioceptive neuromuscular facilitation techniques. Also, for improve the bone healing and tissue proliferation modalities such as pulsed magnetic field can be used. (Kolar et al., 2013).

2.9.4 Rehabilitation for the non- immobilized fracture

In this situation when the segments are treated by osteosynthesis without requirement of being immobilized, rehabilitation can specially focus on affected segment. In this case physical therapies includes: scare care, proprioceptive neuromuscular facilitation and analytical range of motion release in affected segments. For reducing the edema lymphatic

drainage technique is used. Modalities which can be used for the scar treatments are laser and biolamp or distant electrotherapy such as Basset current. While after removing the stiches, hydrotherapy can be initiated such as cold whirlpool and aquatic exercises (Kolar et al., 2013).

2.9.5 Rehabilitation in healed fracture

After the healed process of the bone fracture, gradual extremity loading will be allowed for the patient. For the immobilized fracture bone healing process, the intensive rehabilitation will be initiated. In this stage the goals are improve range of motions and muscle imbalance of the affected segments. Soft tissue relaxations techniques, joint mobilizations, proprioceptive neuromuscular facilitation technique, open and closed kinematic chain and resistive (Thera-band) exercises are indicated. Modalities such as ultrasound or combined electrotherapy to relax hyper tone muscles also the hydrotherapies like contrast baths, aquatic therapy and swimming will be recommended (Kolar et al., 2013).

2.10 Therapeutic approaches

2.10.1 Manipulation

2.10.1.1 Simple joint mobilization

Mobilization of the joint can be done with gentle rhythmic repetitive springing by waiting at the barrier with minimal pressure in the direction of limited joint play. Successful treatment will result in pain relief and increase range of motions. By understanding how this therapy works will give us a more reliable knowledge of the reason of the pain and limitations in the locomotor system, especially in the cases when there are no pathological changes (Lewit, 2010).

2.10.1.2 Skin mobilization

This specific technique is for hyperalgesic zone (HAZs). It has similar effect to the Kibler's skin fold rolling test, and of connective tissue message as supported by Leube and Dicke. It is absolutely painless and it can be used as a self -treatment by the patient it can be also applied

to the very small area of the skin such as the skin could be fold between fingers. The examination can be start by gently stroking the skin surface with a fingertip (Lewit, 2010).

2.10.1.3 Fascia mobilization

The technique is similar to those described above: after taking up the slack, the practitioner waits until release occurs, and the tissue can be shifted in relation to the structure beneath. It is worth emphasizing here that restrictions in the mobility of the deep fascia are a sign of a chronic disease stage (Lewit, 2010).

2.10.2 Muscle energy technique (MET)

Muscle energy technique is one of the manual therapy forms which is utilizing the energy of the muscle in the form of gentle isometric contraction to relax the muscles by autogenic or reciprocal inhibition. In this therapy comparing to the passive stretching, patient is also active. If a sub-maximal contraction of the muscle is followed by stretching of the same muscle it is known as Autogenic Inhibition MET, and if a submaximal contraction of a muscle is followed by stretching of the opposite muscle, then this is known as Reciprocal Inhibition MET (Chaitow, 2013).

2.10.2.1 Post isometric relaxation

The first step starts with taking up the slack by lengthening the muscles to engage the barrier the next one is asking patient to resist against the therapist to the opposite direction of the mobilization with minimum pressure for 5 to 10 second then breathing out deeply and hold it for 5s while resisting and then breathe out and relax while therapist is waiting to feel the release and then engage the new barrier, PIR will be repeated 3 to 5 times, PIR is painless and is suitable for use in a self-treatment setting (Lewit, 2013).

2.10.2.2 Autogenic inhibition

When the muscle contraction is inhibited by activation of the Golgi Tendon Organ (GTO) and the muscle spindles, autogenic and reciprocal inhibition both will occur. GTOs and muscle spindles are the proprioceptors which are locating in and the around the joints and muscles and will respond to changes in in muscle tension and length, which would help to

manage the muscular control and coordination. The GTO, located between the muscle belly and its tendon, senses increased tension when the muscle contracts or stretches. When the muscle contracts, the GTO will be activated and responds by inhibiting this contraction (reflex inhibition) and contracting the opposing (antagonist) muscle group. This process is known as autogenic inhibition. The GTO response plays an important role in flexibility. When the GTO inhibits the (agonist) muscle's contraction and allows the antagonist muscle to contract more readily, the muscle can be stretched further and easier. Autogenic inhibition is often seen during static stretching, such as during a low-force, long-duration stretch. After 7 to 10 seconds, muscle tension increases and activates the GTO response, causing the muscle spindle in the stretched muscle to be inhibited temporarily, which makes it possible to stretch the muscle further. As already mentioned, Autogenic Inhibition METs work on the principle of autogenic inhibition. The two major and well-known types of MET that are based on the concept of autogenic inhibition are Post Isometric Relaxation (PIR) and Post facilitation Stretching (PFS) (Chaitow,2013).

2.10.2.3 The post facilitation stretching technique is performed as follows

The principle is that the shortened and hypertonic muscle will be in a position which is between fully flexed and relaxed state, then patient is asked to contract the agonist by using maximum effort for 5 to 10 seconds while therapist is resisting him, then patient is asked to relax while therapist will stretch the muscle to the new barrier and it is held for 10s, in this stage patient will relax for 20s and the whole procedure will be repeated three to five times (Chaitow, 2013).

2.10.3 Proprioceptive neuromuscular facilitation

Proprioceptive neuromuscular facilitation (PNF) is a concept of treatment. Its underlying philosophy is that all human beings, including those with disabilities, have untapped existing potential The PNF concept has various kinds of techniques which are strengthening as well as relaxation of the muscles which depends on the goal of therapy and it's followed by the diagonal in to the flexion and extension (Alder et al., 2014). This technique enhances the neuromuscular system reaction through the mechanism of proprioceptive stimulation. The

mechanism of PNF initiate from a principle that the brain ‘thinks’ in the movements and not in individual muscles (Kolar et al., 2013).

Movement in the direction of these diagonals always contains three movement components in various combinations:

- Flexion and extension.
- Adduction and abduction.
- External and internal rotation.

2.10.3.1 Facilitative approaches in neuromuscular facilitation

Proprioceptive and exteroceptive stimulation is used for facilitation. The tools which are used in these techniques are: **stimulation through the muscle stretch:** which obtain or increase the strength of the muscle contractions, can inhibit antagonist. Next is **stimulation of joint receptors:** traction of the joint surface, strengthen the muscle activity and improve the movement; compression supports the joint stability. Another tool is **Adequate mechanical resistance:** which can stimulate muscle contraction, improves motor control, enhance the strength and endurance. The therapist has to provide resistance when a specific movement is performed and constantly modifies it based on the patient's strength. The next tool is **Tactile stimulation, manual contact:** the contact of the therapist on the patient extremities allows for the suitable movement and guidance. Manual contact is based on the patient reaction and situation. Based on this reaction therapist perform the technique passively, semi active or actively. Other tools are **auditory stimulation** which is the therapist comments to the patient and **visual stimulation** that patient has to follow the movements with his eyes (Kolar et al., 2013).

2.10.3.2 Strengthening and relaxation technique

The activity of the muscles which are stronger allows the restoration of the activity of the weaker muscles, timing of a movement is another essential element for the treatment. Based on the combination of movement patterns and appropriate stimulation leading to different types of muscle contraction, strengthening and relaxation techniques; which are based on two activation of the agonist and two activation of the antagonist muscles, two types of relaxation and three types of combination techniques. The goals for strengthening techniques are

improving the stability, increase range of motions and relaxation of increased muscle tone, improve muscle strength coordination and the main indications are deficits in proprioception and skin sensation, muscle hypertonia, difficulty in initiating the movements, contractures and muscle weakness (Kolar et al., 2013).

2.10.4 Physical Therapy Modalities

Physical therapy modalities include pain modulators such as hot and cold packs, ultrasound, short-wave diathermy, low-frequency currents (transcutaneous electrical nerve stimulation [TENS], diadynamic currents, and interferential currents), high-voltage galvanic stimulation, laser, and neurostimulation techniques such as deep brain stimulation and transcranial magnetic stimulation. Hot and cold applications could also be used together as in contrast baths. Sometimes, whirlpool could also be chosen for this purpose. All these superficial heat agents should not be applied in high degrees because of possible risk for increase in pain. Although these modalities have been found effective in chronic pain, there is a definite need of studies that support their effectiveness (Akyuz & Ozkok 2014). In general, deep heating agents such as ultrasound and short-wave diathermy should not be recommended in the treatment of neuropathic pain. Although these are helpful especially in the improvement of joint contractures and adhesions by increasing the flexibility of collagen fibres and circulation of connective tissues, these might increase neuropathic pain. Massage is also not proven to be effective in neuropathic pain. In acquired immunodeficiency syndrome patients with neuropathic pain, massage therapy has been applied, but there have been no significant changes on pain intensity (Pieber et al., 2013).

It has been investigated the role of massage in spinal cord injury patients. Although the study claims that massage seems as one of the effective therapies, it does not specify the type of pain have evaluated the effectiveness of different types of electrotherapies. Possible action mechanisms of electrotherapy have been suggested to be local release of neurotransmitters such as serotonin, raised levels of adenosine triphosphate, release of endorphins, and its own anti-inflammatory effects. Dorsal column activation is another mechanism of electrotherapy. It has been shown that low-frequency currents increase microcirculation and endoneural blood flow. Electrotherapy could also be effective in correcting the disrupted microcirculation in diabetic polyneuropathy and increase oxidative capacity in muscles via metabolic effect (Gulseren & Ozge 2015).

2.10.4.1 Electrotherapy

Electrotherapy modalities (also known as electrophysical agents) are types of physical therapy that aim to reduce pain and improve function by an enhancing energy level (electrical, sound, light, magnetic or thermal) into the body. Several electrotherapy modalities exist, including low-level laser therapy, therapeutic ultrasound, interferential current and transcutaneous electrical nerve stimulation (TENS). They may be delivered by various healthcare providers including physiotherapists, physical therapists, chiropractors and osteopaths (Watson, 2010). People seeking treatment for musculoskeletal conditions usually do not receive a single electrotherapy modality in isolation, but as components of a physiotherapy intervention, most often in combination with manual therapy and exercise (Dingemanse, 2013).

In general, the proposed mechanisms of action of electrotherapies in reducing pain is via an increase in energy (electrical, sound, light, magnetic or thermal) into the body, since heating tissue which may increase blood flow and promote healing (Watson, 2010).

2.10.4.2 Electrical stimulation

Electrostimulation is a medical technique that, using electrical impulses acting on the motors of the muscles (motoneurons) or on the nerve endings (TENS pulses), causes a muscular contraction similar to the voluntary one. Electrostimulation is thus based on the natural principle that low-frequency motion current is activated by some organs and parts of the human body such as the heart, brain, muscles, and nerves. These organs create a physiological stimulus that stimulates the drive unit from the path to contraction. This current passes through the body in the form of electrical impulses. Electrostimulation is made with electrodes to be applied on the muscle, the purpose of the various and sophisticated programs is to produce stimuli that give rise to physiological contractions. Medical applications include various types of pain therapy, physical medicine, rehabilitation, sports medicine, rheumatology, reflex-therapy, etc. Although electrostimulation has been born and has developed in the medical field, currently the possibility of modifying the pulse parameters has allowed this technology to spread rapidly in several areas. This therapy can be used to decrease pain and inflammation, improve circulation. And it can help the muscles contract properly. Electrical stimulation often is used to improve the physical therapy program after an injury or illness. (Sears, 2020).

2.10.4.3 Transcutaneous electrical nerve stimulation

TENS, which consists of applying an electric current to relieve pain through electrodes placed on the surface of the skin, is commonly used as non-invasive non-pharmacological coadjutant treatment and is largely free of side effects. Four levels of stimulus intensity can be adjusted in TENS units: subsensory, sensory, motor and noxious. The sensory level is most widely used in clinical practice and research studies. The literature shows that TENS results depend on the application site and stimulus characteristics, such as amplitude, frequency and pulse duration. Conventional TENS can be applied to frequency parameters with a range between 50 and 100 Hz, short pulse duration (from 50 to 100 seconds) and amplitude regulated according to the patient's report: strong paraesthesia, more comfortable and no muscle contraction or pain, is considered to be a high-frequency, low-intensity mode.

Concerning burst TENS, it has been reported that 'bursts of brief pulses are applied at levels that cause muscle contraction as a means of controlling pain; this stimulation mode is known as burst-modulated TENS'. This mode, characterised as low-frequency, high-intensity stimulation, is applied under high-frequency carrier waves (80 to 100 Hz), modulated in low-frequency pulse trains (2 to 5 Hz), with a long pulse duration (>150 seconds) and sufficient amplitude to produce strong and visible, albeit painless, muscle contractions. Painless induced contractions may simply relieve pain in the same way as sensory-level stimulation (via pain gates) (Macedo et al., 2015).

2.10.4.4 High-intensity laser therapy

High-intensity laser therapy that involves higher-intensity laser radiation is a new, painless, and powerful modality that showed remarkable results in pain reduction This therapy with its own photo-chemical, photothermal, and photomechanical actions has many therapeutic benefits including antalgic, anti-oedema, and bio-stimulating effects. Another advantage of this therapy, especially neodymium-doped yttrium aluminium garnet laser, is its greater power and depth of penetration in deep tissues high- intensity laser therapy has satisfactory effects in treating pain, but its analgesic effect in osteoarthritis is less studied (Nazari et al., 2019).

2.10.4.5 Electro-gymnastic therapy

Electro-gymnastic therapy is part of electrostimulation therapy which is used for the muscles which have the strength grade for minimally 2. It has two bipolar electrodes which have to be located at the proximal and distal parts of the muscle belly. The frequency which is used in this therapy is surge TENS with optimal frequency approximately 50Hz and muscle excitation occurs in waves. The contraction takes 3 to 6s and the interval between the contraction 2 to 3 times longer. The length of the application should not be long to cause the muscle fatigue. In general, it should take 15min for phasic and 30min for tonic muscles. There are some general contraindications which could be mentioned such as primary tumours and tubercule, overall cachexia, fresh skin with injuries, thyroid gland area (Kolar et al., 2013).

3. Special part

3.1 Methodology

The clinical work for this bachelor thesis took place at Oblastní Nemocnice Kladno, Czech Republic, from 26.01.2021 to 17.02.2021. All clinical work during this time was performed under the supervision of Mgr. Ilona kučerová and Bc. Tomáš Modlinger. This is a case study of a 64-year-old man who underwent to the surgical repair of the proximal humerus displacement, olecranon and distal end of radius fractures the right upper extremity. The patient has been transferred to the Kladno hospital after having the surgery; the first initial examinations were done 3months after the surgery by me which included in neurological, postural, muscle length and strength, join play and fascia examinations. Therapy was applied in a larger therapy room well equipped with devices of electro therapy, several hydraulic therapy tables, a large cage for sling therapy, gym ball, soft foam balls, and other available equipment. A goniometer, a measure tape and a neurological hammer were also utilized. Therapy was generally performed one times per day in the morning, approximately for one hour. The first therapy session was made on Day 1, and the last on Day 10, for total of 10 sessions.

3.2 Anamnesis

Examined person: P.O male

Year of birth: 1957

Diagnosis

Poly trauma of the right upper extremity on 20.10.2020.

Z509: Rehabilitation on his right upper extremity after poly trauma on 20.10.2020 after accident on.

T940: State after poly trauma combined with injury of right upper extremity, injury of the head, and small contusion of the right lung on 20.10.2020

T921: Fracture of proximal humerus with dislocation, Targon synthesis in humerus. (See the supplement 4)

T922: Fracture of olecranon process, with osteosynthesis. Comminuted fracture of distal radius osteosynthesis was implanted on 20.10.2020 and it was removed on 12.01.2021 (See the supplement 4)

T901: Lacerated wound on the frontal bone.

T914: Small contusion of the right lung.

Assistive devices: None

Dominant limb: Right- handed

Glasses: Yes

Height: 99kg

Weight: 179cm

BMI, somatotype: 31.0

Blood pressure: 120/180

Heart rate: 80 per minute.

Respiratory rates: 13 per minute.

Chief complains

Due to the poly trauma of the right upper extremity which happened on 20 of October 2020, patient's whole range of motion has been decreased in his right shoulder, elbow, and wrist, MCP, IP1 and IP2. Patient is not feeling pain while he is resting but pain starts and aggravates when he wants to do full range of motions in his whole right upper extremity joints furthermore patient is suffering from weakness of the right upper extremity muscles which could be another reason of decreased range of motion and pain for him. Due to these reasons and his diagnosis, his active daily living has been limited and patient doesn't have any pain during sleeping and he only feels pain while doing motions in his hands which is exceeding from the norms that he can provides but none of his upper extremity joints have the full range of motion neither actively and passively.

Personal anamnesis

On October 20 of 2020 patient had car crash while he was driving by his car in the Prague city at midnight, he could not remember anything that how the accident occurred he just remembers after a few hours that he was in the Motol hospital. Police has investigated that the reason of the accident could be that he suddenly fell asleep. After transferring to the hospital by a helicopter it has been found that he was having poly trauma injuries of right upper extremity such as fracture and dislocation of the proximal humerus, fracture of the olecranon process, shattering fracture of the distal end of radius and lacerated wound on his frontal bone, with small contusion of the right lung, he had a surgery for his whole right upper extremity. Patient was hospitalized at Motol hospital for 20 days and stiches was removed 17 days after surgery, he didn't have any rehabilitation in Motol hospital due to the external orthopaedic fixator device that he had on his right upper extremity, but he had 10 days of rehabilitation as inpatient before 4th of February in Kladno hospital outpatient unit. No childhood disorder. Patient is not suffering from any chronic disorders. He has been hospitalized in Kladno hospital on 3rd of February 2021 and I have examined him on 4th.

Pharmacological anamnesis

Novalgin 500mg every 8h

Oxazepam 0-0-0-1// 0

Family anamnesis: Patient's mother had tuberculosis 20 years ago and the rest of family is fine.

Injury anamnesis: None

Past medical and surgical history: None

Past rehabilitation: None

Allergic anamnesis: None

Abuses: None

Diet: Normal diet

Functional anamnesis/history, Mobility activities, ADL, Household activities, sleeping, **sitting:** Patient lives with his wife, in the second floor of the apartment, his sleeping, sitting is normal. He does shop with his wife; he helps his wife with household activities like cooking and cleaning.

Social anamnesis: Well socialized.

Occupational anamnesis: Promoter and instructor of facilities in senior houses.

Sport, regular physical activity: He used to go for rock climbing.

Hobbies: Reading magazines and watching TV, rock climbing.

Prior rehabilitation

Patient had 10 physiotherapy sessions at Kladno hospital as an outpatient. Due to the decreased range of active motions and limitations of his right upper extremity patient has been prescribed to have 10 sessions of therapy only with CPM devices for the right shoulder

flexion, abduction and supination, pronation of the forearm. The result of the therapy was no effective, so it has been decided for him to be hospitalized.

Excerpt from patient's health care file

Three X-ray examinations had been carried out, one was on 20th of October right after the accident when he was moved to Motol hospital, it has been found the fracture of the proximal humerus bone, fracture of the olecranon process and distal end of the radius in his right upper extremity. no x-ray examination of the right lung has been found in Kladno hospital but it has been only reported that he had a small contusion of the right lung.

Second x-ray examination was done during surgery of the whole fractures of the right upper extremity osteosynthesis were done: for proximal humerus fracture: Targon osteosynthesis

Distal end of the radius: plate fixation of the distal radius with palmar approach.

Olecranon process: done with K- wires approach which is not removed yet.

Third x-ray was carried out on 26th of January which was after removing the fixation plate for distal radius, but Targon synthesis of the humerus and K wires of the olecranon process were not removed yet.

RHB indications

1. Improve activities of the daily living.
2. Improve muscle strength of the whole right upper extremity.
3. Improve range of the motions in whole right upper extremity.
4. Scare care.
5. Mobilization of the restricted joints of the right upper extremity.

3.3. Initial Examination by physiotherapist on 03.02.2021

Neurological examination

Mental status

- Patient is oriented from the time and the place point of view
- No impairment in communication abilities.
- Memorizing ability is physiological

- Speech is physiological

Cranial nerves

Nerve	Result
1.Olfactory	Not affected
2.Optic	Not affected
3.Oculomotor	Not affected
4.Trochlaris	Not affected
5.Trigeminus	Not affected
6.Abducens	Not affected
7.Fascial	Not affected
8.Vestibulocochlaris	Not affected
9.Glossopharyngeal	Not affected
10.Vagus	Not affected
11.Accessory	Not affected
12.Hypoglosseal	Not affected

Table 1: Initial examination of cranial nerves

Motor system

According to Ashworth scale

Spasticity / rigidity sign:

Flexors of the arm, forearm, MCP, CMC and extensors of the arm, forearm, MCP, CMC:

Result=0

Examination of individual sensory modalities of the upper extremities

Individual sensory modalities	L	R
Touch	Normal	Normal
Hot	Normal	Normal
Cold	Normal	Normal
Vibration	Normal	Normal
Joint position sense	Normal	Normal
Kinesthesia	Normal	Normal
Two-point discrimination	Normal	Normal
Graphesthesia	Normal	Normal
Stereognosis	Normal	Normal

Table 2: Initial Examination of individual sensory modalities of the upper extremities

Dermatome sensation

Dermatomes	L	R
C5	Not affected	Not affected
C6	not affected	not affected
C7	not affected	not affected
C8	not affected	not affected
T1	not affected	not affected
T2	not affected	not affected
T3	not affected	not affected

Table3: Initial examination of dermatomes sensation

Deep tendon reflexes

Deep tendon reflexes	L	R
Biceps	Hypo reflex	Hypo reflex
Triceps	Hypo reflex	Hypo reflex
Flexors	Hypo reflex	Hypo reflex
T7 to T12	Hypo reflex	Hypo reflex

Table 4: Initial examination of deep tendon reflexes

Paretic signs

Paretic sign	L	R
Mingazzini upper extremity	Negative	Negative

Table 5: Initial examination of paretic signs

Pyramidal signs

Pyramidal sign	L	R
Hoffman	Negative	Negative
Juster	Negative	Negative

Table 6 Initial examination of the pyramidal signs

Observation

Scar's location and length

Scar in his right axilla: 13.5cm
Scar on the distal end of humerus: 3cm
Scar on the olecranon: 8.5cm
Scar at the distal end of the radius: 8cm
Scar on the frontal bone: 13cm

Table7: Initial observation examination

Edema: Edema has been found on his fingers, wrist, and arm of his right upper extremity.

Temperature: Right wrist has been slightly warmer than left side.

Scar's aspection: Scars were limited on his whole right upper extremity and his head. The color of the scars was slightly red, no bruise was found there and all the scars were in proliferative stage except the scar on the frontal bone which is in remodeling stage.

Postural examinations

Plumb line test

Posterior view

- Plumb line goes between his feet, sacrum, through his lumbar spine and it's not passing to the middle of his thoracic, cervical spine due to the lateral tilt of the head to the right side.
- Ankles are leaning outward mostly in his right side.
- Left calf is more prominent than right side.
- Right popliteal line is higher.
- Both knees are valgosity.
- Right gluteal line is higher.
- Right thigh is more prominent than left side.
- Pelvis is in lateral tilt to the right side.
- Both elbows are in semi flexion more in right side

- Elbows are leaning backward more in his right side
- Right scapula is turned externally and it's farther from the spine.
- His body is turned to the left side and leaning forward.
- Right shoulder is lower than left side.
- Head is turned to the right side.

Lateral view: left side

- Plumb line goes slightly posterior to the lateral malleolus, knee, hip, through the lumbar and thoracic vertebras, due to head protraction and shoulder retractions plumb line is not going through his shoulder, external auditory meatus and skull.
- Low arch in his left foot.
- Very slightly flexed of the left knee joint.
- Pelvis is having physiological anterior tilt.
- Increased lordosis in cervical spine with increased kyphotic curve in thoracic spine and physiological lordosis in his lumbar spine.
- Trunk is leaning forward.
- Elbow is in semi flexion.
- Wrist is in slight pronation.
- Fingers are in neutral position
- Hand is in neutral position.
- Shoulder is in retraction.
- Head is in protraction.

Lateral view: right side

- Plumb line goes slightly posterior to the lateral malleolus, knee, hip, through the lumbar and thoracic vertebras, due to head and shoulder retractions plumb line is not going through his shoulder, external auditory meatus and skull.
- Higher arch in right foot compare to the left side.
- Semi flexed right knee.
- Trunk is leaning forward.
- Increased lordosis in cervical spine with increased kyphotic curve in thoracic spine and physiological lordosis in his lumbar spine.
- Elbow is in semi flexion.
- Right hand is in slight rotation

- Fingers are in semi flexion.
- Wrist is in slight supination.
- Shoulder is in retraction and its elevated slightly.
- Head is in protraction.

Anterior view

- Plumb line goes between both feet, between knees, not going completely through his umbilicus, sternum, and his head.
- Narrow base of the support.
- Patient puts more weight on his left side foot.
- Right foot has more arch than left side.
- Left calf muscles are more prominent than right side.
- Right knee is in semi flexion more than left knee.
- Right thigh is more prominent than left side.
- Umbilicus is turned to the left side.
- Trunk is turned to the left side.
- Left thoracobrachial triangular is bigger than right side.
- Both elbows are bended mostly on the right side.
- Left nipple is lower than right side.
- Sternum is pressed in.
- Right clavicle is prominent only, more in the medial border.
- Both shoulders are retracted more on right side.
- Right shoulder is lower than left side.
- Head is turned slightly to the right side.

Gait analysis

- Patient walks with narrow base of support.
- Walking rhythm is non-periodic because patient puts more weight on his left foot.
- Walking speed is slow with short steps; left stride length is shorter than right side.
- Patient is having all the gait phases in both feet such as weight acceptance, single-limb support, limb advancement.
- Ankles are in supinations during walking.
- There is no excessive hip and extension and flexion during gait and it's physiological.

- Pelvis is in lateral tilt.
- Movement of centre of gravity is physiological.
- There is very slight movement of trunk and it's rotated to the left side.
- Abdominal muscles movement are slight.
- Thoracic spine is in increased kyphotic curve and cervical is in increased lordosis and lumbar lordosis just increase very slightly while walking.
- Paravertebral muscles in both sides in whole spine are in hyper tension while walking.
- Right shoulder is elevating and the body is slightly leaning to the left while walking both shoulders are stiff while walking mostly the right side.
- Head is in protraction and slight rotation to the left side
- Movement of the upper extremity is decreased in both side but more in the right side.
- Patient is completely stable while walking

Breathing examination

Chest shape: Physiological

Intensity: Physiological

Frequency: 14 per a minute

Patient's position

Supine, sitting, standing: Patient's breathing wave is starting from his abdomen area and goes to his lower chest and the finishes with slight movement only in his left side of the upper chest.

Palpation of the pelvis

Sagittal plane: Physiological anterior tilt.

Frontal plane: Lateral tilt to the right side.

ASIP: Is higher on the L PSIS: Higher on the L Iliac crest: Higher on the L

Transverse plane: clockwise rotation.

Specific testing of the posture

Romberg test:

Romberg 1: Negative.

Romberg 2: Negative.

Romberg 3: Negative.

Vele test

Grade 1

Standing on two scales: Negative

R: 46kg L: 52kg

Standing on tip toes: Negative

Standing on heels: Negative

Anthropometric measurement

Anthropometric measurement	L	R
Length of whole UE	78cm	77cm
Length of the Humerus	34cm	33cm
Length of the forearm	27cm	25cm
Length of the hand	21cm	19cm

Table 8: Initial examination of the anthropometric measurement

Circumferences	L	R
Upper arm	33cm	35cm
Elbow joint	28cm	29cm
Wrist joint	18.5cm	22cm
MCP	22.5cm	22cm
First MCP, IP1	8cm	8cm
Second MCP IP1	8cm	8cm
Third MCP IP1	7cm	8.5cm
Fourth MCP IP1	6cm	6cm
Fifth MCP IP1	5cm	6cm
Second MCP IP2	8.5cm	9cm
Third MCP IP2	7cm	8cm
Fourth MCP IP2	6cm	8cm
Fifth MCP IP2	5cm	5.5cm

Table 9: Initial examination of the UE circumference measurements

circumference of the head	**57cm**
circumference of the thorax	**111cm**

Table 10: Initial examination of the head and chest circumference measurements

Spinal distances

Forestier Fleche: 3.5cm, not normal distance
Cepojeve's distance: 4cm normal

Table 11: Initial examination of the spinal distances

Movement pattern examination according to Janda

Shoulder abduction

Left side: Negative remodulation movement starts with right shoulder elevation with slight side bending to the right, due to the shortening of the upper trapezius combined with weakness of supraspinatus and serratus anterior muscles.

Movement starts with upper trapezius and levator scapulae muscles contralaterally and then ipsilaterally while inferior angle of right scapula turns externally, then it follows by quadratus lumborum, deltoid, peroneus, supraspinatus and lower trapezius muscles at the end.

Right side: No negative remodulation. Followed by activation of the supraspinatus, deltoid, upper trapezius and levator scapulae contralaterally and then ipsilaterally, quadratus lumborum, peroneus and lower trapezius muscles.

Goniometry examination according to Janda

		Left					
		AROM			PROM		
		Neutral			Neutral		
Shoulder	**S**	60	0	160	60	0	180
	F	110	0	//	130	0	//
	T	120	0	20	130	0	30
	R	65	0	55	75	0	70
Elbow	**S**	0	0	145	0	0	150
	R	80	0	85	85	0	90
Wrist	**S**	70	0	80	75	0	85
	F	10	0	30	25	0	35

Table 12: Initial examination of the ROM for left shoulder, elbow and wrist joints

		Right					
		AROM			**PROM**		
		Neutral			**Neutral**		
Shoulder	S	5	0	110	10	0	130
	F	30	0	//	40	0	//
	T	//	0	10	//	0	15
	R	25	0	30	30	0	35
Elbow	S	0	0	110	0	0	130
	R	15	0	xx	20	0	xx
Wrist	S	20	0	20	25	0	30
	F	5	0	10	10	0	15

Table 13: Initial examination of the ROM for right shoulder, elbow and wrist joints

		Left					
		AROM			**PROM**		
MCP 2nd	**S**	10	0	80	15	0	90
	F	25	0	35	40	0	45
MCP 3rd	**S**	25	0	30	25	0	35
	F	10	0	85	15	0	90
MCP 4th	S	20	0	35	30	0	40
	F	25	0	25	30	0	40
MCP 5th	S	30	0	70	35	0	75
	F	15	0	40	25	0	45
IP1							
2nd finger	S	0	0	80	0	0	95
3rd finger	S	0	0	80	0	0	85
4th finger	S	0	0	85	0	0	95
5th finger	S	0	0	80	0	0	95
IP2							
2nd finger	S	0	0	55	0	0	65
3rd finger	S	0	0	60	0	0	70
4th finger	S	0	0	75	0	0	85
5th finger	S	5	0	60	0	0	75
Thumb CMC	S	0	0	15	10	0	25
	F	50	0	40	65	0	45
Thumb MCP	S	0	0	50	5	0	55
Thumb IP	F	0	0	80	5	0	90

Table 14: Initial examination of ROM for MCP, IP1, IP2 and CMC joints of the left side

		Right					
		AROM			**PROM**		
MCP 2ND	**S**	5	0	80	15	0	85
	F	20	0	35	30	0	45
MCP 3RD	**S**	15	0	30	25	0	35
	F	10	0	65	15	0	75
MCP 4th	S	20	0	35	30	0	40
	F	25	0	25	35	0	40
MCP 5th	S	20	0	60	35	0	70
	F	15	0	30	25	0	35
IP1							
2nd finger	S	0	0	70	0	0	75
3rd finger	S	0	0	65	0	0	70
4th finger	S	0	0	60	0	0	65
5th finger	S	0	0	50	0	0	60
IP2							
2nd finger	S	0	0	55	0	0	65
3rd finger	S	0	0	50	0	0	60
4th finger	S	0	0	75	0	0	85
5th finger	S	5	0	60	0	0	75
Thumb CMC	S	0	0	15	10	0	25
	F	50	0	30	65	0	35
Thumb MCP	S	0	0	40	5	0	45
Thumb IP	F	0	0	60	5	0	65

Table 15: Initial examination of the ROM for MCP, IP1, IP2 and CMC of the right side

Skin and sub skin examination according to the Lewit

skin and sub skin's locations		
Upper arm	Free	Limited in all directions
Lower arm	Free	Limited in all directions
Thorax	Free	Limited in all directions
upper thoracic	Free	Limited in all directions
Lower thoracic	Free	Limited in all directions
lumbar area	Free	Limited in all directions

Table 16: Initial examination of the skin and sub skin examination

Fascia examination according to the Lewit

Fascia examination	L	R
Fascia of the of the chest+ laterally, medially, cranially, caudally	Limited	Limited
dorsal fascia cranially	Limited	Limited
lumbar fascia caudally	Free	Limited
Lateral fascia of the trunk + latero medially	Free	Limited
Fascia of the both arms cranially + caudally + medio laterally	Free	Limited
Fascia of the neck translator	Free	Limited
Fascia of the forearm cranially+ caudally+ medio laterally	Free	Limited

Table 17: Initial examination of the fascia

Muscle tone palpation according to Lewit

Muscle	L	R
Serratus anterior	Normal tone	Hypo tone
Upper trapezius	Normal tone	Hyper tone
Middle trapezius	Normal tone	Normal tone
Lower trapezius	Normal tone	Hypo tone
Rhomboids major	Hyper tone	Hypo tone
Rhomboids minor	Hypo tone	Hypo tone
Levator scapulae	Hyper tone	Hyper tone
Latissimus dorsi	Normal tone	Hyper tone at insertion
Subscapularis	Hypo tone	Hyper tone
Teres major	Normal tone	Normal tone
teres minor	Hypo tone	Hypo tone
Supraspinatus	Normal tone	Hyper tone at insertion
Infraspinatus	Hyper tone	Hypo tone
Pectoralis major	Normal tone	Hyper tone
Pectoralis minor	Normal tone	Hyper tone
Deltoid whole fibers	Normal tone	Hypo tone
Coracobrachialis	Normal tone	Hyper tone

Table 18: Initial examination of the muscle tone for the muscles of the arm

Muscle	L	R
Brachioradialis	Normal tone	Hyper tone
Anconeus	Normal tone	Hypo tone
Triceps brachii	Normal tone	Hypo tone
Biceps brachii	Hyper tone	Hyper tone
Brachialis	Normal tone	Hyper tone
Supinator	Normal tone	Hyper tone
Pronator quadratus	Normal tone	Hyper tone
Pronator teres	Normal tone	Hyper tone
Extensor carpi radialis longus	Normal tone	Hyper tone with tender point
Extensor carpi radialis brevis	Normal tone	Hyper tone
Extensor carpi ulnaris	Hyper tone	Hyper tone
Flexor carpi ulnaris	Normal tone	Hyper tone
Flexor carpi radialis	Normal tone	Hyper tone
Flexor digitorum superficialis	Normal tone	Hyper tone
Flexor digitorum profundus	Normal tone	Hyper tone
Extensor digitorum	Normal tone	Hypertone tone
Extensor indicis	Normal tone	Hyper tone
Extensor digiti minimi	Normal tone	Hyper tone
Palmaris longus	Hypo tone	Hyper tone
Palmar interossei	Normal tone	Hyper tone
Dorsal interossei	Normal tone	Hyper tone
Abductor digiti minimi	Normal tone	Hyper tone
Flexor digiti minimi	Normal tone	Hyper tone
opponens digiti minimi	Normal tone	Hyper tone
Abductor pollicis longus	Normal tone	Hyper tone
Extensor pollicis brevis	Normal tone	Hyper tone
Extensor pollicis longus	Normal tone	Hyper tone
Flexor pollicis longus	Normal tone	Hyper tone
Flexor pollicis brevis	Normal tone	Hyper tone

Table 19: Initial examination of the muscle tone for the forearm and finger muscles

Muscle	L	R
Opponens pollicis	Normal tone	Hyper tone
Abductor pollicis brevis	Normal tone	Hyper tone
Adductor pollicis	Normal tone	Hyper tone
SCM	Normal tone	Normal tone
Scaleni	Hyper tone	Hyper tone
Paravertebral in lumbar area	Hyper tone	Hyper tone
Paravertebral in thoracic area	Hyper tone	Hyper tone
Quadratus lumborum	Hyper tone	Hyper tone

Table 20: Initial examination of the muscle tone for the fingers, neck and back muscles

Muscle length test according to the Janda

	Grading	
Muscle	**L**	**R**
Pectoralis major	Grade0	xx
Pectoralis minor	Grade2	Grade 2
Teres major, latissimus dorsi, rhomboid Major minor	Grade0	xx
Medial shoulder rotators	Grade0	xx
Lateral shoulder rotators	Grade0	xx
Cranial part of trapezius	Grade0	Grade2
Levator scapula	Grade0	Grade1
SCM	Grade0	Grade2

Table 21: Initial examination of the muscle length

xx means that was not available to provide the test position in the patient case

Muscle strength test of the upper extremities according to Kendall

Muscle	L	R
Serratus anterior	5	3-
Upper trapezius	5	4+
Middle trapezius	5	Xx
Lower trapezius	5	Xx
Levator scapulae and Rhomboid	5	Xx
Latissimus dorsi	5	Xx
medial rotators group test	5	3-
Teres major	5	Xx
teres minor	5	3
Supraspinatus	5	3-
Infraspinatus	5	Xx
Pectoralis major upper fibres	5	3
Pectoralis major lower fibres	5	3
Pectoralis minor	5	4
Deltoid	5	3+
Anterior and posterior deltoid	5	3+
Coracobrachialis	5	4+
Brachioradialis	5	4
Triceps brachii	5	4+ shaking

Table 22: Initial examination of muscle strength for muscles around the scapula, and arm

XX means it was not possible to provide the test due to the limitation and severe pain

Muscle	L	R
Biceps brachii and brachialis	5	4-
Supinator	5	Xx
Pronator quadratus	5	Xx
Pronator teres	5	Xx
Extensor carpi radialis longus	5	3
Extensor carpi radialis brevis	5	3
Extensor carpi ulnaris	5	3
Flexor carpi ulnaris	5	Xx
Flexor carpi radialis	5	Xx
Flexor digitorus superficialis	10	Xx
Flexor digitorum profundus	10	Xx
Extensor digitorum	10	7
Extensor indicis	10	7
Extensor digiti minimi	10	8

Table 23: Initial examination of muscle strength for muscles of the arm, and fingers

Muscle	L	R
Palmaris longus	10	xx
Lumbricales	10	xx
Palmar interossei	10	8
Dorsal interossei	10	xx
Abductor digiti minimi	10	xx
Flexor digiti minimi	10	xx
Opponens digiti minimi	10	xx
Abductor pollicis longus	10	7
Abductor pollicis brevis	10	7
Extensor pollicis brevis	10	8
Extensor pollicis longus	10	8
Flexor pollicis brevis	10	xx
Flexor pollicis longus	10	xx
Opponens pollicis	10	xx
Adductor pollicis	10	xx

Table 24: Initial examination of muscle strength of the fingers

Neck muscles

Muscles	L	R
Posterolateral neck extensors	5	5
Anterolateral neck flexors	5	5
Anterior neck flexors	5	5

Table 25: initial examination of neck muscle strength

Joint play examination according to Lewit

Limitations		
Joints with directions	**L**	**R**
Atlanto occipital		
Anteflexion	Free	Free
Retroflexion	Free	Free
Rotation	Free	Free
Side bending	Free	Free
C1 C2		
Side bending	Free	Free
Rotation	Free	Free
C-TH		
Rotation	Free	Limited
Side bending	Free	Limited
Shoulder		
Craniocaudal	Free	Free
Ventrodorsal	Free	Limited
Acromioclavicular	Free	Limited
Dorsoventral		
Craniocaudal	Free	Limited
Sternoclavicular		
Caudocranial	Free	Free
Scapula thoracic	Free	Limited

Table 26: Initial examination of the joint play for cervical, AC, SC and scapula thoracic

Limitations		
Joints with directions	**L**	**R**
Elbow		
Laterally	Free	Limited
Medially	Free	Limited
Wrist		
Dorsal flexion	Free	Xx
Palmar flexion	Free	Xx
Individual carpal bones		
Triquetrum	Free	Limited
Lunate	Free	Limited
Pisiform	Free	Limited
Hamate	Free	Limited
Capitate	Free	Limited
Trapezoid	Free	Limited
Trapezium	Free	Limited
Scaphoid	Free	Limited
CMC		
Laterolaterally	Free	Limited
Dorsopalmar	Free	Limited
MCP 1st		
Laterolaterally	Free	Limited

Table 27: Initial examination of the joint play for elbow, wrist, metacarpal bones, CMC and MCP1st joints
Xx means it was not possible to provide the test due to the limitation and severe pain MCP

Limitations		
Joint with directions	**L**	**R**
Dorsopalmar	Free	Limited
MCP 2nd		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
MCP 3rd		
Laterolaterally	Free	Limited
Dorsopalmar	Free	Limited
MCP 4th		
Laterolaterally	Free	Limited
Dorsopalmar	Free	Limited
MCP 5th		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP (1)		
IP (1)1		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP (1)2		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP (1)3		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP(1) 4		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP (1)5		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited

Table 28: Initial examination of the joint play for MCP2st, MCP3st, MCP4st, MCP5st, IP(1)1 to IP(3) for IP(1)4, and IP(1)5

Limitation		
Joint with limitations	**L**	**R**
IP(2)1		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP(2)2		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP(2)3		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP(2)4		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP(2)5		
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
ribs 2 to 12		
Inhlation and exhalation	Free	Limited only ribs 2 to 6
Rib 1	Free	Limited

Table 29: Initial examination of the joint play for IP(2) 1 to 5, ribs 2 to 12 and rib1

Deep stabilization system

Diaphragm test

In this case patient was not able to give any resistance against the therapist palpated hands that would result that deep stabilization does not function optimally.

Active daily living examinations

Patient is totally independent to sit and stand up from the bed.

For taking his clothes off or wearing them he mostly uses his left hand.

Brushing teeth is available with his left hand.

Patient uses his mobile and laptop with both left and right hand but mostly with his left.

Showering and going to the toilet is done independently.

Result: patient is completely independent.

3.4 Initial examination conclusion

Due to the patient diagnosis which is polytrauma after accident patient is suffering from decreased active, passive range of motions and muscle strength in his whole right upper extremity which is connected to the limited joints such as glenohumeral, scapula, acromioclavicular, sternoclavicular, elbow, wrist, MCP, CMC and IP also with hypertonicity and weakness of muscles around this joints like biceps brachii, coracobrachialis, flexors and extensors of the wrist with supinator and pronator and limited fascia of the whole upper extremity. All these limitations could be the exact reason why patient can have not full range of mobility. On the other hand, patient is completely independent in his ADL activities such as sitting, standing, walking, brushing teeth, showering, and toileting plus writing and using laptop and mobile phone.

3.5 The goal of short-term therapeutic unit

1. Decrease edema.
2. Increase blood circulation around the area of the scars and decrease stiffness of the scars.
3. Improve range of motions.
4. Release joints blockage.
5. Release limitations of soft tissue.
6. Relaxations of the hypertonic muscles.
7. Increase muscle strength for whole upper extremity of the right side.
8. Decrease muscle shortness.

3.5.1 The plan of short-term therapeutic unit

1. Cryotherapy
2. Soft tissue technique- scar care according to Lewit
3. Constant passive motions (CPM device)
4. Manual joint mobilizations according to Lewit
5. Soft tissue releasing technique according to Lewit
6. Post isometric relaxation techniques (PIR) according to Lewit
7. Proprioceptive neuromuscular facilitation (PNF) techniques according to Kabat for the whole right upper extremity and Electro-gymnastic for weakened muscles of the right UE.

8. The post facilitation stretching technique according to Janda.

3.5.2 Long- term therapeutic goal

1. Increase muscle strength of the right upper extremity emphasizing on Serratus anterior and lower fixator of the scapula.
2. Stretching of the pectoralis, external rotators, biceps muscles and strengthening of triceps, internal rotators.

3.5.3 Long- term therapeutic plan

1. Training the serratus anterior and lower part of trapezius in all four positions according to Lewit.
2. Stretching exercises with Thera bands.

3.6 Day by day therapeutic unit

3.6.1 Day 1

04.02.2021

Parts of initial examination were done

Present state

Subjective: Patient feels pain while doing semi supination, pronation in his wrist and abduction, flexion internal rotation and external rotation, but he is motivated to do the exercises.

Objective: Patient's range of motion is limited in his whole upper extremity, with limited scars but patient feels really excited for the therapy.

Goals of today therapeutic unit:

1. Increase ROM of the right shoulder and wrist joint.
2. Decrease scars stiffness.
3. Decrease edema
4. Skin, sub skin and fascia stretching
5. Joint mobilization
6. Strengthening weakened muscles and stretching shortened muscles

Therapy proposal:

1. Constant passive motions.

2. Cryotherapy.
3. Soft tissue relaxation for the scars according to Lewit
4. Soft tissue relaxation technique for the fascia, skin and sub skin according to Lewit
5. Joint mobilization for the restricted right joints according to Lewit.
6. Proprioceptive neuromuscular facilitation according to the Kabat

Description of the today's therapeutic unit

1. CPM devices were applied for the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion: 125 Abduction:60 and wrist: supination: 20 pronation:20
2. Patient use ice on his upper extremity such as wrist, elbow and shoulder joints to decrease edema for 10 to 12 min every time before starting the therapy.
3. As the stiches were removed scar care according to Lewit has been applied for all the scars on his head and right upper extremity in S shape, sustained pressure. Reaching the barrier wait with constant pressure till the physiological barrier will be released for 5min.
4. Soft tissue relaxation technique for of fascia and skin and sub skin according to Lewit. For fascia, skin and sub skin of the right upper extremity in medio laterally, anterior caudally and translatory directions, for the right lumbar fascia in caudal direction and for left and right thoraco- dorsal fascia in cranial directions, for fascia of the chest on the left and right sides in cranial, caudal latero-lateral directions and left trunk fascia in lateral and medial directions with patient in supine, prone positions for 15 mins totally and waiting in all directions to feel the release.
5. Joint mobilization according to Lewit in supine position for the right PIP, DIP. MCP, CMC in lateral and medially and cranial and caudal directions, wrist and carpal bones in dorsal, palmar directions, only for the wrist joint in supination and pronation directions, mobilization were done in semi supination and pronation due to the limitation and the pain in the wrist joint. Repetition 5 to 10 times till fill the release and immediately joints were checked if they are released or not.
6. PNF for the right upper extremity, first flexion and extension diagonal, strengthen technique, repeated contraction were used, each diagonal were repeated for 3 times for the right upper extremity in supine position.

Subjective result:

Patient felt pain in his right shoulder and wrist joints after PNF, but during other therapies patient didn't feel any pain. Release in the restricted joints were felt by the patient except the wrist joint for supination and pronation.

Objective result:

Patient was motivated while having pain during PNF, slight decreased of the limitation of the joint play was observed in MCP. IP, DIP and CMC joints except the wrist joints for the supination and pronation. Other therapies were done without any pain. Slight release of the fascia was felt after the therapy only for the lumbar and thoraco- dorsal fascia but still whole UE fascia was limited. Scars were less limited after the therapy, after CPM session increase ROM was observed in shoulder joint only.

3.6.2 Day 2

05.02.2021

Parts of initial examinations were done and finished

Present state

Subjective: Patient feels motivated, with feeling slightly released in his upper extremity.

Objective: Patient feels excited to do exercise, active range of motions was checked and slight increase in movement fluency has been seen.

Goals of today therapeutic unit:

1. Increase ROM of the right upper extremity.
2. Decrease edema.
3. Decrease scars stiffness.
4. Skin sub skin and fascia stretching.
5. Decrease joint play limitations.
6. Relaxation of hypertonic supinator, pronator, forearm flexors and extensors muscles of the right UE.
7. Stretching of the shortened upper trapezius and pectoralis muscles of the right UE.
8. Strengthening weakened muscles and stretching shortened muscles of the right UE.

Proposal therapy:

1. Constant passive motions.
2. Cryotherapy
3. Soft tissue relaxation for the scars according to the Lewit.
4. Soft tissue relaxation technique for the limited fascia according to the Lewit.
5. Joint mobilization for the restricted right joints according to Lewit.
6. Post isometric relaxation according to the Lewit.
7. Post facilitation stretching techniques according to Janda.
8. PNF according to the Kabat.

Description of the today's therapeutic unit:

1. CPM devices were applied to the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion: 130 Abduction:65 and wrist: supination: 20 pronation:20
2. Patient use ice on his right upper extremity such as wrist, elbow and shoulder joints to decrease edema for 10 to 12 min every time before starting the therapy
3. As the stiches were removed scar care according to Lewit, has been applied for all the scars on his head and right upper extremity in S shape, sustained pressure. Reaching the barrier wait with constant pressure till the physiological barrier will be released for 5min.
4. Soft tissue relaxation technique for of fascia and skin and sub skin according to Lewit. For fascia, skin and sub skin of the right upper extremity in medio laterally, anterior caudally and translatory directions, for the right lumbar fascia in caudal direction and for left and right thoraco- dorsal fascia in cranial directions, for fascia of the chest on the left and right sides in cranial, caudal latero-lateral directions and left trunk fascia in lateral and medial directions with patient in supine, prone positions for 15 mins totally and waiting in all directions to feel the release.
5. Joint mobilization according to Lewit ,for the right UE, 2 to 6 right ribs during inhalation and exhalation, right elbow in medial and lateral directions , carpal bones in palmar and dorsal directions, glenohumeral in cranial- caudal and ventral- dorsal, acromioclavicular dorsa;- ventral, cranial- caudal, scapula forward and backward directions, and first rib also C-TH spine in side bending and rotation directions only for the wrist joint, supination and pronation mobilization were done in semi supination and pronation due to the limitation and the pain in the wrist joint. All the

mobilization were applied while the patient was in supine, sitting positions. Repetition 5 to 10 times till fill the released at the end all the joints were checked.

6. PIR according to Lewit were applied for the right supinator and pronator muscles in semi supinated and pronated position of the forearm due to the limited ROM and for the right forearm flexors and extensors all the therapies were repeated 3 to 5 times and patient was in supine position.
7. Post facilitation with stretching according to Janda were applied for the right pectoralis major and left and right minor muscles and right upper trapezius all the therapies were repeated 3 to 5 times and patient was in supine position.
8. PNF according to Kabat for the right upper extremity, first flexion and extension diagonal, strengthen technique, repeated contraction were used, each diagonal were repeated for 3 times for the right upper extremity in supine position.

Subjective result:

Patient feels a slight increased motion while feeling pain during second flexion and extension pattern but other therapies were pain free.

Objective result:

Patient cooperated during whole therapy and slight increased motions were observed in his right upper extremities especially after PIR and PFS therapies, but there was a minimum increase in supination and pronation motions of the right hand. All Joints after the mobilization were slightly released after the therapy. After PNF strengthening techniques was slight fluency and increase in ROM was observed. Oedema of the whole right UE has decreased. Release of the fascia has been felt after the therapy. Scars were less limited after the therapy; CPM session increase ROM was observed in shoulder joint only.

3.6.3 Day 3

08.02.2021

Present state

Subjective: Patient feels motivated, with feeling slightly released in his upper extremity.

Objective: Patient feels excited to do exercise, active range of motions was checked and slight increase in movement fluency has been seen.

Goals of today therapeutic unit:

1. Increase ROM of the right upper extremity.
2. Decrease edema.
3. Decrease scars stiffness.
4. Skin sub skin and fascia stretching.
5. Decrease joint play limitations.
6. Relaxation of hypertonic supinator, pronator, forearm flexors and extensors muscles of the right UE.
7. Stretching of the shortened upper trapezius and pectoralis muscles of the right UE.
8. Strengthening weakened muscles and stretching shortened muscles of the right UE.

Proposal therapy:

1. Constant passive motions.
2. Cryotherapy.
3. Soft tissue relaxation for the scars according to the Lewit.
4. Soft tissue relaxation technique for the limited fascia according to the Lewit.
5. Joint mobilization for the restricted right joints according to Lewit.
6. Post isometric relaxation according to the Lewit.
7. Post facilitation stretching techniques according to Janda.
8. PNF according to the Kabat electro-gymnastic therapy.

Description of the today's therapeutic unit:

1. CPM: was applied for the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion:135 Abduction:70 and wrist: supination: 25 pronation:25
2. Patient use ice on his right upper extremity such as wrist, elbow and shoulder joints to decrease edema for 10 to 12 min every time before starting the therapy
3. As the stiches were removed, scar care according to Lewit has been applied for all the scars on his head and right upper extremity in S shape, sustained pressure. Reaching the barrier wait with constant pressure till the physiological barrier will be released for 5min.
4. Soft tissue relaxation technique for of fascia and skin and sub skin according to Lewit. For fascia, skin and sub skin of the right upper extremity in medio laterally, anterior caudally and translatory directions, for the right lumbar fascia in caudal direction and

for left and right thoraco- dorsal fascia in cranial directions, for fascia of the chest on the left and right sides in cranial, caudal latero-lateral directions and left trunk fascia in lateral and medial directions with patient in supine, prone positions for 15 mins totally and waiting in all directions to feel the release.

5. Shoulder distraction according to Lewit in direction of long axis of the arm in supine position and shaking mobilization of the elbow joint in extension while patient is sitting, mobilizations for 1 minute for each joint approximately till the released is felt.
6. Post facilitation with stretching according to Janda were applied for the right pectoralis major and left and right minor muscles and right upper trapezius all the therapies were repeated 3 to 5 times and patient was in supine position.
7. PIR according to Lewit were applied for the right supinator and pronator muscles in semi supinated and pronated position of the forearm due to the limited ROM and for the right forearm flexors and extensors all the therapies were repeated 3 to 5 times and patient was in supine position.
8. PNF according to Kabat for the right upper extremity, first flexion and extension diagonal, strengthen technique, repeated contraction were used, each diagonal were repeated for 3 times for the right upper extremity in supine position.

Electro-gymnastic therapy was applied for the infraspinatus muscle of the right side with the intensity: 45mA, duration: 10min, motoric threshold, frequency: 50Hz, impulse width: 300 μs, stimulation time: 5s, rest time: 5s regime: cc, rectangular shape.

Subjective result:

Patient felt happy with the exercises and showing his range of motions to the therapists. But he felt slight pain during supination and pronation movements in PNF and PIR exercises.

Objective result:

Patient was satisfied after therapy, and increased range of motions was clear specially in his shoulder joint for flexion, internal, external rotation and abduction. Limitation and pain were observed during PIR and PNF therapies specially for the supination and pronation of the right hand. Joint play limitation has been decreased after shoulder distraction and elbow shaking, Oedema of the whole right UE has decreased. Release of the fascia has been felt after the

therapy. Scars were less limited after the therapy, CPM session increase ROM was observed in shoulder joint and wrist joints for flexion, abduction. Supination and pronation.

3.6.4 Day 4

09.02.2021

Present state

Subjective: Patient feels motivated, and the most difficult movement for him is supination and pronation of the tight hand.

Objective: Patient feels excited to do exercise, active range of motions was checked and slight increase in movement fluency has been seen compared to yesterday.

Goals of today therapeutic unit:

1. Increase ROM of right upper extremity joints.
2. Decrease scars stiffness.
3. Decrease edema.
4. Skin sub skin and fascia stretching.
5. Decrease right UE joints limitation.
6. Strengthening weakened muscles and stretching shortened muscles of the right UE.
7. Relaxation of the hypertonic muscles of the right UE; supinator, pronator, flexors and extensors of the forearm and external and internal rotators of shoulder.
8. Stretching of the shortened muscles of the right UE; pectoralis major, minor and upper trapezius.

Proposed therapy:

1. Constant passive motions.
2. Cryotherapy
3. Soft tissue relaxation for the scars according to the Lewit.
4. Stretching of the limited fascia according to the Lewit.
5. Joint mobilization according to Lewit.
6. Post facilitation stretching according to the Janda.
7. Post isometric relaxation according to Lewit.
8. PNF according to the Kabat and electro-gymnastic therapy.

Description of the today's therapeutic plan:

1. CPM was applied for the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion:140 Abduction:75 and wrist: supination:30 pronation:30
2. Patient use ice on his upper extremity such as wrist, elbow and shoulder joints to decrease edema for 10 to 12 min every time before starting the therapy.
3. Soft tissue relaxation for scars according to Lewit, as the stiches were removed, scar care has been applied for all the scars on his head and right upper extremity in S shape, sustained pressure. Reaching the barrier wait with constant pressure till the physiological barrier will be released for 5min.
4. Soft tissue relaxation technique for of fascia and skin and sub skin according to Lewit. For fascia, skin and sub skin of the right upper extremity in medio laterally, anterior caudally and translatory directions, for the right lumbar fascia in caudal direction and for left and right thoraco- dorsal fascia in cranial directions, for fascia of the chest on the left and right sides in cranial, caudal latero-lateral directions and left trunk fascia in lateral and medial directions with patient in supine, prone positions for 15 mins totally and waiting in all directions to feel the release.
5. Joint mobilization according to Lewit in supine position for the right PIP, DIP. MCP, CMC in lateral and medially and cranial and caudal directions, wrist and carpal bones in dorsal, palmar directions, only for the wrist joint in supination and pronation directions, mobilization were done in semi supination and pronation due to the limitation and the pain in the wrist joint. Repetition 5 to 10 times till fill the release and immediately joints were checked if they are released or not.
6. Post facilitation with stretching according to Janda were applied for the right pectoralis major and left and right minor muscles and right upper trapezius all the therapies were repeated 3 to 5 times and patient was in supine position.
7. PIR according to Lewit were applied for the right supinator and pronator muscles in semi supinated and pronated position of the forearm due to the limited ROM and for the right forearm flexors and extensors and for the right shoulder internal and external rotators all the therapies were repeated 3 to 5 times and patient was in supine position.
8. PNF according to Kabat for the right upper extremity and scapula, first and second flexion and extension diagonal, strengthen technique, repeated contraction were

used, each diagonal were repeated for 3 times for the right upper extremity in supine position.

Electro-gymnastic therapy was applied for the infraspinatus muscle of the right side with the intensity: 45mA, duration: 10min, motoric threshold, frequency: 50Hz, width of impulse: 300 µs, stimulation time: 5s, rest time: 5s regime: cc, rectangular shape.

Subjective result:

Patient feels pain in his wrist while doing strengthening technique of the PNF especially during for the right upper extremity, he can cooperate during scapula PNF without having pain, also during PFS with stretching he felt limitation and pain during supinator and pronator muscles therapies

Objective result:

Patient felt tired after PNF strengthening, but he could resist against the therapist resistance during strengthening techniques and he was shaking while resisting against supination and pronation. While applying the PFS therapies, patient was shaking during supinator and pronator muscles therapies but he could collaborate till the end. Increase in range of motion in whole right upper extremity was observed after the therapy Oedema of the whole right UE has decreased. Release of the fascia has been felt after the therapy. Scars were less limited after the therapy, CPM session increase ROM was observed in shoulder joint and wrist joints for flexion, abduction Supination and pronation.

3.6.5 Day 5

10.02.2021

Present state

Subjective: Patient feels motivated, and the most difficult movement for him is supination and pronation of the tight hand.

Objective: Patient feels excited to do exercise, active range of motions was checked and slight increase in movement fluency has been seen compared to yesterday.

Goals of today therapeutic unit:

1. Increase ROM of right upper extremity joints.
2. Decrease scars stiffness.
3. Skin sub skin and fascia stretching.

4. Decrease right UE joints limitation.
5. Strengthening weakened muscles and stretching shortened muscles of the right UE.
6. Relaxation of the hypertonic muscles of the right UE; supinator, pronator, flexors and extensors of the forearm and external and internal rotators of shoulder.
7. Stretching of the shortened muscles of the right UE; pectoralis major, minor and upper trapezius.

Proposed therapy:

1. Constant passive motions.
2. Soft tissue relaxation technique for the scars according to the Lewit.
3. Soft tissue relaxation technique for the limited fascia according to the Lewit.
4. Joint mobilization for the restricted right joints according to Lewit.
5. PNF according to the Kabat and electro-gymnastic.
6. Post isometric relaxation techniques according to Lewit.
7. Post facilitation stretching technique according to the Janda.

Description of today's therapeutic plan:

1. CPM was applied for the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion:145 Abduction:80 and wrist: supination:35 pronation:35
2. Soft tissue relaxation for the scars according to Lewit, as the stiches were removed. Scar care has been applied for all the scars on his head and right upper extremity in S shape, sustained pressure. Reaching the barrier wait with constant pressure till the physiological barrier will be released for 5min.
3. Soft tissue relaxation technique for of fascia and skin and sub skin according to Lewit. For fascia, skin and sub skin of the right upper extremity in medio laterally, anterior caudally and translatory directions, for the right lumbar fascia in caudal direction and for left and right thoraco- dorsal fascia in cranial directions, for fascia of the chest on the left and right sides in cranial, caudal latero-lateral directions and left trunk fascia in lateral and medial directions with patient in supine, prone positions for 15 mins totally and waiting in all directions to feel the release.
4. Joint mobilization for the restricted right joints such as ribs 2 to 6 during inhalation and exhalation, carpal bones in palmar and dorsal directions also C-TH spine in side bending and rotation directions and wrist joint in supination and pronation directions

were done in semi supination and pronation due to the limitation and the pain in the wrist joint. Repetition 5 to 10 times till fill the release and immediately joints were checked if they are released or not.

5. PNF for the right upper extremity and scapula, first and second flexion and extension diagonal, strengthen technique, repeated contraction were used, each diagonal were repeated for 3 times for the right upper extremity in supine position.

   Electro-gymnastic therapy was applied for the infraspinatus muscle of the right side with the intensity: 45mA, duration: 10min, motoric threshold, frequency: 50Hz, width of impulse: 300 µs, stimulation time: 5s, rest time: 5s regime: cc, rectangular shape

6. PIR according to Lewit were applied for the right supinator and pronator muscles in semi supinated and pronated position of the forearm due to the limited ROM and for the right forearm flexors and extensors and for the right shoulder internal and external rotators all the therapies were repeated 3 to 5 times and patient was in supine position.
7. Post facilitation with stretching according to Janda were applied for the right pectoralis major and left and right minor muscles and right upper trapezius all the therapies were repeated 3 to 5 times and patient was in supine position.

Subjective result:

Patient feels tired and slight pain in his wrist while doing strengthening technique of the PNF, but he could collaborate. Patient didn't feel any pain during mobilization of the restricted joints. Only PFS method for the supinator and pronator muscles were slightly painful for him.

Objective result:

Patient felt tired after PNF strengthening but he cooperated very well, he was shaking slightly during repeated contraction against his supinator and pronator muscles. Other therapies were applied without having any pain only during PFS method for the supinator and pronator muscles huge limitation could be felt so the hand position was in semi supination and pronation. Release of the fascia has been felt after the therapy. Scars were less limited after the therapy, CPM session increase ROM was observed in shoulder joint and wrist joints for flexion, abduction. Supination and pronation

3.6.6 Day 6

11.02.2021

Present state

Subjective: Patient feels motivated, and the most difficult movement for him is supination and pronation of the right hand.

Objective: Patient feels excited to do exercise, active range of motions was checked and slight increase in movement fluency has been seen compared to yesterday.

Goals of today therapeutic unit

1. Increase ROM of right upper extremity joints.
2. Decrease scars stiffness.
3. Skin sub skin and fascia stretching.
4. Decrease right UE joints limitation.
5. Strengthening weakened muscles and stretching shortened muscles of the right UE.
6. Relaxation of the hypertonic muscles of the right UE; supinator, pronator, flexors and extensors of the forearm and external and internal rotators of shoulder.
7. Stretching of the shortened muscles of the right UE; pectoralis major, minor and upper trapezius.

Proposed therapy

1. Constant passive motions.
2. Soft tissue relaxation technique for the scars according to the Lewit.
3. Soft tissue relaxation technique for the limited fascia according to the Lewit.
4. Joint mobilization for the restricted right joints according to Lewit.
5. PNF according to the Kabat and electro-gymnastic therapy.
6. Post isometric relaxation techniques according to Lewit.
7. Post facilitation stretching technique according to the Janda.

Description of the today's therapeutic plan

1. Constant passive motions were applied for the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion:150 Abduction:85 and wrist: supination:40 pronation:40

2. Soft tissue relaxation techniques according to Lewit as the stiches were removed scar care has been applied for all the scars on his head and right upper extremity in S shape, sustained pressure. Reaching the barrier wait with constant pressure till the physiological barrier will be released for 5min.
3. Soft tissue relaxation technique for of fascia and skin and sub skin according to Lewit. For fascia, skin and sub skin of the right upper extremity in medio laterally, anterior caudally and translatory directions, for the right lumbar fascia in caudal direction and for left and right thoraco- dorsal fascia in cranial directions, for fascia of the chest on the left and right sides in cranial, caudal latero-lateral directions and left trunk fascia in lateral and medial directions with patient in supine, prone positions for 15 mins totally and waiting in all directions to feel the release.
4. Proprioceptive neuromuscular facilitation according to the Kabat in supine position, first and second flexion and extension diagonal, strengthen technique, repeated contraction were used each diagonal were repeated for 5 times for the right upper extremity and for the right scapula.

Electro-gymnastic therapy was applied for the infraspinatus muscle of the right side with the intensity: 45mA, duration: 10min, motoric threshold, frequency: 50Hz, width of impulse: 300 µs, stimulation time: 5s, rest time: 5s regime: cc, rectangular shape.

5. Joint mobilization according to Lewit for the restricted right joints; such as ribs 2 to 6 during inhalation and exhalation, carpal bones and first rib in all directions and C-TH spine in side bending and rotation directions only in whole directions only for the wrist joint, supination and pronation mobilization were done in semi supination and pronation due to the limitation and the pain in the wrist joint. Repetition 5 to 10 times till fill the release and immediately joints were checked if they are released or not.

Right Shoulder distraction according to Lewit, in direction of long axis of the arm in supine position and shaking mobilization of the elbow joint in extension while patient is sitting, mobilizations for 1 minute for each joint approximately till the released is felt.

6. PIR according to Lewit were applied for the right supinator and pronator muscles in semi supinated and pronated position of the forearm due to the limited ROM and for the right forearm flexors and extensors and for the right shoulder internal and external rotators all the therapies were repeated 3 to 5 times and patient was in supine position.

7. Post facilitation with stretching according to Janda were applied for the right pectoralis major and left and right minor muscles and right upper trapezius all the therapies were repeated 3 to 5 times and patient was in supine position.

Subjective result:

Patient did not feel any pain during PNF according Kabat strengthening technique and he could cooperate; he was only complaining about the slight pain while resisting against supination and pronation during PNF. Other therapies were done without any compliment.

Objective result:

Beside the weakness and slight shaking which was observed during PNF strengthening of right upper extremity specially during supination and pronation of the both diagonals patient could collaborate very well. Other therapies were applied without any pain and limitation only the PFS according to Janda method for the supinator and pronator muscles were difficult for the patient and he was shaking. At the end when patient was asked for the active movement slightly increased in the whole ROM of right upper extremity joins comparing to the beginning of the exercise were observed. Whole scars of the right upper extremity and head is free now, fascia is restricted only in right upper extremity specially in right forearm in cranial- caudal and translatory directions.

3.6.7 Day 7

12.02.2021

Present state

Subjective: Patient does not complain about any pain only about limited range of motions in his wrist which is supination and pronation

Objective: No edema was found in patient right upper extremity, beside limited range of motions of his wrist, it can be observed that his overall range of motion in right upper extremity has been increased.

Goals of today therapeutic unit:

1. Increase ROM of right upper extremity.
2. Skin sub skin and fascia stretching.

3. Decrease right UE joints limitation.
4. Strengthening weakened muscles and stretching shortened muscles of the right UE.
5. Relaxation of the hypertonic muscles of the right UE; supinator, pronator, flexors and extensors of the forearm and external and internal rotators of shoulder.
6. Stretching of the shortened muscles of the right UE; pectoralis major, minor and upper trapezius.

Proposed therapy:

1. Constant passive motions.
2. Soft tissue relaxation technique for the scars according to the Lewit.
3. Soft tissue relaxation technique for the limited fascia according to the Lewit.
4. Joint mobilization for the restricted right joints according to Lewit.
5. PNF according to the Kabat and electro-gymnastic therapy.
6. Post isometric relaxation techniques according to Lewit.
7. Post facilitation stretching technique according to the Janda.

Description of today's therapeutic unit:

1. Constant passive motions were applied for the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion:155 Abduction:90 and wrist: supination:40 pronation:40
2. Soft tissue relaxation techniques according to Lewit, as the stiches were removed scar care has been applied for all the scars on his head and right upper extremity in S shape, sustained pressure. Reaching the barrier wait with constant pressure till the physiological barrier will be released for 5min.
3. Soft tissue relaxation technique for of fascia and skin and sub skin according to Lewit. For fascia, skin and sub skin of the right upper extremity in medio laterally, anterior caudally and translatory directions, for the right lumbar fascia in caudal direction and for left and right thoraco- dorsal fascia in cranial directions, for fascia of the chest on the left and right sides in cranial, caudal latero-lateral directions and left trunk fascia in lateral and medial directions with patient in supine, prone positions for 15 mins totally and waiting in all directions to feel the release.

4. PNF according to Kabat in supine position, first and second flexion and extension diagonal, strengthen technique, repeated contraction were used each diagonal were repeated for 5 times for the right upper extremity and for the right scapula.

   Electro-gymnastic therapy was applied for the infraspinatus muscle of the right side with the intensity: 47mA, duration: 10min, motoric threshold, frequency: 50Hz, width of impulse: 300 µs, stimulation time: 5s, rest time: 5s regime: cc, rectangular shape.
5. Joint mobilization according to Lewit for the restricted right joints such as ribs 2 to 6 during inhalation and exhalation, carpal bones in dorsal and palmar directions, DIP, PIP, all MCP, CMC in dorsal, palmar, lateral- lateral directions, wrist in supination, pronation, radial and ulnar ductions, elbow in lateral- medial , glenohumeral ventral-dorsal and caudal- cranial, scapula forward and backward and first rib and C-TH spine in side bending and rotation directions only for the wrist joint, supination and pronation mobilization were done in semi supination and pronation due to the limitation and the pain in the wrist joint. Repetition 5 to 10 times till fill the release and immediately joints were checked if they are released or not.

   Shoulder distraction according to Lewit, in direction of long axis of the right arm in supine position and shaking mobilization of the elbow joint in extension while patient is sitting, mobilizations for 1 minute for each joint approximately till the released is felt.
6. PIR according to Lewit were applied for the right supinator and pronator muscles in semi supinated and pronated position of the forearm due to the limited ROM and for the right forearm flexors and extensors and for the right shoulder internal and external rotators all the therapies were repeated 3 to 5 times and patient was in supine position.
7. Post facilitation with stretching according to Janda were applied for the right pectoralis major and left and right minor muscles and right upper trapezius all the therapies were repeated 3 to 5 times and patient was in supine position.

Subjective result:

Patient feels pain in his wrist while doing strengthening technique of the PNF for the supination and pronation movement but it is less than yesterday. Patient feels increased range of motions in his whole upper extremity

Objective result:

Patient felt tired after PNF strengthening he felt slight pain and shaking during supination and pronation but less than yesterday so he could collaborate better than other therapy days. After joint mobilization, all the joints were free. Patient still felt pain during PFS for supinator and pronators, other therapies were pain free. Increased ROM was observed when patient was asked to the active motions at the end of therapy session. All fascia, skin and sub skin were free in all directions.

3.6.8 Day 8

15.02.2021

Present state

Subjective: Patient was feeling slight increased range of motion in his shoulder he did not complain about any pain.

Objective: No edema was found in patient right upper extremity, beside limited range of motions of his wrist, it can be observed that his overall range of motion in right upper extremity has been increased

Goals of today therapeutic unit:

1. Increase ROM of right upper extremity.
2. Decrease right UE joints limitation.
3. Strengthening weakened muscles and stretching shortened muscles.
4. Relaxation of the right hypertonic supinator and pronator muscles.
5. Stretching of the shortened pectoralis major, minor, upper trapezius, extensors and flexors of the right, shoulder internal and external rotators of the right UE.

Proposed therapy

1. Constant passive motions.
2. Joint mobilization for the restricted right joints according to Lewit.
3. PNF according to the Kabat and electro-gymnastic therapy.
4. Post isometric relaxation techniques according to Lewit.
5. Post facilitation stretching technique according to the Janda.

Description of the today's therapeutic unit:

1. Constant passive motions were applied for the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion:160 Abduction:90 and wrist: supination:45 pronation:45
2. Soft tissue relaxation technique for of fascia and skin and sub skin according to Lewit. For fascia, skin and sub skin of the right upper extremity in medio laterally, anterior caudally and translatory directions, for the right lumbar fascia in caudal direction and for left and right thoraco- dorsal fascia in cranial directions, for fascia of the chest on the left and right sides in cranial, caudal latero-lateral directions and left trunk fascia in lateral and medial directions with patient in supine, prone positions for 15 mins totally and waiting in all directions to feel the release.
3. PNF in supine position, first and second flexion and extension diagonal, strengthen technique, repeated contraction were used each diagonal were repeated for 5 times for the right upper extremity and for the right scapula.

   Electro-gymnastic therapy was applied for the infraspinatus muscle of the right side with the intensity: 47mA, duration: 10min, motoric threshold, frequency: 50Hz, width of impulse: 300 µs, stimulation time: 5s, rest time: 5s regime: cc, rectangular shape.
4. PIR according to Lewit were applied for the right supinator and pronator muscles in semi supinated and pronated position of the forearm due to the limited ROM and for the right forearm flexors and extensors and for the right shoulder internal and external rotators all the therapies were repeated 3 to 5 times and patient was in supine position.
5. Post facilitation with stretching according to Janda were applied for the right pectoralis major and left and right minor muscles and right upper trapezius all the therapies were repeated 3 to 5 times and patient was in supine position.

Subjective result:

Patient feels slight pain with shaking in his wrist while doing strengthening technique of the PNF. Other therapies were applied without having pain and patient mentioned about the

released and increased strength and range of motions in his whole right upper extremity after the therapy.

Objective result:

Patient was slightly shaking during the PNF strengthening techniques for his wrist joint during supination and pronation resistances. Other therapies were applied without any pain, increased range of motions was observed after asking patient to do the active movement but range of motion improvement in supination and pronation was less than other joints. During PFS therapy, increase range of motion were observed for muscles such as pectoralis major and minor, upper trapezius, internal and external rotators of the shoulder, flexors and extensors of the forearm have no shortness but this enhancement is less in supination and pronation of the wrist joint.

3.6.9 Day 9

16.02.2021

Present state

Subjective: Patient does not complain about any pain and slightly increased in the range of motion of his whole upper extremity.

Objective: No edema was found in patient right upper extremity, beside limited range of motions of his wrist, it can be observed that his overall range of motion in right upper extremity has been increased.

Goals of today therapeutic unit:

1. Increase ROM of right upper extremity joints.
2. Decrease right UE joints limitation.
3. Strengthening weakened muscles and stretching shortened muscles.
4. Relaxation of the right hypertonic supinator and pronator muscles.
5. Stretching of the shortened pectoralis major, minor, upper trapezius, extensors and flexors of the right, shoulder internal and external rotators of the right UE.

Proposed therapy:

1. Constant passive motions.
2. Joint mobilization for the restricted right joints according to Lewit.

3. PNF according to the Kabat and electro-gymnastic therapy.
4. Post isometric relaxation techniques according to Lewit.
5. Post facilitation stretching technique according to the Janda.

Description of the today's therapeutic unit:

1. Constant passive motions were applied for the right shoulder and wrist joint 30 min for each joint: Shoulder: Flexion:160 Abduction:95 and wrist: supination:50 pronation:50
2. Shoulder distraction in direction of long axis of the arm in supine position and shaking mobilization of the elbow joint in extension while patient is sitting, mobilizations for 1 minute for each joint till the released is felt.

   Joint mobilization for the restricted right joints such as wrist joint in supination and pronation directions was done in semi supination and pronation due to the limitation and the pain in the wrist joint.
3. PNF in supine position, first and second flexion and extension diagonal, strengthen technique, repeated contraction were used each diagonal were repeated for 5 times for the right upper extremity and for the right scapula.

   Electro-gymnastic therapy was applied for the infraspinatus muscle of the right side with the intensity: 48mA, duration: 10min, motoric threshold, frequency: 50Hz, width of impulse: 300 μs, stimulation time: 5s, rest time: 5s regime: cc, rectangular shape.
4. PIR according to Lewit were applied for the right supinator and pronator muscles in semi supinated and pronated position of the forearm due to the limited ROM and for the right forearm flexors and extensors and for the right shoulder internal and external rotators all the therapies were repeated 3 to 5 times and patient was in supine position.
5. Post facilitation with stretching according to Janda were applied for the right pectoralis major and left and right minor muscles and right upper trapezius all the therapies were repeated 3 to 5 times and patient was in supine position.

Subjective result:

Patient feels pain in his wrist while doing strengthening technique of the PNF for the supination and pronation movement but it's less than yesterday. Patient feels increased range of motions in his whole upper extremity

Objective result:

Patient felt tired after PNF strengthening he felt slight pain and shaking during supination and pronation but less than yesterday so he could collaborate better than other therapy days. After joint mobilization, wrist joint is very slightly limited. Patient still felt pain during PFS for supinator and pronators, other therapies were pain free. Increased ROM was observed when patient was asked to the active motions at the end of therapy session. Significant increase ROM was observed after CPM therapy session.

3.6.10 Day 10

17.02.2021

Present state

Subjective: Patient does not complain about any pain only while doing pronation and slightly increased in the range of motion of his whole upper extremity was observed.

Objective: No edema was found in patient right upper extremity, beside limited range of motions of his wrist, it can be observed that his overall range of motion in right upper extremity has been increased.

Goals and plans of today therapeutic unit:

Final examination assessments were done completely.

3.7 Final Examination by physiotherapist: on 18.02.2021

Neurological examination

Mental status

- Patient is oriented from the time and the place point of view
- No impairment in communication abilities.
- Memorizing ability is physiological
- Speech is physiological

Cranial nerves

Nerve	Result
1.Olfactory	Not affected
2.Optic	Not affected
3.Oculomotor	Not affected
4.Trochlaris	Not affected
5.Trigeminus	Not affected
6.Abducens	Not affected
7.Fascial	Not affected
8.Vestibulocochlaris	Not affected
9.Glossopharyngeal	Not affected
10.Vagus	Not affected
11.Accessory	Not affected
12.Hypoglosseal	Not affected

Table 30: Final examination of cranial nerves

Motor system

According to Ashworth scale

Spasticity / rigidity sign:

Flexors of the arm, forearm, MCP, CMC and extensors of the arm, forearm, MCP, CMC:

Result=0

Examination of individual sensory modalities on upper extremities

Individual sensory modalities	L	R
Touch	Normal	Normal
Hot	Normal	Normal
Cold	Normal	Normal
Vibration	Normal	Normal
Joint position sense	Normal	Normal
Kinesthesia	Normal	Normal
Two-point discrimination	Normal	Normal
Graphesthesia	Normal	Normal
Stereognosis	Normal	Normal

Table 31: Final examination of individual sensory modalities on upper extremities

Dermatome's sensation

Dermatomes	L	R
C5	Not affected	Not affected
C6	not affected	not affected
C7	not affected	not affected
C8	not affected	not affected
T1	not affected	not affected
T2	not affected	not affected
T3	not affected	not affected

Table 32: Final examination of dermatome

Deep tendon reflexes

Deep tendon reflexes	L	R
Biceps	Hypo reflex	Hypo reflex
Triceps	Hypo reflex	Hypo reflex
Flexors	Hypo reflex	Hypo reflex
T7 to T12	Hypo reflex	Hypo reflex

Table 33: Final examination of deep tendon reflexes

Paretic signs

Paretic sign	L	R
Mingazzini upper extremity	Negative	Negative

Table 34: Final examination of paretic signs

Pyramidal signs

Pyramidal sign	L	R
Hoffman	Negative	Negative
Juster	Negative	Negative

Table 35: Final examination of pyramidal signs

Observation

Scar's location and length

Scar in his right axilla: 13.5cm
Scar on the distal end of humerus: 3cm
Scar on the olecranon: 8.5cm
Scar at the distal end of the radius: 8cm
Scar on the frontal bone: 13cm

Table36: Final examination of the scar's length

Edema: No edema was found on his whole right upper extremity.

Temperature: Symmetrical on both right and left upper extremities.

Scar's aspection: No limitation on his whole right upper extremity and his head. The color of the scars was slightly red, no bruise was found there and all the scars were in remodelling stage.

Postural examinations

Plumb line test

Posterior view

- Plumb line goes through his feet, sacrum, through his lumbar spine and it's not passing to the middle of his thoracic, cervical spine and his head is having lateral tilt to the right.

- Ankles are leaning outward mostly in his right side.
- Left calf is more prominent than right side.
- Right popliteal line is higher.
- Both knees are in valgocity
- Right gluteal line is higher.
- Right thigh is more prominent than left side.
- Pelvis is in lateral tilt to the right side.
- Both elbows are in slight semi flexion more in right side
- Right elbow is only leaning backward.
- His body is turned to the left side and leaning forward.
- Right shoulder is lower than left side.
- Head is turned to the right side.

Lateral view: left side

- Plumb line goes slightly posterior to the lateral malleolus, knee, hip, through the lumbar and thoracic vertebras, due to the head protraction and shoulder retractions plumb line is not going through his shoulder, external auditory meatus and skull.
- Lower arch in his left foot.
- Very slightly flexed left knee joint.
- Pelvis is having physiological anterior tilt.
- Increased lordosis in cervical spine with slight increased kyphotic curve in thoracic spine and physiological lordosis in his lumbar spine.
- Trunk is slightly leaning forward.
- Left elbow is in semi flexion.
- Left wrist is in slight pronation.
- Left shoulder is in retraction
- Head is slight in protraction.

Lateral view: right side

- Plumb line goes slightly posterior to the lateral malleolus, knee, hip, through the lumbar and thoracic vertebras, due to the head protraction and shoulder retractions plumb line is not going through his shoulder, external auditory meatus and skull.
- Higher arch in right foot compare to the left side.
- Semi flexed right knee.
- Trunk is leaning forward.
- Increased lordosis in cervical spine with increased kyphotic curve in thoracic spine and physiological lordosis in his lumbar spine.
- Right elbow is in semi flexion.
- All fingers are in slight semi flexion.
- Right wrist is in slight supination.
- Left hand is in slight internal rotation.
- Left fingers are in very slight semi flexion.
- Right shoulder is in retraction and its elevated slightly.
- Head is in protraction.

Anterior view

- Plumb line goes between both feet, between knees, not going completely through his umbilicus, sternum, and his head.
- Narrow base of the support.
- Right foot has more arch than left side.
- Patient puts more weight on his left foot.
- Left calf muscles are more prominent than right side.
- Right knee is in semi flexion more than left knee.
- Right thigh is more prominent than left side.
- Umbilicus is turned to the left side.
- Trunk is turned to the left side.
- Left brachiotriangular is slightly bigger than right side.
- Both elbows are slightly bended, more on the right side.
- Left nipple is lower than right side.
- Sternum is pressed in.
- Right clavicle is prominent only mostly in the medial border.
- Both shoulders are retracted more on right side.

- Right shoulder is slightly lower than left side.
- Head is turned slightly to the right side.

Gait analysis

- Patient walks with narrow base of support.
- Walking rhythm is non-periodic because patient puts more weight on his left foot.
- Walking speed is slow with short steps, left stride length is shorter than right side.
- Patient is having all the gait phases in both feet such as weight acceptance, single-limb support, limb advancement.
- Feet are in supination during walking.
- There is no excessive hip and extension and flexion during gait and its physiological.
- Pelvis is in lateral tilt to the right side.
- Movement of centre of gravity is physiological.
- Trunk is moving physiologically during walking and it is moved forward with slight rotation to the left.
- Abdominal muscles movement are slight.
- Thoracic spine is in increased kyphotic curve and cervical is in increased lordosis and lumbar lordosis just increase very slightly while walking.
- Paravertebral muscles whole spine are in hypertension while walking.
- Right shoulder is slightly elevating, and the body is slightly leaning to the left while walking both shoulders are swinging during walking
- Head is in protraction and slight rotation to the right side
- Movement of the upper extremities are physiological.
- Patient is completely stable while walking.

Breathing examination

Chest shape: physiological.

Intensity: physiological.

Frequency: 13 per min.

Patient's position

Supine, sitting and prone: Patient's breathing wave is starting from his abdomen area and goes to his lower chest and the finishes in his upper chest, movement of the chest is clearly observable.

Palpation of the pelvis

Sagittal plane: Physiological anterior tilt.

Frontal plane: Lateral tilt to the right side.

ASIP: Higher on the left PSIP: Higher on the left Iliac crest: Higher on the left

Transverse plane: Clockwise rotation.

Specific testing of the posture

Romberg test:

Romberg 1: Negative.

Romberg 2: Negative.

Romberg 3: Negative.

Vele test: Grade 1

Standing on two scales: Negative

L: 46kg R: 52kg

Result: Negative

Standing on tip toes: Negative

Standing on heels: Negative

Anthropometric measurement

Anthropometric measurement		
	L	**R**
Length of whole UE	78cm	77cm
Length of the Humerus	34cm	33cm
Length of the forearm	27cm	25cm
Length of the hand	21cm	19cm
Circumference of upper arm	33cm	33cm
Circumference of the elbow joint	28cm	28cm
Circumference of the wrist joint	18.5cm	20.5cm

Table 37: Final examination of anthropometric and circumference examination

Circumference measurement	L	R
Circumference of MCP	22.5cm	22.5cm
Circumference of first MCP, IP1	8cm	7.5 cm
Circumference of second MCP IP1	8cm	8cm
Circumference of third MCP IP1	7cm	7cm
Circumference of fourth MCP IP1	6cm	6cm
Circumference of fifth MCP IP1	5cm	5cm
Circumference of second MCP IP2	8.5cm	8.5cm
Circumference of third MCP IP2	7cm	7cm
Circumference of fourth MCP IP2	6cm	6cm
Circumference of fifth MCP IP2	5cm	5cm

Table 38: Final examination of circumference examination

circumference of the head	57cm
circumference of the thorax	111cm

Table 39: Final examination of circumference of the neck

Goniometry examination according to Janda

		Left					
		AROM			PROM		
		Neutral			Neutral		
Shoulder	**S**	60	0	160	60	0	180
	F	110	0	//	130	0	//
	T	120	0	20	130	0	30
	R	65	0	55	75	0	70
Elbow	**S**	0	0	145	0	0	150
	R	80	0	85	85	0	90
Wrist	**S**	70	0	80	75	0	85
	F	10	0	30	25	0	35

Table 40: Final examination of the ROM for the left shoulder, elbow and wrist joints

		Right					
		AROM			**PROM**		
		Neutral			**Neutral**		
Shoulder	S	35	0	130	50	0	150
	F	60	0	//	75	0	//
	T	//	0	15	//	0	20
	R	40	0	70	70	0	90
Elbow	S	0	0	120	0	0	145
	R	30	0	15	45	0	25
Wrist	S	45	0	50	65	0	75
	F	15	0	25	20	0	35

Table 41: Final examination of the ROM for the right shoulder, elbow and wrist joints

		Left					
		AROM			**PROM**		
MCP 2nd	**S**	10	0	80	15	0	90
	F	25	0	35	40	0	45
MCP3rd	**S**	25	0	30	25	0	35
	F	10	0	85	15	0	90
MCP 4th	S	20	0	35	30	0	40
	F	25	0	25	30	0	40
MCP 5th	S	30	0	70	35	0	75
	F	15	0	40	25	0	45
IP1							
2nd finger	S	0	0	80	0	0	95
3rd finger	S	0	0	80	0	0	85
4th finger	S	0	0	85	0	0	95
5th finger	S	0	0	80	0	0	95
IP2							
2nd finger	S	0	0	55	0	0	65
3rd finger	S	0	0	60	0	0	70
4th finger	S	0	0	75	0	0	85
5th finger	S	5	0	60	0	0	75
Thumb CMC	S	0	0	15	10	0	25
	F	50	0	40	65	0	45
Thumb MCP	S	0	0	50	5	0	55
Thumb IP	F	0	0	80	5	0	90

Table 42: Final examination of the ROM for the left MCP, CMC, IP1 and IP2 joints

		Right					
		AROM			**PROM**		
MCP 2ND	**S**	10	0	85	15	0	90
	F	30	0	40	40	0	50
MCP 3RD	**S**	15	0	30	25	0	35
	F	30	0	65	15	0	80
MCP 4th	S	20	0	35	30	0	45
	F	25	0	25	35	0	40
MCP 5th	S	25	0	60	35	0	75
	F	20	0	30	25	0	35
IP1							
2nd finger	S	0	0	70	0	0	80
3rd finger	S	0	0	65	0	0	80
4th finger	S	0	0	65	0	0	75
5th finger	S	0	0	50	0	0	65
IP2							
2nd finger	S	0	0	55	0	0	75
3rd finger	S	0	0	50	0	0	70
4th finger	S	0	0	75	0	0	90
5th finger	S	5	0	60	0	0	80
Thumb CMC	S	0	0	15	10	0	35
	F	50	0	30	65	0	45
Thumb MCP	S	0	0	40	10	0	55
Thumb IP	F	0	0	60	10	0	70

Table 43: Final examination of the ROM for the right MCP. CMC, IP1 and IP2 joints

Skin and sub skin examination according to the Lewit

	L	R
skin and sub skin's locations		
Upper arm	Free	Free
Lower arm	Free	Free
Thorax	Free	Free
upper thoracic	Free	Free
Lower thoracic	Free	Free
lumbar area	Free	Free

Table 44: Final examination of skin and sub skin

Fascia examination according to the Lewit

Fascia examination		
	L	**R**
Fascia of the chest+ laterally, medially, cranially, caudally	Free	Free
dorsal fascia cranially	Free	Free
lumbar fascia caudally	Free	Free
Lateral fascia of the trunk + latero medially	Free	Free
Fascia of the both arms cranially + caudally + medio laterally	Free	Free
Fascia of the neck translator	Free	Free
Fascia of the forearm cranially+ caudally+ medio laterally	Free	Free

Table 45: Final examination of fascia

Muscle tone palpation according to Lewit		
Muscle	**L**	**R**
Serratus anterior	Normal tone	slightly hyper tone
Upper trapezius	Normal tone	Hyper tone only at insertion
Middle trapezius	Normal tone	Normal tone
Lower trapezius	Normal tone	Normal tone
Rhomboids major	Normal tone	Normal tone
Rhomboids minor	Hypo tone	Hypo tone
Subscapularis	Normal tone	Normal tone
Levator scapulae	Hyper tone	Hyper tone only at insertion
Latissimus dorsi	Normal tone	Normal tone
Teres major	Normal tone	Normal tone
Teres minor	Hypo tone	Normal tone
Supraspinatus	Normal tone	Hyper tone at insertion
Infraspinatus	Normal tone	Normal tone
Pectoralis major	Normal tone	Normal tone

Table 46: Final examination of muscle tone for muscles around the scapula

Muscle	L	R
Pectoralis minor	Normal tone	Hyper tone only at insertion
Deltoid whole fibres	Normal tone	Hyper tone
Coracobrachialis	Normal tone	Slightly Hyper tone
Brachioradialis	Normal tone	Hyper tone
Anconeus	Normal tone	Hypo tone
Triceps brachii	Normal tone	Normal tone
Biceps brachii	Hyper tone	Hyper tone only long head
Brachialis	Normal tone	Normal tone
Supinator	Normal tone	Normal tone
Pronator quadratus	Normal tone	Hyper tone
Pronator teres	Normal tone	Hyper tone
Extensor carpi radialis longus	Normal tone	Hyper tone only at insertion
Extensor carpi radialis brevis	Normal tone	Normal tone
Extensor carpi ulnaris	Hyper tone	Hyper tone at insertion
Flexor carpi ulnaris	Normal tone	Normal tone
Flexor carpi radialis	Normal tone	Hyper tone at insertion only
Flexor digitorum superficialis	Normal tone	Hyper tone
Flexor digitorum profundus	Normal tone	Hyper tone
Extensor digitorum	Normal tone	Normal tone
Extensor indicis	Normal tone	Hyper tone
Extensor digiti minimi	Normal tone	Hyper tone
Palmaris longus	Hypo tone	Hyper tone
Palmaris brevis	Normal tone	Hyper tone
Lumbricales	Normal tone	Hyper tone
Palmar interossei	Normal tone	Normal tone
Dorsal interossei	Normal tone	Hyper tone
Abductor digiti minimi	Normal tone	Hyper tone
Flexor digiti minimi	Normal tone	Hyper tone
Opponens digiti minimi	Normal tone	Hyper tone
Abductor pollicis longus	Normal tone	Hyper tone
Extensor pollicis brevis	Normal tone	Hyper tone
Extensor pollicis longus	Normal tone	Hyper tone
Flexor pollicis brevis	Normal tone	Hyper tone
Flexor pollicis longus	Normal tone	Hyper tone
Opponens pollicis	Normal tone	Hyper tone
Abductor pollicis brevis	Normal tone	Hyper tone
Adductor pollicis	Normal tone	Hyper tone
SCM	Normal tone	Normal tone
Scaleni	Hyper tone	Hyper tone
Paravertebral in lumbar area	Hyper tone	Hyper tone
Paravertebral in thoracic area	Hyper tone	Hyper tone
Quadratus lumborum	Hyper tone	Hyper tone

Table 47: Final examination of muscle tone for the arm, fingers, neck and back

Muscle length test according to Janda

	Grading	
Muscle	**L**	**R**
Pectoralis major	Grade0	Grade0
Pectoralis minor	Grade 0	Grade 1
Teres major, latissimus dorsi, rhomboid Major minor	Grade0	Grade1
Medial shoulder rotators	Grade0	Grade1
Leteral shoulder rorators	Grade0	Grade0
Cranial part of trapezius	Grade0	Grade0
Levator scapula	Grade0	Grade0
SCM	Grade0	Grade0

Table 48: Final examination of muscle length

Muscle strength test of the upper extremity according to Kendall

Muscle	L	R
Serratus anterior	5	4+
Upper trapezius	5	5
Middle trapezius	5	3
Lower trapezius	5	4+
Levator scapulae and Rhomboid	5	4+
Latissimus dorsi	5	4shaking
Medial rotators group test	5	4-
Teres major	5	4
Teres minor	5	3+
Supraspinatus	5	4
Infraspinatus	5	4
Pectoralis major upper fibers	5	4
Pectoralis major lower fibers	5	4
Pectoralis minor	5	5
Deltoid	5	4

Table 49: Final examination of muscle strength for muscles around the scapula and arm

Muscle	L	R
Anterior and posterior deltoid	5	4+
Coracobrachialis	5	5
Brachioradialis	5	4+
Triceps brachii	5	4+ shaking
Biceps brachii and brachialis	5	5
Supinator	5	4
Pronator quadratus	5	xx
Pronator teres	5	xx
Extensor carpi radialis longus	5	4+
Extensor carpi radialis brevis	5	4+
Extensor carpi ulnaris	5	4+
Flexor carpi ulnaris	5	xx
Flexor carpi radialis	5	xx
Flexor digitorum superficialis	10	xx
Flexor digitorum profundus	10	xx
Extensor digitorum	10	9
Extensor indicis	10	8

Table 50: Final examination of muscle strength for the arm, forearm and fingers

Muscle	L	R
Extensor indicis	10	8
Extensor digiti minimi	10	9
Palmaris longus	10	Xx
Lumbricalis	10	Xx
Palmar interossei	10	9
Dorsal interossei	10	Xx
Abductor digiti minimi	10	Xx
Flexor digiti minimi	10	Xx
Opponens digiti minimi	10	Xx
Abductor pollicis longus	10	8
Abductor pollicis brevis	10	8
Extensor pollicis brevis	10	9
Extensor pollicis longus	10	9
Flexor pollicis brevis	10	Xx
Flexor pollicis longus	10	Xx
Opponens pollicis	10	X
Adductor pollicis	10	9

Table 51: Final examination of muscle strength for fingers

Xx means it was not possible to provide the test due to the limitation and severe pain

Neck muscles:

Muscles	L	R
Posterolateral neck extensors	5	5
Anterolateral neck flexors	5	5
Anterior neck flexors	5	5

Table 52: Final examination of muscle strength for neck and paravertebral

Joint play examinations according to Lewit

Limitations		
Joints with directions	**L**	**R**
Atlanto occipital		
Anteflexion	Free	Free
Retroflexion	Free	Free
Rotation	Free	Free
Side bending	Free	Free
C1 C2		
Side bending	Free	Free
Rotation	Free	Free
C-TH		
Rotation	Free	Free
Side beding	Free	Free
Shoulder		
Craniocaudal	Free	Free
Ventrodorsal	Free	Free

Table 53: Final examination of joint play for cervical, and shoulder joints

	L	R
Joints with directions	**Limitations**	**Limitations**
Acromioclavicular		
Dorsoventral	Free	Free
Craniocaudal	Free	Free
Sternoclavicular		
Caudocranial	Free	Free
Scapula thoracic	Free	Free
Elbow	Free	
Laterally	Free	Free
Medially	Free	Free
Wrist		
Dorsal flexion	Free	Free
Palmar flexion	Free	Free
Individual carpal bones		
Triquetrum	Free	Free palmary

Table 54: Final examination of joint play for AC, SC, elbow, wrist and metacarpal bones

Joints with directions	L	R
Lunate	Free	Free palmary
Pisiform	Free	Free palmary
Hamate	Free	Free palmary
Capitate	Free	Free palmary
Trapezoid	Free	Free palmary
Trapezium	Free	Free palmary
Scaphoid	Free	Free palmary
CMC		
Laterolaterally	Free	Free
Dorsopalmar	Free	Free
MCP 1		
Laterolaterally	Free	Free
Dorsopalmar	Free	Free
MCP2		
Dorsopalmar	Free	Free
Laterolaterally	Free	Free
MCP3		
Laterolaterally	Free	Free
Dorsopalmar	Free	Free
MCP4		
Laterolaterally	Free	Free
Dorsopalmar	Free	Free
MCP5		
Dorsopalmar	Free	Free
Laterolaterally	Free	Free
IP (1)		
IP1		
Dorsopalmar	Free	Free
Laterolaterally	Free	Free

Table 55: Final examination of joint play for carpal bones, MCP and IP (1) joint

IP2	L	R
Dorsopalmar	Free	Limited
Laterolaterally	Free	Limited
IP3		
Dorsopalmar	Free	Free
Laterolaterally	Free	Free
IP4		
Dorsopalmar	Free	Free
Laterolaterally	Free	Free
IP5		
Dorsopalmar	Free	Free
Laterolaterally	Free	Free
IP2		
IP(2)1	Free	Free
Dorsopalmar	Free	Free
Laterolaterally		
IP(2)2	Free	Free
Dorsopalmar	Free	Free
Laterolaterally		
IP(2)3	Free	Free
Dorsopalmar	Free	Free
Laterolaterally		
IP(2)4	Free	Free
Dorsopalmar	Free	Free
Laterolaterally		
IP(2)5	Free	Free
Dorsopalmar	Free	Free
Laterolaterally		
ribs 2 to 12	Free	Free
Inhalation and exhalation		
Rib 1	Free	Free

Table 56: Final examination of joint play for IP2, ribs 2 to 12 and rib1

3.8 Final examination conclusion

According to the final examinations, it can be concluded that patient's mobility and strength has increased in his affected side which is in right upper extremity. The enhancement in the active and passive range of motions is found in all joins such as glenohumeral, acromioclavicular, elbow, wrist, MCP and IP, and increase in strength of the muscles of the right upper extremity such as biceps brachii, infraspinatus, supinator, pronator, flexors and extensors of the forearm is letting patient to have more range of motions with better fluency. Decrease in muscle shortness with releasing of the fascia could be another reason which has been affected for patient to affect his mobility.

3.9 Therapy effect evaluation

Due to the initial examination and chief problem which was the decreased mobility of the whole right upper extremity, therapeutic units were applied for the patient, during whole 10 sessions of the therapy, patient could collaborate with the therapist and he was physically and mentally accepting them also, therapist found the prominent increase in his mobility, range of motions and increase muscle strength of his right upper extremity with decreased pain. During final examinations after the last day of the therapeutic unit the improvement has been investigated.

To illustrate it, in plumb line test and gait examinations, patient's posture has been improved, patient had less tendency to have forward bending trunk, the protraction of the shoulder and head has been decreased, the mobility of the trunk and right arm has been significantly increased during his gait, this was also clear during his static posture of plumb line examination , the positions of the right fingers are forearm has been changed and there was less tendency to bend the fingers and with very slight elevation of the right shoulder.

Based on the initial and final examination of the anthropometric measurement there was a specific decline in the circumference of the right upper arm, elbow, wrist and MCP, CMC and IP joints which could be because of the cryotherapy which were done for the patient. Due to the final examination of the right skin, sub skin fascia examinations, no limitations were found in all those areas, which shows the effectivity of the soft tissue relaxation technique according to Lewit which were applied passively to the patient without having pain and he could collaborate with therapist this improvement has been observed from day 8 of therapy sessions that, the soft tissue relaxation technique has not been applied for him anymore. This technique also leads to decrease the limitation of the scars and leads to improve the blood circulation around the area of the scars on his whole right upper extremity.

Patient could also collaborate with therapist during scare care therapy which has been based on soft tissue relaxation techniques according to Lewit and he was applying for himself during his rest time in his room you can also see the improvement in the tables below:

3.9.1 Comparison between initial and final examination of the skin and sub skin according to Lewit

skin		
sub skin	Initial	Final
Upper arm	Limited in all directions	Free
Lower arm	Limited in all directions	Free
Thorax	Limited in all directions	Free
upper thoracic	Limited in all directions	Free
Lower thoracic	Limited in all directions	Free
Lumbar area	Limited in all directions	Free

Table 57: Comparison between initial and final examination of the skin and sub skin

3.9.2 Comparison between initial and final examination of fascia according to Lewit

Fascia examination	Initial	Final
Fascia of the of the chest+ laterally, medially, cranially, caudally	Limited	Free
dorsal fascia cranially	Limited	Free
lumbar fascia caudally	Limited	Free
Lateral fascia of the trunk + latero medially	Limited	Free
Fascia of the both arms cranially + caudally + medio laterally	Limited	Free
Fascia of the neck translatory	Limited	Free
Fascia of the forearm cranially+ caudally+ medio laterally	Limited	Free

Table 58: Comparison between initial and final examination of fascia

Another improvement which was clear after final examinations was the decrease shortness of the shortened muscles as it can be seen in the table below:

3.9.3 Compression between final and initial examinations of muscle strength testing for muscles of the right shoulder girdle and neck according to Kendall

	Grading	
Muscle	**Initial**	**Final**
Pectoralis major	**xx**	**Grade0**
Pectoralis minor	**Grade2**	**Grade 1**
Teres major, latissimus dorsi, rhomboid Major minor	**xx**	**Grade1**
Medial shoulder rotators	**Xx**	**Grade1**
Lateral shoulder rotators	**xx**	**Grade0**
Cranial part of trapezius	**Grade2**	**Grade0**
Levator scapula	**Grade1**	**Grade0**
SCM	**Grade2**	**Grade0**

Table 59: Compression between final and initial muscle strength testing for muscles of the shoulder girdle and neck

Based on the achievement which is clear in the table above it can be seen that the muscles shortness has been decreased significantly in the muscles such as upper trapezius, SCM, levator scapula, even, in muscles like pectoralis major both sternal and clavicular part, internal and external rotators of the shoulder and rhomboid major and minor, latissimus dorsi and teres major which the initial tests were not possible to be provided due to the pain and severe limitation and shortness of the muscles fibers but at the end of therapy session during the final examination patient was able to provide the test position and the shortness of the pectoralis major whole fibers, medial and lateral shoulder rotators has been solved and it was only in grade 1, and the rest of the muscles were in no shortness except pectoral minor in grade 1, all these improvements could be as a result of the PFS therapy according to Janda which had special effect with stretching the shortened muscles which needs patient cooperation, in this case patient could cooperate with the therapist very well while he was feeling slight pain during giving resistance to the therapist for the medial and later shoulder rotators, he was slightly shaking but he could accept the pain and continue till end of the therapy, so PFS had a major effect to stretch the shortened muscles and also improve the range of the motions of the shoulder also, PNF according to Kabat would be another therapy

that had a great range of effects to stretch the muscles during each diagonal but it can be concluded that PFS had more significant effect on the patient case to stretch the shortened muscles comparing to PNF.

Other therapy which had remarkable effect on relaxation of the hypertonic muscles is PIR according to the Lewit this improvement can be observed for some specific muscles in the table below:

3.9.4 Comparison between the final and initial examinations of muscle tone palpation for the right shoulder and forearm

Muscle	Initial	Final
Pectoralis major	**Hyper tone**	**Normal tone**
Pectoralis minor	**Hyper tone**	**Hyper tone only at insertion**
Upper trapezius	**Hyper tone**	**Hyper tone only at insertion**
Latissimus dorsi	**Hyper tone at insertion**	**Normal tone**
Subscapularis	**Hyper tone**	**Normal tone**
Supraspinatus	**Hyper tone at insertion**	**Hyper tone only at insertion**
Pronator quadratus	**Hyper tone**	**Hyper tone**
Pronator teres	**Hyper tone**	**Hyper tone**
Supinator	**Hyper tone**	**Normal tone**
Extensor digitorum	**Hyper tone**	**Normal tone**
Extensor Carpi radialis longus	**Hyper tone**	**Hyper tone only at insertion**
Extensor Carpi radialis brevis	**Hyper tone**	**Normal tone**
Extensor carpi ulnaris	**Hyper tone**	**Normal tone**
Flexor's carpi radialis	**Hyper tone**	**Hyper tone only at insertion**
Flexor carpi ulnaris	**Hyper tone**	**Normal tone**

Table 60: Comparison between the final and initial Muscle tone palpation for the shoulder, and forearm muscles.

It can be concluded the effectivity of the PIR according to Lewit for the muscles such as supinator, pronator, upper trapezius, extensor and flexors of the forearm and internal and external rotators of the shoulders which decreased the hyper tensions and during this therapy patient could collaborate without having pain. One of the most significant improvements which could be observed was in his goniometry examinations according to Janda for the active and passive motions as you can see in the table below:

3.9.5 Comparison between the initial and final examinations of active range of motions of the right upper extremity according to Janda

Initial examination					Final examination	
Shoulder						
S	**5**	**0**	**110**	**35**	**0**	**130**
F	**30**	**0**	//	**60**	**0**	//
T	//	**0**	**10**	//	**0**	**15**
R	**30**	**0**	**30**	**40**	**0**	**70**
Elbow						
S	**0**	**0**	**110**	**0**	**0**	**120**
R	**15**	**0**	**xx**	**30**	**0**	**15**
Wrist						
S	**20**	**0**	**20**	**45**	**0**	**50**
F	**10**	**0**	**10**	**15**	**0**	**25**
MCP II						
S	**10**	**0**	**10**	**15**	**0**	**65**
F	**10**	**0**	**20**	**30**	**0**	**35**
MCP III						
S	**10**	**0**	**20**	**15**	**0**	**60**
F	**5**	**0**	**15**	**30**	**0**	**35**
S	**10**	**0**	**30**	**15**	**0**	**60**
F	**10**	**0**	**10**	**15**	**0**	**40**
S	**25**	**0**	**30**	**35**	**0**	**60**
F	**20**	**0**	**30**	**20**	**0**	**40**

Table 61: Comparison between initial and final active range of motion examination
Xx means it was not possible to provide the test due to the limitation and severe pain

3.9.6 Comparison between the initial and final examinations of passive range of motions of the right upper extremity according to Janda

Initial examination					Final examination	
Shoulder						
S	**10**	**0**	**130**	**50**	**0**	**150**
F	**40**	**0**	//	**75**	**0**	//
T	//	**0**	**15**	//	**0**	**20**
R	**30**	**0**	**35**	**70**	**0**	**90**
Elbow						
S	**0**	**0**	**130**	**0**	**0**	**145**
R	**20**	**0**	**Xx**	**45**	**0**	**25**
Wrist						
S	**20**	**0**	**30**	**65**	**0**	**75**
F	**10**	**0**	**15**	**20**	**0**	**35**
MCP II						
S	**20**	**0**	**35**	**30**	**0**	**75**
F	**15**	**0**	**30**	**35**	**0**	**45**
MCP III						
S	**15**	**0**	**30**	**20**	**0**	**70**
F	**15**	**0**	**25**	**35**	**0**	**45**
MCP IV						
S	**15**	**0**	**35**	**20**	**0**	**75**
F	**15**	**0**	**15**	**30**	**0**	**45**
MCP V						
S	**20**	**0**	**45**	**35**	**0**	**65**
F	**30**	**0**	**35**	**35**	**0**	**55**

Table 62: Comparison between initial and final passive range of motion examination for shoulder, Xx means it was not possible to provide the test due to the limitation and severe pain

According to the both tables above it can be understood that active and passive range of motions had great range of improvement in all the joints of patient right upper extremity such as shoulder, elbow, wrist, MCP and IP which could show the effectiveness of the joint mobilization according to Lewit, PNF according to Kabat and CPM therapies with cooperation of the patient in each session although these improvements were not in optimal range according to Janda but still in the patient case and comparing to initial examination this could be assume as a positive effect of the therapy. This situation also restricted us for mobilization of the wrist joint during palmar and dorsal directions, but in this case, since the mobilization was performed passively patient didn't feel any pain comparing to the PFS technique according to Janda also the constant passive motion can be counted as another therapy which was helpful to increase active and passive range of motions in flexion and abduction of the shoulder but it was less effective to increase the range of motions of supination and pronation of the wrist, especially for active ROM comparing to the passive

motion. Another therapy that I have mentioned above and which was effective to increase range of the motions was PNF according to Kabat, by using strengthening techniques, repeated contractions for the right upper extremity and scapula muscles, the strength of the whole area has been increased and this improvement, had a significant effect on the active ROM specially this has been also reported by the patient every time at the end of the therapy session and it has been mentioned also in the result of each therapy session. During all these therapies such as mobilization of the joints, CPM and PNF patient could perfectly collaborate only having pain while giving resistance to the therapist during strengthening techniques of the PNF with emphasis on his pronator muscles during first and second extensions of the right upper extremity diagonal and supinator muscle during first flexion diagonal. The other prominent change was in his muscle strength examinations which can be compared in the table below.

3.9.3 Comparison between the initial and final examinations of the muscle strength for the right upper extremity

	Initial	Final
Muscle		
Serratus anterior	**3-**	**4+**
Upper trapezius	**4+**	**5**
Middle trapezius	**Xx**	**3**
Lower trapezius	**Xx**	**4+**
Levator scapulae and Rhomboid	**Xx**	**4+**
Latissimus dorsi	**Xx**	**4 shaking**
Medial rotators group test	**3-**	**4-**
Teres major	**Xx**	**4**
Teres minor	**3**	**3+**
Supraspinatus	**3-**	**4**
Infraspinatus	**Xx**	**4**
Pectoralis major upper fibers	**3**	**4**
Pectoralis major lower fibers	**3**	**4**
Pectoralis minor	**4**	**5**
Deltoid	**3+**	**4**
Anterior and posterior deltoid	**3+**	**4+**
Brachioradialis	**4**	**4+**
Coracobrachialis	**4+**	**5**
Triceps brachii	**4+ shaking**	**4+ shaking**
Biceps brachii and brachialis	**4-**	**5**
Supinator	**xx**	**4**

Table 63: comparison of initial and final muscle strength for muscles around scapula, shoulder and forearm

Based on the muscle strength test, significant increase in the strength of the muscles is observed such as supinator, infraspinatus, latissimus dorsi, levator scapulae and rhomboid, middle and lower trapezius that patient could not actively perform the muscle action in the beginning but in final examination he could have performed actively and being tested.

The most appropriate and beneficial therapy which had a great effect to increase the strength of the muscles of the whole right UE is PNF according to Kabat the first and second diagonal with strengthening techniques, of the repetitive contraction which has been applied to the right UE and scapula.

During this technique patient has been told to resist against therapist resistance during all diagonals which he could perfectly collaborate but while resisting against supination and pronation he felt slight pain and shaking but still could manage to finish the therapy till the end of the diagonals. For the PNF of the scapula patient did not feel any pain to resist against the therapist and wide range of the enhancement in ROM was observed there.

Other therapy which has been used for increasing the strength of the right upper extremity muscles with emphasis on infraspinatus and teres minor was electro-gymnastic, to compare this therapy with PNF according to Kabat, I have to say that this therapy had minimum effect to improve the strength of those muscles during this therapy patient was completely passive and he did not feel any pain and he could cooperate with the therapist till end of the session.

As a prognosis it can be predicted that in this patient case his ROM of the right UE will increase during more active and strengthening exercises specially for the pronation of the right forearm, this prognosis is based on the effectivity of the therapies during 10 sessions comparing to the beginning of initial examinations and cooperation of the patient.

In general, there are wide range of improvement in active and passive ROM, strength, fascia and joint play and anthropometric measurements of the whole right upper extremity comparing to the first day of the therapy and it has been observed that the only test which was still impossible for the patient to perform but still improvement was completely clear in the goniometry examination was pronator muscle and pronation action which still made the patient to not be satisfied with it. So, it can be assumed that in general all the therapies were effective and helpful for the patient, but this improvement was less effective on the pronation action.

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5.Supplement

Supplements 1:

Application for approval by UK FTVS Ethics Committee:

Informed consent

University Karlova

Faculty of physical education and sport

José Martího

31, 162 52

Praha 6-Veleslavín

INFORMOVANÝ SOUHL

AS Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, zákonem č. 101/2000 Sb., o ochraně osobních údajů a o změně některých zákonů, ve znění pozdějších předpisů, Helsinskou deklarací, přijatou 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013) a dalšími obecně závaznými právními předpisy Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe na ……., kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření a průběh Vaší terapie bude publikován v rámci bakalářské práce na UK FTVS, s názvem ……

Získané údaje, fotodokumentace, průběh a výsledky terapie budou uveřejněny v bakalářské práci v anonymizované podobě. Osobní data nebudou uvedena a budou uchována v anonymní podobě. V maximální možné míře zabezpečím, aby získaná data nebyla zneužita.

Jméno a příjmení řešitele..... Podpis: .....

Jméno a příjmení osoby, která provedlapoučení.....Podpis: .....

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele. Místo, datum ..... Jméno a příjmení pacienta ..... Podpis pacienta: ..... Jméno a příjmení zákonného zástupce .....…. Vztah zákonného zástupce k pacientovi ..... Podpis: ……

Abbreviations:

Supplements 2:

A

AC**:** Acromioclavicular joint

AROM: Active range of motion

ADL: Active daily living activities

ASIP: Anterior superior iliac spine

C

- C1 – Cervical 1
- C2 – Cervical 2
- C3 – Cervical 3
- C4 – Cervical 4
- C5 – Cervical 5
- C6 – Cervical 6
- C7 – Cervical 7
- C8 – Cervical 8

- C-TH: Cervico thoracic joint
- CPM: Constant passive movement
- CP: Carpomethecarpal joint
- CC: Centimeter

- CMC: Carpometacarpal joint

D

- DIP: Distal interphalangeal joint

E

- EXT: Extension

F

- Fig: Figure
- FLX: Flexion
- F: Frontal plane

G:

- GTO: Golgi tendon organs

H

- Hz: Hertz
- HFC: high frequency current

L

- L: Left
- LFC: Low frequency current

M

- MCP: Metacarpophalangeal
- mA: Milli ampere
- Min: Minutes
- M: Muscle
- MET: Muscle energy technique
- µ: Micro second
- MFC: middle frequency current

- IP**:** Interphalangeal joint

O

- OA: Occupational anamnesis

P

- PNF: Proprioceptive neuromuscular facilitation
- PIR: Post isometric relaxation
- PROM: Passive range of motion
- PIP: Proximal interphalangeal joint
- Pic: Picture
- PFS: Post facilitation stretching
- PSIS: Posterior superior iliac spine
- PA: Personal anamnesis

R

- ROM: Range of motion
- R: Right
- R: Rotation

S

- SFTR: Sagittal frontal transverse rotational
- S: Second
- SC: Sternoclavicular joint
- S: Sagittal plane
- SCM: Sternocleidomastoid muscle

T

- UE: upper extremity
- T: transverse plane
- TENS: transcutaneous electrical nerve stimulation

U

- US: Ultrasound

Supplement 3:

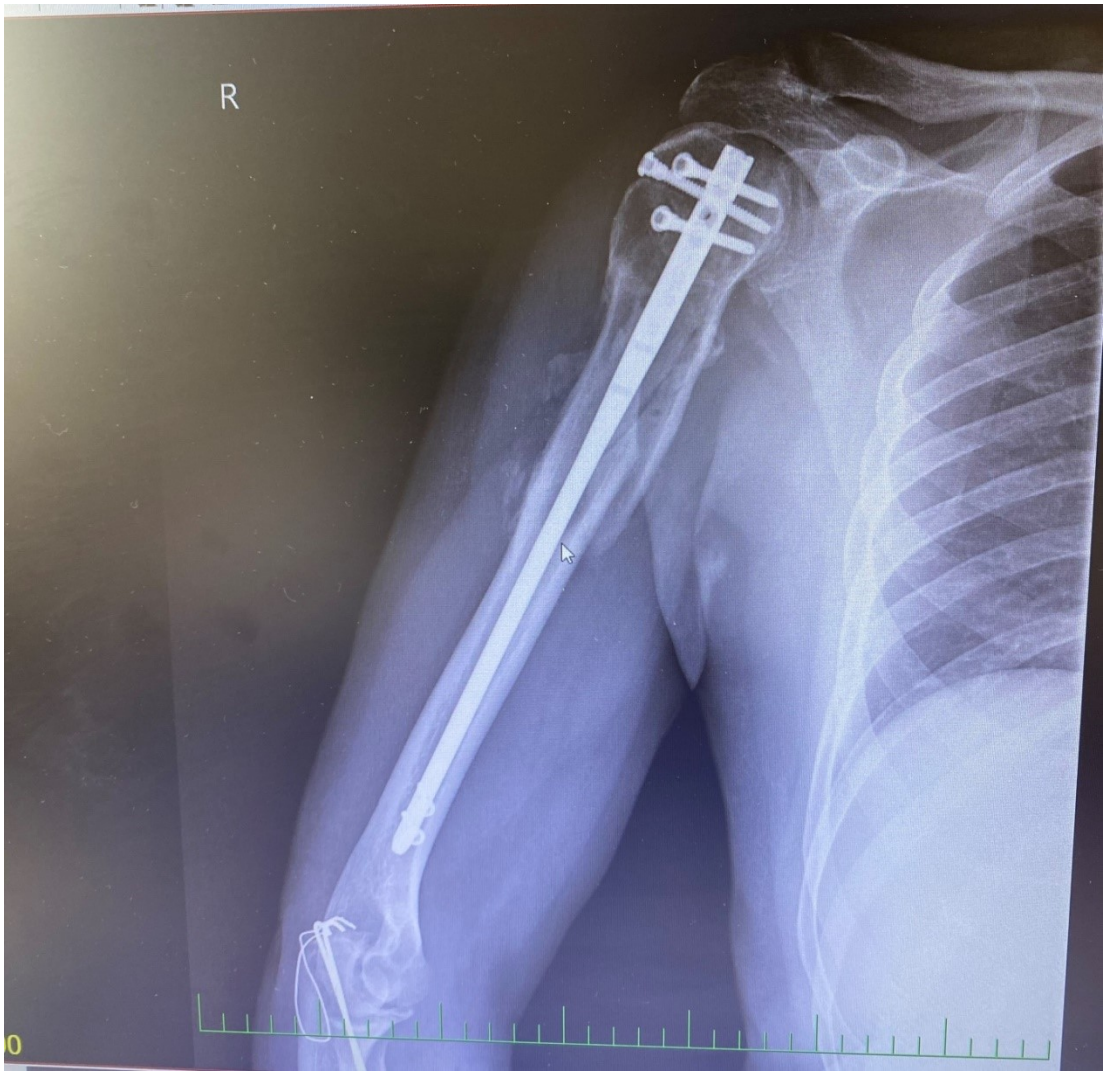
List of tables:

Supplement 4:

List of pictures:

Pic1: X-ray of fracture of proximal humerus on 20.10.2020

Pic2: X-ray of proximal humerus after humeral nail surgery approach and olecranon x-ray after osteosynthesis on 5.01.2021



Pic3: X-ray fracture of distal radius on 05.01.2021 after surgery medial view

Pic4: X-ray fracture of distal radius on 05.01.2021 after surgery frontal view

Supplements 5

Ethics committee approval

CHARLES UNIVERSITY
FACULTY OF PHYSICAL EDUCATION AND SPORT
José Martího 31, 162 52 Prague 6-Veleslavín

I confirm that this project description corresponds to the plan of the project and, in case of any change, especially of the methods used in the project, I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.

In Prague, 14.01.2021 Applicant's signature:

Approval of UK FTVS Ethics Committee

The Committee: Chair: doc. PhDr. Irena Parry Martínková, Ph.D.
Members: prof. PhDr. Pavel Slepička, DrSc.
prof. MUDr. Jan Heller, CSc.
PhDr. Pavel Hrásky, Ph.D.
Mgr. Eva Prokešová, Ph.D.
Mgr. Tomáš Ruda, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 011/2021

Date of approval: 15.1.2021

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.
The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.

UNIVERZITA KARLOVA
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6
– 20 –
Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee