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Case Study of Physiotherapeutic Treatment of a Patient with the Diagnosis of Reverse Shoulder Endoprosthesis.

Bachelor thesis

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Declaration

I, Marek Hroch, hereby declare that I have written this bachelor thesis by myself and cited all of the literature and other information sources I have used while writing my thesis. Neither this thesis nor any of its chapters have been used to achieve different or the same academic degree.

Additionally, I declare that all information, examinations, and therapeutic procedures in this thesis were based on the knowledge I have learned throughout my studies at the Charles University Faculty of Physical Education and Sport and during hospital and clinical work placement practices under the supervision of qualified physiotherapists.

Finally, I declare that all techniques used in the practical part of this paper were non-invasive and that my patient agreed and gave consent for this case study.

Prague, January 2024 Marek Hroch

Abstract

Title: Case Study of Physiotherapeutic Treatment of a Patient with the Diagnosis of Reverse Shoulder Endoprosthesis.

Thesis aim: The theoretical part of this bachelor thesis aims to understand the anatomy, biomechanics, and kinesiology of the shoulder joint and to consider the injury solution by reverse shoulder arthroplasty and subsequent rehabilitation. The practical part then aims to analyze the effect of therapeutic procedures applied to the patient.

Method: The theoretical part of this thesis was completed by literary research on the topic of the shoulder joint and specifically reverse shoulder arthroplasty. The practical part is based on a case study of a patient with this diagnosis. The case study is a product of my clinical work placement in Medicentrum Praha, a.s., where I had the opportunity to work with a patient for 10 consecutive therapeutic units. As part of the practical part of this thesis, a complex entry kinesiological examination was carried out along with a description of day-to-day therapy, a final kinesiological examination, and a subsequent summary and evaluation of the therapeutic effect.

Result: The cooperation between me and the patient lasted for 10 working days. During this time, the patient improved the range of motion in his shoulder joint, increased muscle strength, and gradually became more self-sufficient with the operated extremity. These results show that the therapeutic intervention was effective.

Conclusion: The therapies used were beneficial in the specific diagnosis of the patient.

Key words: shoulder girdle, reverse shoulder arthroplasty, rehabilitation, treatment, case study.

Abstrakt

Název: Kazuistika fyzioterapeutické péče o pacienta po reverzní totální endoprotéze ramenního kloubu.

Cíl práce: Cílem této práce je teoretické zpracování problematiky reverzní náhrady ramenního kloubu a vytvoření kazuistiky fyzioterapeutické péče o pacientku s touto diagnózou, včetně zhodnocení efektu terapie.

Metoda: Teoretická část této práce pojednává o reverzní artroplastice ramenního kloubu, její problematice a následné rehabilitaci. Praktická část je založena na kazuistice pacientky s touto diagnózou. Kazuistika je výsledkem mé klinické stáže v Medicentru Praha, a.s., kde jsem měl možnost pracovat s pacientkou po dobu 10 po sobě jdoucích terapeutických jednotek. Jako součást praktické části této práce bylo provedeno komplexní vstupní kineziologické vyšetření spolu s popisem denní terapie, výstupním kineziologickým vyšetřením a následným shrnutím a hodnocením terapeutického účinku.

Výsledky: Spolupráce mezi mnou a pacientkou trvala přesně 10 pracovních dní. Za tuto dobu pacientka dosáhla zvýšení rozsahu pohybu spolu se zvýšením svalové síly, zmírnění bolesti, a také získání patřičné soběstačnosti po relativně čerstvé operaci. Díky těmto výsledkům lze prokázat, že terapie byly efektivní.

Závěr: Použité terapeutické postupy byly pro pacienta účinné a přínosné.

Klíčová slova: ramenní pletenec, reverzní artroplastika ramene, rehabilitace, léčba, kazuistika.

List of abbreviations and used symbols

AAROM - active assisted range of motion

AC - acromioclavicular

ADL - activities of daily living

AROM - active range of motion

BMI - body mass index

C - cervical

CPM - continuous passive movement

EMG - electromyography

FTVS - Fakulta Tělesné Výchovy a Sportu

Ga-Al-A - gallium aluminum arsenide

L - lumbar

LE - lower extremity

PNF - proprioceptive neuromuscular facilitation

PIR - post-isometric relaxation

PROM - passive range of motion

RSA - reverse shoulder arthroplasty

ROM - range of motion

SC - sternoclavicular

SIAS - spina iliaca anterior superior

SIPS - spina iliaca posterior superior

Th - thoracic

UE - upper extremity

UK - Univerzita Karlova

° - degrees

% - percent

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1. Introduction

Reverse shoulder arthroplasty is a surgical procedure similar to arthroplastic interventions of the hip and knee joints. Although being less common compared to those of the lower extremity, the results of reverse shoulder arthroplasty are promising and the procedure can be used in cases of more severe damage to the shoulder girdle. Post-surgical rehabilitation is absolutely critical with this diagnosis as the shoulder has important functional uses in activities of daily living. Not only that, appropriate physiotherapy can also help the patient with decreasing pain as well as speeding up the recovery process, thus allowing him to return to previous level of function sooner.

The aim of this thesis is to provide an overview of the shoulder girdle, its problematics and related injuries. The theoretical part also includes specific information about shoulder arthroplasty, with emphasis on the reverse shoulder endoprosthesis model. The practical section consists of a case study based on my personal cooperation with a female 76-year-old patient with this diagnosis. This cooperation resulted from my clinical work placement in Medicentrum Praha, a.s., under the supervision of Bc. Vojtěch Oplt between the dates of 8.1.2024 and 7.2.2024.

The patient is a senior woman with the aim to return to her previous level of functioning. Although being less active, she still has responsibilities of taking care of the household, cooking and occasionally looking after her grandchildren. Her condition is arguably one of the more problematic ones as she suffered a critical proximal humerus fracture with the head of the humerus twisting by 180º. Thanks to this, the immobilization period before the surgery was prolonged and the recovery process post-surgery thus became more challenging. The therapeutic interventions used were based on guidelines and tools found in appropriate literature sources. The progress made and challenges faced were summarized in the final sections of this work and the evaluation of the effect of my intervention was discussed as well.

2. Theoretical part

2.1. The shoulder girdle and upper extremity

The shoulder is a complex articulation responsible for connecting the upper extremity with the trunk (Bakhsh & Nicandri, 2018). Functionally, the upper extremities serve as the main manipulation organ of the body, being responsible for fine motor skills, interaction with the environment and self-care. They also play a significant role in social interaction and communication. The shoulder joint, as a root joint of the upper extremity, is thus extremely important because it is responsible for managing the utmost basic needs of an individual as well as allowing his proper interpersonal engagement (Véle, 2006).

2.2. Shoulder anatomy

To begin with, it is important to differentiate between the shoulder joint and shoulder girdle. The shoulder joint is better scientifically known as the glenohumeral joint and consists only of the scapula and humerus. The shoulder girdle, however, consists of the scapula, clavicle, and the proximal humerus and thus encompasses a number of joints, including the glenohumeral joint. Although the difference between them is clear, these two terms still do get easily interchanged among the non-professional public as well as among patients. For reasons described in the upcoming sections of this work, it is clinically more relevant to discuss the shoulder girdle as a whole rather than simply looking at the articulation between the humerus and scapula (Kolář, 2013; Palastanga et al., 2006; Ramponi, 2011).

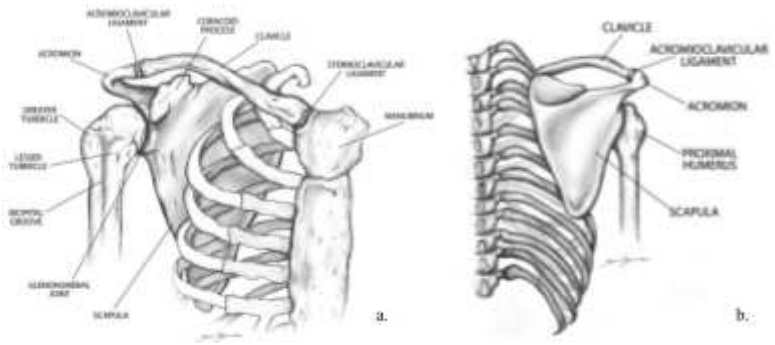

Figure no. 1 - Anatomy of the shoulder girdle; (a.) anterior view (b.) posterior view (Ramponi, 2011)

2.2.1. Bones of the shoulder girdle

As mentioned above, the shoulder girdle is composed of three bones: scapula, clavicle, proximal humerus.

The scapula is a rather large and flat bone located on the posterolateral aspect of the thorax. In its neutral position, it covers the distance between the second and seventh rib, with its spine being on the level of the 3rd thoracic vertebra and its lower angle near the 7th thoracic vertebra. It is held and connected to the thorax strictly by muscles and its lateral position is maintained by the clavicle; this anatomical connection allows great mobility of this bone relative to the thorax and ribs. The costal (anterior) surface is hollowed and relatively smooth, called the subscapular fossa. The posterior surface is divided by the spine of the scapula into two surfaces: supraspinous fossa and infraspinous fossa. All three of these surfaces have key muscular relevance as some muscles of the shoulder girdle originate in these regions. Being shaped triangularly, the scapula also has a superior, medial and lateral border. The place of connection between the superior and medial angle forms the superior angle. Likewise, the inferior angle is formed at the place of connection of the lateral and medial border. The connection between the lateral and superior border, however, is interrupted by three important structures: the glenoid fossa, acromion and coracoid process. These structures are important in terms of joint and connection with other bones of the shoulder girdle (Palastanga et al., 2006).

The clavicle is a subcutaneous bone placed horizontally between the sternum and acromion. It holds the scapula in its lateral position and therefore allows the arm to be independent of the trunk. Its S-shape allows movement of the clavicle around its own axis as well as relatively good force distribution properties - clavicular rotation is approximately 45º. The length of this segment usually reaches between 12 and 15 cm during adulthood (Kolář, 2013).

Finally, the humerus is the largest bone of the shoulder girdle as well as of the upper limb. It articulates with the scapula at its most cranial part where the head of the humerus is located. This structure is smooth, round, faces upwards, medially and posteriorly, and is much greater in surface area than the glenoid fossa which it articulates with. On the lateral aspect of the bone, next to the head, the prominence of the greater tubercle is located - the lesser tubercle is placed more anteriorly and can be

found below the anatomical neck. These two tubercles are then separated by the intertubercular groove, which is, much like the tubercles, also a place of muscle attachment. The bone of the humerus then continues caudally, with the deltoid tuberosity being located approximately in the middle on the anterolateral surface. The caudal part of the bone is then anteriorly completed by the radial fossa, coronoid fossa, the medial and lateral epicondyles and finally the capitulum and trochlea - the articulating surfaces for the radius and ulna. Posteriorly, the humerus finishes by the olecranon fossa, which encloses the olecranon process of the ulna during elbow extension (Palastanga et al., 2006).

2.2.2. Joints and ligaments of the shoulder girdle

Most literature understands the shoulder within four joints - the glenohumeral, sternoclavicular, acromioclavicular and scapulothoracic joints (Yang et al., 2021). However, in his work *Clinical Rehabilitation (2013)* professor Kolář introduces the idea of so-called “true” and “false” joints and includes the subacromial connection as part of the shoulder girdle joint complex. A “true” joint is defined as a normal joint, meaning a place where two bones make contact and interact with one another. A “false” joint, on the other hand, is described as some connection that further increases the mobility of the entire extremity. For this reason, the glenohumeral, acromioclavicular and sternoclavicular joints are defined as “true” joints, while the scapulothoracic joint and subacromial connection are identified as “false” joints (Kolář, 2013).

The glenohumeral joint, also known as the shoulder joint, is a synovial ball-and-socket joint that is made by the articulation of the surfaces of the head of the humerus and glenoid fossa of the scapula. The glenoid fossa is further deepened by the glenoid labrum, which further provides stability and shock-absorption abilities of the otherwise very anatomically unstable joint. The joint capsule is loose and attaches itself to articular margins of both bones with its attachment on the humerus being slightly more caudal. The capsule is then reinforced by three ligaments: superior glenohumeral ligament, middle glenohumeral ligament, and inferior glenohumeral ligament. Superior to them is the transverse humeral ligament, which passes across the intertubercular groove and has a more lateral insertion on the humerus. The arch above the joint is completed by the coracohumeral and coracoacromial ligaments. Unlike in the other “true” joints of the shoulder girdle, the stability of the shoulder joint is maintained

mainly by muscles, especially muscles of the rotator cuff - supraspinatus, infraspinatus, subscapularis, teres minor (Palastanga et al., 2006).

Next, the acromioclavicular (AC) joint connects the clavicle with the shoulder blade; the lateral end of the clavicle is linked with the coracoid process of the scapula via an incomplete intra-articular disc. The acromioclavicular ligament connects the clavicle directly to the acromion. There are further two coracoclavicular ligaments, trapezoid ligament and conoid ligament, which connect the clavicle to the coracoid process of the scapula. The importance of these ligaments is high as mainly the coracoclavicular ligament is responsible for maintaining the stability of this segment (Palastanga et al., 2006).

The last "true" joint of the shoulder girdle is the sternoclavicular (SC) joint which is anatomically a saddle-shaped synovial joint but functionally a ball and socket articulation. It articulates the medial end of the clavicle with the clavicular notch of the sternum and the first costal cartilage. The joint has four ligaments: anterior sternoclavicular, posterior sternoclavicular, interclavicular, and costoclavicular. Much like in the AC joint, most stability is provided also by the ligaments, particularly the costoclavicular ligament (Palastanga et al., 2006).

The scapulothoracic joint, being the first "false" joint of the shoulder girdle, is formed by the connective tissue of the muscles on the anterior side of the scapula and posterior aspect of the chest wall. This connective tissue has functional importance in terms of the physiological gliding of the scapula relative to the thorax (Kolář, 2013). There is no ligamentous attachment of the scapula to the thorax; its position is maintained strictly by atmospheric pressure and axioscapular muscles, including the trapezius, serratus anterior, rhomboid major, rhomboid minor, and levator scapulae (Culham & Peat, 1993).

Finally, the subacromial joint is the second "false" joint of the shoulder girdle. This is the thin connective tissue and bursae making up the space between the inferior aspect of the acromion, the tendons of the rotator cuff, the joint capsule and the inner surface of the deltoid muscle. It provides a cushion for the rotator cuff tendons and is therefore essential for the movement of the subacromial connection (Greenberg, 2014; Kolář, 2013).

2.2.3. Muscles moving the shoulder girdle

The anatomy of shoulder girdle muscles can be described in many ways and the muscles categorized variously. Overall, it could be said that we can differentiate the muscles into two main groups: the ones responsible for stabilizing the scapulothoracic articulation and moving the scapula, and the ones responsible for stabilizing and moving the glenohumeral joint. The muscles can, then, be further categorized based on the motion they carry out - multiple muscles are responsible for the same component of movement at a given sector. With the scapula, there are a total of 6 muscles playing an important role: the trapezius, serratus anterior, levator scapulae, rhomboid major and minor, and the pectoralis minor. The scapula and essentially the whole shoulder girdle can be moved in terms of three planes of motion: protraction - retraction, elevation - depression, lateral rotation - medial rotation. Then there are 8 muscles carrying out the movement in the glenohumeral joint in all planes of motion - frontal, sagittal and transverse. The shoulder complex is, therefore, predominantly made up of 14 muscles. (Crowe & Elhassan, 2016; Palastanga et al., 2006).

To begin with, the muscles responsible for retracting the shoulder girdle include the rhomboid major, rhomboid minor, and the medial and caudal fibers of the trapezius. Out of these three, it is likely trapezius with the greatest relevance; it is exceptionally active during activities involving carrying a heavy load and is also a part of several functional muscle chains that contribute to the appropriate segmental alignment of the head, neck and trunk. Antagonist to these muscles are the serratus anterior and pectoralis major, which protract the shoulder girdle. The first mentioned plays a vital role in stabilizing the scapula during movements of the upper limb while the latter is primarily important in weight bearing the body on the upper limbs. Both can also play a role as accessory inspiratory muscles (Crowe & Elhassan, 2016; Palastanga et al., 2006; Véle, 2006).

Elevation of the shoulder girdle is made possible mainly by the cranial fibers of the trapezius as well as the levator scapulae. Much like the trapezius, the levator scapulae can play a role when carrying load in the hand as it prevents the downward movement of the entire pectoral girdle. Bilateral contraction of both of these muscles then produces extension of the neck while unilateral contractions result in lateral flexion of the cervical spine. Depression of the scapula is mostly a passive process that is

accomplished through the use of gravity. Active scapular depression is impossible as the anatomical structure of the muscle fibers always forces the scapula into retraction rather than strict depression in the craniocaudal direction (Hotta et al., 2020; Palastanga et al., 2006).

Finally, when talking about the shoulder girdle as a whole, medial and lateral rotations are possible. The muscles rotating the pectoral girdle medially include the rhomboid major, rhomboid minor, pectoralis minor and levator scapulae. The combination of the muscle activation that results in the subsequent medial rotation is quite complex: the axis of rotation of this movement is below the spine of the scapula and the pectoralis minor pulls the lateral side of this axis downwards, while the rhomboids and levator scapulae pull the medial side upwards. Lateral rotation of the girdle is made possible by the trapezius and serratus anterior, where the mechanism is more simple: both muscles are positioned so that together they elevate the acromion while moving the inferior angle of the scapula laterally, which causes the glenoid fossa to face more directly upwards. This movement is key in increasing the movement of flexion and abduction of the upper limb (Palastanga et al., 2006).

As mentioned before, the glenohumeral joint is able to carry out movements in all planes of motion and is the most mobile joint in the human body. The humerus in the shoulder is able to carry out flexion, extension, abduction, adduction, rotations as well as horizontal abduction and adduction, all in a relatively large range of motion (Omoumi et al., 2010; Palastanga et al., 2006). For precise values of physiological ranges of motion in given directions, see *Table 1.0*.

First, flexion of the arm at the shoulder joint is made possible by the pectoralis major, the anterior fibers of the deltoid, the long head of the biceps brachii and the coracobrachialis. This is especially true during the first 90º of flexion, at which point the trapezius and serratus anterior also contribute until for the remaining range of motion. At 120º of arm flexion, trunk muscles engage in activity and increased lumbar lordosis and lateral flexion can also be spotted. Arm extension, on the other hand, is made possible by five muscles: the latissimus dorsi, teres major, pectoralis major, deltoid (posterior fibers), and the long head of the triceps brachii. It is logical that the activity of some of these muscles limit the actions of the flexors, although that does not always have to be the case. One prime example of that could be the relationship between the

pectoralis major and latissimus dorsi. These two muscles work together in climbing movements as both of them are used to pull the trunk upwards when the arms are fixed above the head (Palastanga et al., 2006; Véle, 2006).

Abduction of the humerus is provided by the supraspinatus and deltoid, with the emphasis being mostly on the former during the first 45º of movement. The deltoid takes over this effort during the second phase up to 90º, from where movement is always accompanied by a degree of external rotation. Therefore, the muscles of the rotator cuff as well as the trapezius and serratus anterior also engage. Much like with flexion, the final ranges of motion are accompanied by increased lordosis and lateral flexion. Adduction is then facilitated by the coracobrachialis, pectoralis major, latissimus dorsi and teres major. The clinical relevance of these muscles in terms of adduction is, however, limited by the fact that the movement itself is always accompanied by the force of gravity and one therefore seldom has to use greater force to adduct the arm (Kolář, 2013; Palastanga et al., 2006; Véle, 2006).

Rotations are a clinically essential aspect in shoulder problematics as this movement, especially external rotation, is often first affected during some shoulder-related pathology (Cyriax, 1982). Muscles responsible for externally rotating the shoulder include the teres minor, infraspinatus and the posterior fibers of the deltoid. Internal rotation of the shoulder is provided by the subscapularis, teres major, latissimus dorsi, pectoralis major and the anterior fibers of the deltoid. Some of these muscles are of special importance because they belong to the rotator cuff - teres minor, infraspinatus, supraspinatus, and subscapularis. As was mentioned already, the rotator cuff plays an essential role in the stability of the glenohumeral joint; during movements of the head of the humerus in the glenoid fossa, the function of these muscles reduce the sliding and shearing movements that could eventually lead to luxations. Similarly, when, for example, carrying weight, these four muscles brace the head of the humerus against the glenoid fossa (Palastanga et al., 2006).

Finally, the subclavius is an often forgotten muscle of the shoulder girdle but serves a great function as it is responsible for the stabilization of the clavicle. Thanks to its anatomical structure, it acts by pulling the clavicle towards the disc of the sternoclavicular joint and thus depressing the lateral end during shoulder girdle movements. In some humans, approximately 5%, an anomalous similar muscle called

the subclavius posticus runs parallel to the subclavius. Compared to the subclavius, the presence of subclavius posticus can be problematic as it may compress the brachial plexus and can also be involved in the vascular thoracic outlet syndrome (Al-Redouan et al., 2023).

Movement	Physiological range of motion
Flexion	150-170º
Extension	40º
Abduction	180º
Adduction	20-40º
External rotation with 90º arm abduction	90º
Internal rotation with 90º arm abduction	70º
Horizontal abduction	40-50º
Horizontal adduction	130-160º

Table no. 1 - Physiological range of motion in the shoulder (Kolář, 2013)

2.2.4. Nerve supply of the shoulder girdle

The innervation of the shoulder perhaps does not serve a similar clinical relevance as the innervation of more peripheral structures where peripheral paresis are far more common. However, the shoulder girdle is strongly linked with the brachial plexus and pathologies, as well as traumatic incidents, of the shoulder may significantly affect the function and nerve supply of the whole upper extremity (Gutkowska et al., 2018).

The brachial plexus arises from the nerve roots of C5 - Th1 and distally gradually divides into subsequent trunks, divisions, cords, and branches. For the anatomy of the shoulder girdle, the following nerves of the brachial plexus are relevant: suprascapular nerve, medial and lateral pectoral nerves, upper and lower subscapular nerve, axillary nerve and musculocutaneous nerve. The suprascapular nerve gives direct input to the supraspinatus and infraspinatus while the medial and lateral pectoral nerves innervate the pectoralis major and minor. The upper and lower subscapular nerves

facilitate the respective portions of the subscapularis muscle. The axillary nerve then innervates the teres minor, the long head of triceps brachii as well as the deltoid. Finally, the musculocutaneous nerve is responsible for the function of coracobrachialis, biceps brachii and brachialis (Bakhsh & Nicandri, 2018).

2.2.5. Vascular supply of the shoulder girdle

Much like the nerves concerning the shoulder girdle, vascular supply of this structure is key to assessing the effects of injury and subsequent surgical interventions. The main vascular supply of the shoulder is given by the axillary artery, which originates at the border of the 1st rib from the subclavian artery. Its proximal parts are placed more anterior and thus supply the clavicle, acromion, pectoralis muscles and the deltoid. The main branch then gives off three important subsequent branches - the subscapular artery and the anterior and posterior humeral circumflex arteries. The subscapular artery provides supply for the posterior aspect of the shoulder as well as the latissimus dorsi. The posterior humeral circumflex artery supplies the anterior deltoid, shoulder capsule, and the humeral head while the anterior humeral circumflex artery supplies the anterior aspects of the proximal humerus (Padegimas et al., 2017).

2.3. Injuries to the shoulder

With the shoulder being a complex joint with high functional demands, it is not surprising that its injuries are highly prevalent through physicians' offices world wide. It is estimated that the global community prevalence of shoulder pain reaches 16% with a global incidence of 37.8 per 1000 persons each year (Lucas et al., 2022). The etiology may be various - sports participation, traumatic accidents, chronic conditions, degenerative changes can all be a driving factor to experiencing shoulder discomfort in one's life. While chronic shoulder pain is definitely not uncommon among the general population, direct injuries to the shoulder are what requires immediate medical care. For this reason, the following section will focus on the most common orthopedic shoulder injuries.

To begin with, the first common injury to the shoulder girdle are acromioclavicular (AC) injuries. These are usually a result of sports participation with direct trauma to the shoulder - typically in the form of a fall directly on the joint with

the arm in an adducted position. The ligaments responsible for maintaining AC stability then get either sprained, partially torn or completely torn, causing a dislocation of the joint potentially along with some other damage such as joint capsule or deltotrapezial fascia disruption. The injury is rated based on severity using the Rockwood classification from type I (mildest) to type VI (most severe). Acromioclavicular dislocations account for 12% of all dislocations involving the shoulder (Cibulas et al., 2019; Monica et al.. 2016).

Related to acromioclavicular injuries, clavicle fractures are also frequently associated with sports injuries or direct trauma. They make up 2.6% of all fractures in the adult population and are often easily diagnosed as they are almost always accompanied by visible bone deformity or even skin penetration. Injuries to the clavicle should always take into account the examination of the brachial plexus as well as vascular analysis even though such complications are relatively rare. The fractures are then categorized by the Allman classification, which is based on where the fracture of the bone is located. The most common ones are group I fractures which are located in the middle one-third of the clavicle; these account for 80% of all (Kim, 2022; Ramponi & Jo Cerepani, 2021).

Glenohumeral dislocations are perhaps the most well-known of all of these injuries among the general public. The shoulder joint is the most frequently dislocated joint with an incidence of around 25 per 100,000 persons annually (Szyluk et al., 2022). Most of these dislocations are anterior with a common mechanism of high combined forces of abduction, extension and external rotation in the joint. Posterior dislocations are then usually caused by a posteriorly-directed force on a flexed shoulder. Superior and inferior luxations are not that common with a prevalence of less than 1%. Neurovascular assessment should, again, always be assessed as the axillary nerve injury is often associated with glenohumeral dislocations as well as limitation of perfusion. Furthermore, associated rotator cuff injuries also become more probable as patients age - this is further problematic as the stability of the joint decreases even more once the rotator cuff is affected. Bankart and Hill-Sachs lesions are also relevant, especially in cases of multiple shoulder dislocations (Hill & Khodaee, 2022; Omoumi et al., 2010; Rutgers et al., 2022; Saavedra-Islas et al., 2022).

Another common injury resulting from perhaps even more traumatic situations are proximal humerus fractures. Although their prevalence is mainly among the older population, younger patients may also suffer, especially through participation in sports or motor vehicle crashes. In the older population, proximal humerus fractures occur as a result of low-energy falls and are the third most common fracture seen in the elderly population. The rate of damage is categorized by the Neer classification which is based on the number of separated major anatomical segments. The most frequent ones are one-part and two-part fractures, which account for 70% and 20% of all humeral fractures respectively. Subsequently, a complex shoulder examination is necessary to adequately manage such an injury. Rotator cuff injuries are very frequently associated with humerus fractures as well as motor and sensory deficits of the axillary, median, radial and ulnar nerve. Vascular examination is also important with great emphasis being on the axillary as well as the more distal radial artery. Management of this injury is then various with both conservative and surgical approaches, one of which being through the use of reverse shoulder arthroplasty (Monica et al.. 2016; Rudran et al., 2022; Stahl & Fuente, 2016).

Finally, one last common and medically significant injury to the shoulder girdle are rotator cuff tears. Although chronic rotator cuff tears are also common and may even be asymptomatic, acute tears do occur both in the elderly as well as the younger population. Much like in the previously mentioned injuries, rotator cuff tears occur in the adult population by significant trauma such as glenohumeral dislocation or vehicle accidents. However, even a fairly minor injury may cause an acute tear in the elderly, with its prevalence estimated to be more than 10% among people older than 60 years. Unlike the other abovementioned injuries, the diagnosis and classification of rotator cuff tears remains problematic - magnetic resonance imaging as well as ultrasonography serve as the first-line visualization methods but arthroscopic evaluation still remains the benchmark for most accurate diagnosis. This can in turn lead to greater complications as misdiagnosed rotator cuff tears bring the risk of progression, especially in the form of cuff atrophy and subsequently irreversible changes in the structure (Monica et al.. 2016; Plancher et al., 2021; Ryösä et al., 2016).

2.4. Shoulder arthroplasty

2.4.1. History of shoulder arthroplasty

The first attempts to perform some forms of shoulder arthroplasty are most likely linked to the Romanian physician Themistocles Gluck, who worked in Germany in the second half of the 19th century. He spent most of his time treating tuberculosis infections and realized that the use of joint replacements may be one of solutions for his more problematic patients. Gluck then began experimenting with the invention of artificial joints and soon came up with a design of a shoulder endoprosthesis made primarily out of ivory. Evidence of using this design on a living subject, however, was never documented (Gartsman & Edwards, 2008).

Not later after, however, in 1893 the French surgeon Jules Emile Péan recorded the first shoulder replacement on a patient suffering from tuberculosis arthropathy. The artificial joint was designed by J. Porter Michaels, a French dentist, and it consisted of a rubber humeral head boiled in paraffin attached to a platinum shaft by a metal wire. This surgery was, at first, considered successful until approximately 2 years later when it was removed due to recurrent infections (Frankle et al., 2016).

The next more successful attempts to artificially replace the shoulder came in the mid 20th century when Frederick Krueger used a vitallium implant to replace the humeral head of his patient with osteonecrosis. Only 3 years after, Dr. Charles Neer began performing hemiarthroplasty to treat complex proximal humeral fractures and soon became the leading figure of shoulder replacement solutions. In the 1970s, Neer reported the use of shoulder arthroplasty for the treatment of glenohumeral arthritis. This marked the era of the first-generation endoprosthesis, which were then followed by second- and third-generation replacements. The research and development of shoulder arthroplasty accelerated through the years and now provides, with its various forms, solutions to different shoulder pathologies (Gartsman & Edwards, 2008).

2.4.2. Different types of shoulder arthroplasty

To this day, there are overall four main types of shoulder endoprosthesis - total shoulder replacement, stemmed hemiarthroplasty, resurfacing hemiarthroplasty, and reverse total shoulder replacement. The choice of the correct endoprosthesis type is

made by the surgeon and is always dependent on the rate of damage as well as functional demands of the affected shoulder. While some of these joint replacement models may be advised for only mild and very localized damage, such as arthritis of the head of the humerus, others may be rather suitable for multiple injuries occurring in the shoulder at once (Rasmussen et al., 2023).

Beginning with the total shoulder replacement, this procedure involves replacing the humeral head with a metal ball-like structure and the glenoid with a plastic socket. As such, both arthritic joint surfaces are removed and this approach is thus a relatively good solution for degenerative changes in the joint. Some types of post-traumatic proximal humerus fractures are also suitable for this method. However, several studies reported complications with the anatomic shoulder arthroplasty, especially concerning the glenoid component loosening from its attachment and, in turn, causing failure of the joint mechanism. For this reason anatomic total shoulder replacement is often not the choice of preference for surgeons when other methods are also suitable (Castagna & Garofalo, 2018).

The next common approach is shoulder hemiarthroplasty - this means that the surgeon replaces only the head of the humerus, leaving the glenoid untouched. Stemmed hemiarthroplasty is an approach involving the replacement of the humeral head with a metal-ball and stem, much like in the traditional shoulder replacement. This technique is then especially useful when the proximal humerus is severely fractured but the glenoid socket being normal; arthritis involving only the head of the humerus, some serious torn rotator cuff conditions, as well as shoulders with severely weakened proximal bone are also indicated for this method. Resurfacing hemiarthroplasty, on the other hand, is the replacing of the humeral head with a cap-like prosthesis without a stem (see *Figure no. 2*). This approach is beneficial in situations when the glenoid still has an intact cartilage surface, when there are no fresh fractures of the proximal humerus, and also generally when the surgeon aims to preserve as much of the bone as possible (Schultz et al., 2021; Zhang et al., 2020).

Finally, reverse shoulder arthroplasty (RSA) is the approach when the socket and ball are reversed, essentially causing an opposite mechanical interaction of the joint. RSA is an appropriate approach in completely torn rotator cuffs, severe arthritis, proximal humerus fracture, but also in situations when previous methods of shoulder

replacements failed. The precise biomechanics, advantages, indications, contraindications, as well as subsequent rehabilitation after RSA surgery will be described in detail further in this paper (Boudreau et al., 2007).

Figure no. 2 - X-Ray images post (a.) anatomic total shoulder replacement (b.) stemmed hemiarthroplasty (c.) resurfacing hemiarthroplasty
(Weatherby et al., 2021; Zhang et al., 2020)

2.5. Reverse shoulder arthroplasty (RSA)

As has been already mentioned, reverse shoulder arthroplasty provides an alternative approach to the anatomical total shoulder endoprosthesis. As the name suggests, the mechanism of the joint in RSA is turned around, meaning that the artificial joint head is located proximally while the joint socket is peripheral. In practice, this means that the surgeon removes the affected joint surface on the scapula and places the metallic glenoid sphere on the surface of the cavity. After that, a humeral stem is implanted into the proximal humerus with a humeral cap being located in the place of the humeral head (Goetti et al., 2021). A detailed image of this system can be seen in *Figure no. 3*.

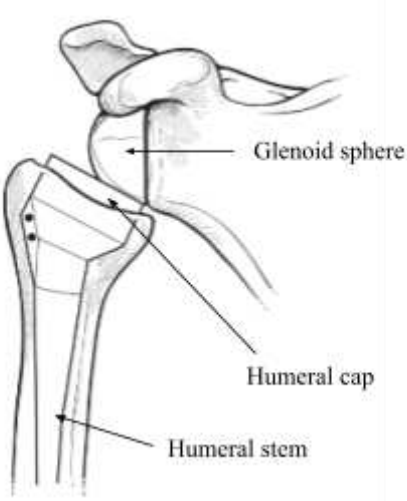

Figure no. 3 - Illustration image of reverse shoulder arthroplasty

(Gartsman & Edwards, 2008)

2.5.1. Biomechanics of RSA

The biomechanics of reverse shoulder arthroplasty bring several benefits compared to the anatomical shoulder endoprosthesis and provide useful measures for some specific conditions. Overall, it can be summed up that the most important advantages of RSA biomechanics are medialization of center of rotation, distalization of the humerus, and consequent muscle force changes due to the endoprosthesis (Goetti et al., 2021).

The medialization of center of rotation allows to change torque forces into compressive forces between the glenoid sphere and humeral cap. This, in turn, provides stability and greater component integration which is especially important in situations when there is complete disruption of the rotator cuff. In fact, it has been proven that RSA designs reduce joint reduction forces in the shoulder by almost 42% of body weight (Goetti et al., 2021).

Distalization of the humerus is another key feature of reverse shoulder arthroplasty and is closely linked to the medialization of the center of rotation. As the RSA is implemented into the body, the humeral insertion of the deltoid has to be distalized from its origin at the acromion. This causes an overall increase in length of the muscle and since the overall tension produced by a muscle is a sum of its resting and active tension, the deltoid is automatically able to produce more torque over the joint. It

has been estimated that the distalization of 1 cm can increase deltoid efficiency by 30% (Frankle et al., 2016).

Finally, in cases when the condition of the rotator cuff is repairable and not excessive, the reverse shoulder arthroplasty is designed to a more lateralized position. This will biomechanically preserve the function of subscapularis and teres major and allow greater motion in the axial plane. Not only that, this modification will significantly increase scapulothoracic participation in range of motion following the surgery, allowing the patient a more functional shoulder (Goetti et al., 2021).

2.5.2. Indications of RSA

As may be evident from the advantages of RSA biomechanics, the indications of this approach are various. Firstly, rotator cuff diseases with and without arthritis are perhaps the most common indication - mainly concerning the elderly population, reverse shoulder endoprosthesis may significantly improve surgery outcome, their subsequent function and quality of life. Patients with rheumatoid arthritis are also very often satisfied with RSA. It is reported that their range of motion improves drastically (more than 60% on average) after the surgery with almost 94% of satisfaction rate. Furthermore, reverse shoulder arthroplasty is very commonly used for acute proximal humerus fractures which has several functional benefits. Probably the main one is that RSA does not require tuberosity healing meaning that less restraints are needed especially in the early postoperative period. Finally, RSA is also frequently used after previously failed shoulder endoprosthesis solutions (Jarrett et al., 2013).

2.5.3. Contraindications of RSA

Contraindications regarding reverse shoulder arthroplasty are mostly similar to those concerning any other orthopedic surgery. The most important one, however, concerns the paralysis of the deltoid and rotator cuff muscles. The reason for this is quite logical as the deltoid is the main muscle working the shoulder after RSA; paralysis of this muscle would mean a completely immobile shoulder. Neuropathic joints are also of great concern although different approaches may be used to resolve such a problem. Apart from that, active or recent infections, debilitating medical status or uncorrectable shoulder instability are also among the most important contraindications. (Kumar & Kelly, 2023)

2.5.4. Complications regarding RSA

Although reverse shoulder arthroplasty has many advantageous outcomes, it is also prone to complications. In fact, the overall complication rate for primary RSA is approximately 15%, while a revision surgery may increase this to 40% (Barco et al., 2016). The most common of complications is the instability of the joint which is likely caused by poor deltoid tension, subscapularis insufficiency, surgeon's malposition of components or generally poor soft tissue support. After that, infection is also highly prevalent and often occurs in older treatment groups with significant medical conditions. Further, scapular notching may result from humeral component impingement and may lead to decreased ROM, strength as well as increased pain. Other complications include nerve palsy, especially of the axillary nerve, loosening of components as well as acromial insufficiency due to the impingement of the humeral head against the acromion (Nicholson et al., 2011; Singhal & Rammohan R, 2018).

2.6. Rehabilitation after reverse shoulder arthroplasty

2.6.1. Preoperative care

Preoperative care preceding reverse shoulder arthroplasty is highly dependent based on the patient's diagnosis and indication for surgery. If, for example, the patient suffers with rheumatoid arthritis, there is no need for fixation or special interventions before the surgery. However, if the cause is traumatic and there is, for example, a proximal humeral fracture, most surgeons immobilize the joint for the time leading up to the surgery. If the indication for surgery is not acute and the patient does not go immediately to surgery after the injury, this time is used for the education of the patient about his condition and the surgery he will undergo. If subsequent rehabilitation is already planned, the patient will also be introduced to the rehabilitation plan as well as to contraindicated movements he will not be able to perform after the surgical intervention (Giacomo, 2016).

2.6.2. Postoperative care - phase 1

The first phase of rehabilitation concerns the first 2-3 weeks after surgical intervention. The goals during this phase are to maintain the integrity of the replaced joint, reducing swelling, minimizing pain, as well as gradually increasing shoulder

passive range of motion. The patient will wear an abduction-type sling during this time. Patients after previously failed shoulder arthroplasty and hence revision surgery may be required to continue the sling for up to 6 weeks. Therapists educate the patient on the positioning of the affected extremity; in supine position, the patient is instructed to support their UE from below to avoid extension and the advice of "always being able to visualize the elbow regardless of the activity" is given. Physiotherapeutic activities then mainly concern swelling management, which is most frequently done by cryotherapy or compression - it is generally recommended to use cryotherapy for the first 72 hours after surgery, then depending on the level of pain. Passive movements of the shoulder are carried out mainly in the scapular plane with elevation as tolerated to 90º and external rotation up to 30º. Submaximal isometric muscle strengthening may also be introduced, specifically concerning the deltoid and periscapular muscles. (Giangarra & Manske, 2018)

2.6.3. Postoperative care - phase 2

The second phase of rehabilitation takes place between the 4th and 6th week after surgery and builds on the habits and principles of the first phase. The goals remain almost identical - protect the surgical repair, minimize pain, manage swelling, increase passive range of motion and improve the active movements in the peripheral joints of the UE. If the surgeon finds it suitable, the sling may be gradually discontinued but carefully so that the patient keeps the upper extremity protected. Manual therapy can now be introduced in terms of scar treatment as the stitches are often extracted during this phase; treatment of the upper trapezius and shoulder stabilizers can also be performed through soft tissue techniques. Passive movements are progressed with the aim to reach 140º of elevation and external rotation to 45º in the scapular plane. Isometric exercises should also be part of day-to-day therapy and palpable muscle contractions should be felt in the scapular musculature (Hagen et al., 2020; Hotta et al., 2020).

2.6.4. Postoperative care - phase 3

The third phase of postoperative care consists of the progression from passive range of motion to active or active-assisted range of motion with initiation of strengthening of primary dynamic shoulder stabilizers. This period occurs from week 6

to 12 and the main goals are to continue the progression of PROM, gradually restore AROM, control pain and inflammation, and continue to protect the surgical site and restrain from any high-demanding activities for the extremity. Passive movement is now used in various positions and not strictly in the scapular plane (except for rotations) while AROM/AAROM is appropriate in the plane of the scapula. Active movements should not be done extensively in case of poor movement stereotypes. Progression in elbow, wrist and hand strengthening should be made and scapulothoracic rhythmic stabilization as well as isotonic exercises for the deltoid and periscapular muscles should also be introduced. Gradual progression should be made into isotonic external and internal rotation exercises in the glenohumeral joint. Cryotherapy may still be used as pain management (Giangarra & Manske, 2018).

2.6.5. Postoperative care - phase 4

The fourth phase of rehabilitation usually starts at the 12th week post-surgery. It is initiated when the patient has appropriate PROM/AROM/AAROM and is able to isotonically activate each portion of the deltoid and periscapular muscles with appropriate mechanics. The main goal here is to enhance the functional use of the upper extremities as well as to improve its general mechanics, muscular strength, power, and endurance. The therapist should introduce resistive exercises for the hand, wrist, elbow and arm; all of these strengthening techniques should be done with low weight but high number of repetitions. For these reasons, this phase could be referred to as the moderate strengthening phase. It is generally recommended not to lift more than 3 kg with the operated arm and sudden pushing and jerking movements of the shoulder should also be limited (Giangarra & Manske, 2018).

2.6.6. Postoperative care - phase 5

The final phase of therapy is a continued home program and is typically introduced at 4 months after surgery. At this point, the patient should demonstrate a functional pain-free shoulder with minimal limitations - it is a general requirement, however, that for the patient to be dispatched from professional physiotherapy, he should achieve 120º of elevation with functional external rotation of 30º. Once he is dispatched, a home exercise program is constructed consisting of continued strength gaining, progression toward a return to functional and recreational activities as well as

enhancement of ADL performance. The patient should always be instructed on the limitations in activities by his surgeon or physical therapist based on the condition. It is generally recommended to not bear more than 6 kg in the affected arm indefinitely to ensure the integrity of the operated shoulder (Giangarra & Manske, 2018).

2.6.7. Prognosis

It has been shown that reverse shoulder arthroplasty improves function, quality of life and satisfaction in patients with a given diagnosis indicated for this surgery. These improvements are associated with reduction of pain as well as functional compensation which results from the intervention (İlyas & Egeli, 2023). The overall rate of return to sport is 79.1% with 71.4% returning to the same level of sporting activity (Davey et al., 2021). Although the RSA implant has an estimated vitality of 6-10 years, the satisfaction rate of patients is approximately 82% at 10-years of follow up (Sheth et al., 2022).

2.7. Up-to-date and evidence-based approaches in rehabilitation

2.7.1. Dry needling for scar treatment

In a recent narrative review of scientific literature by Evgeni Rozenfeld and others (2020), the use of dry needling has been discussed in regard to scar treatment. It has been shown that dry needling of scars is effective not only in the facilitation of the scar healing process but also the reduction of pain and other scar-related symptoms. The authors further also mention that this therapeutic procedure can reduce scar sensitivity as well as facilitate scar mobility. The recommended technique of dry needling is via the "surrounding the dragon" method (see *Figure no. 4*) and it can be especially beneficial to patients with hypertrophic as well as generally painful post-operative scars. As shoulder arthroplasty is a relatively invasive surgery that leaves a long scar, dry needling could, perhaps, be one of the methods of rehabilitation when it comes to scar treatment.

Figure no. 4 - "Surrounding the dragon" method of dry needling scar treatment
(Rozenfeld et al., 2020)

2.7.2. Proprioceptive Neuromuscular Facilitation

Proprioceptive neuromuscular facilitation (PNF) is a renowned, frequently-used therapeutic technique which can be applied to various diagnoses and malfunctions of the locomotor apparatus. Much research has been done on its effect on strength, power output, proprioception and pain-modulation throughout the years. Although literature for its application on post-operative reverse shoulder arthroplasty treatment is limited, several studies were carried out on other diagnosis of shoulder pathologies. One randomized controlled trial from Ping Lin and others (2022) compared the effect of PNF and simple joint mobilization techniques on patients with frozen shoulders. The results showed that patients undergoing PNF treatment had significantly better range of motion compared to the control group (simple joint mobilization) as well as decreased pain (Lin et al., 2022). Several RSA rehabilitation protocols even explicitly mention the use of PNF exercises; Massachusetts General Hospital Sports Medicine, for example, advises to implement upper extremity diagonals at 9 weeks post-op reverse shoulder arthroplasty. However, in the case of RSA, special care has to be taken as some PNF movements may involve the use of contraindicated motion. In such a case, exercises should not be prescribed or should be adapted accordingly.

2.7.3. Laser and light therapy

Laser therapy is one type of physical therapy often prescribed to patients after surgery and generally many types of musculoskeletal conditions. Its effect on pain, the healing process and recovery has been discussed extensively and there are several guidelines for the use of laser therapy in clinical practice (Poděbradský & Vařeka, 1998). In a recent randomized clinical trial by Homa Bahrami and others (2023), the

effect of low-level laser and with Bioptron light therapy on pain and function following total knee arthroplasty has been studied. The low-level laser was set on output parameters of 804 nm, Ga-Al-As semiconductor diodes, a power density of 500 mW, a dosage of 10J per session in 2 points (5J/Point), for 10 seconds. The Bioptron light was set on a 10 minute treatment of 480-3400 nm; 95% polarization; 40 mW/cm2; and 2.4 J/cm2. These procedures were applied for the first 3 days immediately after surgery. The results showed that both physical modalities improved range of motion, decreased pain, as well as opioid consumption (Bahrami et al., 2023). A similar approach could, therefore, be potentially applied to reverse shoulder arthroplasty with the exception of the effect on range of motion as the joint is usually immobilized for the first weeks post-surgery.

2.7.4. Continuous passive motion

Continuous passive motion (CPM) through the use of machines is another physical modality applied during postoperative rehabilitation of the shoulder girdle. In a literature review by Christoph Schulze and others (2021), it has been shown that CPM has overall positive effects on shoulder mobility as well as level of pain in conditions of rotator cuff repair as well as in conservative therapy of shoulder stiffness. Since there is no available literature for reverse shoulder arthroplasty directly, the level of evidence for this diagnosis is discussable. It could be expected, nevertheless, that continuous passive motion through the use of machines at an appropriate time of the recovery process would be beneficial for the patient. This is primarily because passive movements are advised in the early stages of RSA rehabilitation and the use of CPM machines could allow for higher doses of passive motion and in turn further maximize the physiotherapeutic effect.

2.7.5. Codman pendulum exercises

Codman pendulum exercises are perhaps the most common type of exercise found in shoulder rehabilitation protocols. Their main goal is to passively mobilize the glenohumeral joint without damaging the recently repaired tissue in the shoulder (see *Figure no. 5*). Although some literature argues that pendulum exercises depend mainly on truncal movement and produce very little movement in the glenohumeral and scapulothoracic joints (Cunningham et al., 2020), the effect of these exercises on muscle

activation cannot be confuted. In fact, a recent paper studied the electromyographic activation of the rotator cuff and deltoid musculature in several different early-stage shoulder rehabilitation exercises. It has been found that Codman pendulum exercises induce low EMG activity in the muscles; the level of activity when compared to the other exercises, however, is relatively equal (Edwards et al., 2021). For this reason it could be argued that Codman exercises are suitable for reverse shoulder arthroplasty rehabilitation as not only do they gently stretch the soft tissue of the shoulder and allow for gentle mobilization, but also initiate activity in the key muscle groups necessary for post-surgical stability. The initiation of this exercise is recommended within the first days once the immobilizing sling is removed (Giangarra & Manske, 2018).

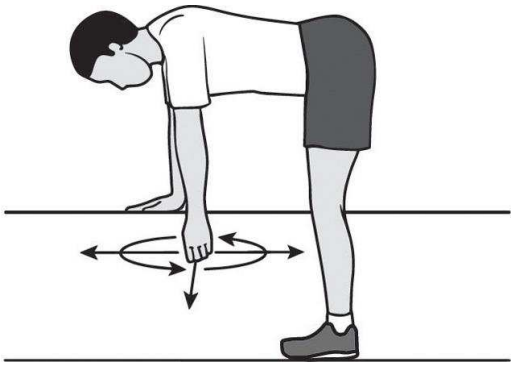

Figure no. 5 - Codman pendulum exercises
(OrthoInfo, 2022)

3. Practical part (case study)

3.1. Methodology

The aim of the practical part of this bachelor thesis is to create a case study of a patient with the diagnosis of reverse shoulder arthroplasty. This case study was carried out between the dates of 8.1.2024 and 7.2.2024 in Medicentrum Praha, a.s., under the supervision of Bc. Vojtěch Oplt.

Before the entry kinesiological examination, the patient was informed about our cooperation in regard to my bachelor thesis and was introduced to all the details about physiotherapeutic examinations and procedures that will be used. The ethics of the research were approved by the head of the Physiotherapy department on 22.1.2024 based on the fulfilled conditions of the Ethical Comitee FTVS UK. The original Application for approval along with a sample of the Informed Consent can be found in the Appendices of this paper.

The initial and final kinesiological examinations took place in a physiotherapeutic ambulance on the premises of Medicentrum Praha, a.s. The individual therapeutic units then took place primarily in the room where the patient was hospitalized. The patient underwent two physiotherapy sessions per day - one with me during the morning, another in the afternoon with one of my colleagues at the workplace. Each therapeutic session took approximately 45 minutes, always depending on the patient's subjective condition and state. The kinesiological examinations took longer and lasted more than 90 minutes each.

The examination procedures used were all based on the ones I was taught during my bachelor studies at the Faculty of Physical Education and Sport and were done under the supervision of Bc. Vojtěch Oplt. The tools used for carrying out the examinations include: a goniometer, a tape measure, a neurological hammer and a therapeutic bed.

The therapeutic interventions were also based on the approaches that I was taught during the three years at the faculty. These include: passive movements, active assisted movements, active movements, soft tissue techniques, soft-ball techniques, joint mobilization, post-isometric relaxation, stretching, analytical muscle

strengthening, trigger point treatment, scar treatment, conditioning exercises, proprioceptive neuromuscular facilitation and developmental kinesiology approaches. The tools used for these techniques included an overball, a wooden stick, the patient's bed, and a gymnastic ladder.

3.2. Anamnesis

Examined person: L.M., female

Year of birth: 1948

Diagnosis: 5 weeks post reverse total shoulder replacement (right) following a proximal fracture of the right humerus.

Status praesens (subjective): The patient is currently 5 weeks after reverse total shoulder replacement (11.12.2023) following a proximal humeral fracture and a 180° turn of the right humeral head. The fracture occurred on 12.11.2023 and the shoulder was immobilized in a medical abduction sling up to the point of surgery. After surgery, movement was further disallowed for 4 weeks and the sling was maintained throughout this time. The patient removed the sling five days ago and is now beginning her rehabilitation process. She feels pain upon movement and palpation of the right shoulder and there is significant restriction of motion in all directions - active movement is almost impossible. When resting, the patient does not complain of pain and does not have difficulties sleeping or carrying out basic tasks that do not involve the affected extremity.

Status praesens (objective): Weight 74 kg; height 159 cm; BMI 29.27; blood pressure 145/75; pulse 85 bpm; body temperature 36.5 °C.

Chief complaint: The patient tripped and fell on a path walk, fracturing the proximal aspect of her right humerus, and the humeral head rotated by 180°. She was immediately taken to the Thomayer's hospital where the shoulder was immobilized and the surgery was planned in the Motol hospital. The shoulder joint was then replaced via a reverse total shoulder endoprosthesis; there were no complications during the surgery.

The patient was then released home for 4 weeks and consequently hospitalized in Medicentrum Praha, a.s. for intensive rehabilitation care. The reason for the hospitalization is decreased muscle strength, poor range of motion, and pain after the surgery.

Family anamnesis: Negative - nothing related to status praesens.

Social anamnesis: Lives in a 3+1 apartment with her husband. Mother of 1 child.

Abusus: Occasionally alcohol, does not smoke.

Occupational anamnesis: Now in pension; used to be a governess.

Allergies: PNC-V, Biseptol, ascorutin.

Pharmacological anamnesis: Orcal 10 mg x-0-0//1. Hydrochlorothiazide 25 mg x0-0// 1/2, vasocardin 50 mg x-0-1//1, atoris 10 mg x-0-1//0, Secatoxin forte 15 drops in the morning, oxazepam 10mg in the afternoon, Aulin 100mg x-0-0//1, Salazopyrin 500mg x-0-3//3.

Interests/hobbies: Occasional walks outside, taking care of the household.

Previous rehabilitation: None

Excerpt from patient's healthcare file (translated to English):

Head: innervation symmetrical, throat without pathological findings, thyroid gland normal, movement of tongue in axis.

Thorax: periodical heart rate, breathing normal

Abdomen: soft and easily palpable, no pain, without pathological resistance

Lower extremities: slight edema, negative Homan's.

Status localis orthpaedicus: scar stabilized, no pain upon movement, ventral flexion 0-30, abduction 0-30. Perfusion and sensitivity are normal.

RTG: not available.

Rehabilitation assessment:

- patient partially independent
- edema and swelling on the operated extremity: none
- hematomas: none
- spasms: none
- range of motion: flexion 0-60, abduction 0-40, internal rotation 0-20, external rotation 0.
- muscle strength: shoulder girdle shows atrophy.

End of excerpt.

X-ray images of the patient's condition:

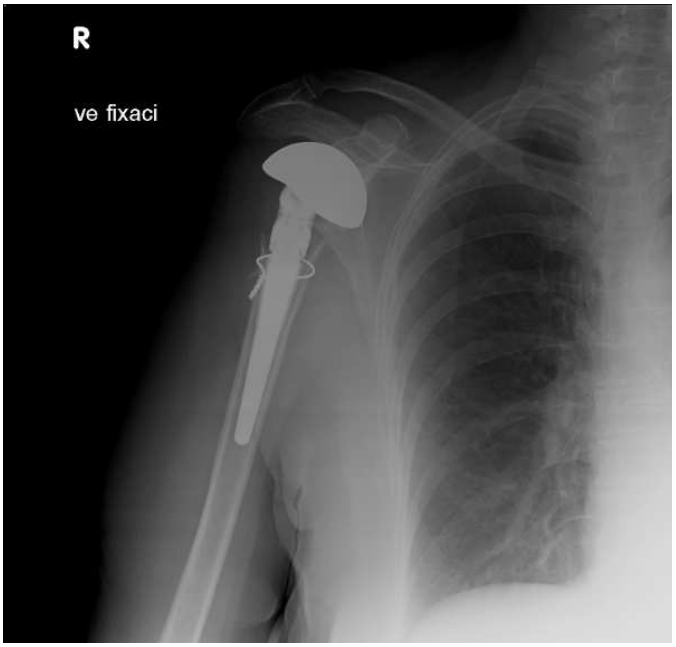

Figure no. 6 - X-ray image of the patient's surgically repaired shoulder via reverse shoulder endoprosthesis

3.3. Initial Kinesiological Examination

The entry kinesiological examination was carried out on the 18th of January 2024 in Medicentrum Praha, a.s.

3.3.1. Static segmental assessment

Front view: The patient has a rather narrow base of support. There is significant valgosity of both knee joints but the level of the knees is equal. The pelvis maintains a neutral position in the frontal plane. The right shoulder is more elevated than the left and the thoraco brachial triangle on the right is narrower than the left. The right upper extremity is held in a flexed position - there is greater flexion of the elbow joint and the hand is in contact with the right thigh. A scar of approximately 15 cm in length is visible on the anterior aspect of the right shoulder; the scar is clean and the skin around it appears to be in greater tension and pulled in the direction of the scar. Below the scar, in the distal parts of the right humerus, noticeable swelling and hematoma appear. There is atrophy of the right m. deltoideus as well as the muscles of the right arm. Both m. trapezius are quite prominent; the right side, however, is more bulging and the head is also leaned more to the right side.

Side view: Both side views show decreased lumbar lordosis but great thoracic kyphosis. The shoulders are bilaterally protracted and elevated and the hematoma on the right upper extremity is also visible from the side view. The head is protracted and almost no curvature is seen in the cervical spine as a result of the shoulder position and activity of m. trapezius.

Back view: The back view confirms the valgosity of both knee joints. The right subgluteal line is higher than the left as well as the right infrascapular line than the left. The right thoraco brachial triangle is narrower than the left and the right upper extremity can be seen in the flexed position from this view as well. The rotator cuff muscle prominence is less on the right scapula compared to the left and there is bilateral scapular abduction. The head remains in a tilted position to the right.

3.3.2. Modified stance assessment

Rhomberg I: negative

Rhomberg II: negative

Rhomberg III: positive; instability and laterolateral deviations.

Vele test: positive

3.3.3. Dynamic spine examination

Forward flexion: The patient is unable to reach the ground with the fingers. The thoracic spine increases its kyphosis but the lumbar spine does not follow and remains straight, i.e. most of the movement is done in the thoracic vertebrae. The head remains extended and does not copy the curvature of the rest of the spine. The patient does not experience any pain during this movement.

Backward extension: Almost no backward extension is achieved by the patient. Firstly, she cannot place her right hand on the posterior aspect of her pelvis due to limited shoulder mobility as well as contraindicated movements. Next, the thoracic spine achieves almost no extension and the lumbar spine overcompensates for the limitation of the segment above. No pain is experienced but the patient clearly is not comfortable throughout this movement and appears less stable as well.

Lateral flexion: Lateral flexion to the left side is greater than to the right. There is no fluent curvature of the spine - the spine rather bends in the region of the Th/L junction and no other movement is visible in the more cranial or caudal parts. The head and cervical spine also do not contribute to the lateral flexion as the axis of the C spine remains neutral throughout the movement.

3.3.4. Gait assessment

The patient walks with a narrow base of support. The length of the steps is small and the pace is relatively short - almost as if she is afraid to walk with every step. There is decreased hip flexion and therefore the heel-strike and toe-off phase is also limited; the patient shuffles her feet along the floor. The arm swing is also limited and the upper extremities do not support the gait; the right upper extremity shows almost no movement as the whole arm remains in a flexed position. The left UE shows some signs of a physiologic arm swing. The head is in a protracted position and the entire body is

flexed forward during walking as the center of gravity appears to be in front of the base of support.

3.3.5. Pelvis palpation

The right iliac crest appears to be higher than the left. This is further confirmed by the position of the SIAS as the right one is also higher than the left - the position of the SIPS also validates this fact. From these findings, there is a clear lateral tilt of the pelvis noticeable upon palpation.

3.3.6. Spinal distances

Distance	Result
Thomayer	20 cm
Schober	2.5 cm
Stibor	7 cm
Čepojev	1.5 cm
Otto	Flexion: 1.5 cm Extension: 1 cm
Fleche Fostier	0 cm
Lateroflexion	Right: 10 cm Left: 11 cm

Table no. 1 - Spinal distances examination (initial kinesiological examination)

3.3.7. Anthropometric measurements

Upper extremity lengths		
Measurement	Right	Left
Upper extremity length	69 cm	69 cm
Length of humerus	28 cm	28 cm
Length of forearm	23 cm	23 cm
Length of hand	17 cm	17 cm
Upper extremity circumferences		

Measurement	Right	Left
Humerus relaxed	27 cm	30 cm
Humerus flexed	28 cm	30 cm
Elbow	27 cm	29 cm
Wrist	19 cm	19 cm
Metacarpals	20 cm	20 cm
Fingers	17 cm	17 cm

Table no. 2 - Anthropometric measurements (initial kinesiological examination)

3.3.8. Goniometric measurements

Shoulder joint				
Plane	Right		Left	
	Active	Passive	Active	Passive
S	X-0-10	X-0-30	35-0-165	40-0-170
F	20-0-0	45-0-0	160-0-0	170-0-0
T	X-0-X	X-0-X	10-0-100	20-0-105
R	X-0-25	X-0-30	60-0-50	75-0-75
Elbow joint				
Plane	Right		Left	
	Active	Passive	Active	Passive
S	20-30-100	10-30-110	5-30-115	0-30-120
Radioulnar joint (forearm)				
Plane	Right		Left	
	Active	Passive	Active	Passive
R	75-0-50	80-0-70	75-0-60	80-0-70
Wrist joint				
Plane	Right		Left	
	Active	Passive	Active	Passive

S	60-0-50	65-0-60	60-0-50	65-0-60
T	10-0-10	10-0-10	10-0-10	10-0-10

Table no. 3 - Goniometric measurements of the upper extremities (initial kinesiological examination)

X - contraindicated movement.

3.3.9. Muscle length test according to Janda

Muscle group	**According to Janda** **(right / left)**
M. Pectoralis major	X / Grade 1
M. Trapezius	Grade 2 / Grade 2
M. Levator scapulae	Grade 2 / Grade 2
M. Sternocleidomastoideus	Grade 1 / Grade 1

Table no. 4 - Muscle length test (initial kinesiological examination)

X - contraindicated movement

3.3.10. Non-specific muscle strength test

The following table shows a representation of a non-specific muscle strength test based on the analytical movements in each joint. It has been inspired by the muscle strength test according to Janda; rated identically on a scale 1-5.

Shoulder joint		
Movement	Right	Left
Flexion	1	4+
Extension	*X*	4+
Abduction	1	4+
External rotation	*X*	4
Internal rotation	2	4
Horizontal abduction	*X*	4
Extension in abduction	*X*	4
Elbow joint		

Movement	Right	Left
Flexion	3	4+
Extension	3	4
Forearm		
Movement	Right	Left
Supination	3	4
Pronation	3	4
Wrist joint		
Movement	Right	Left
Flexion	3+	4
Extension	3	4
Radial duction	3	3+
Ulnar duction	3	3+

Table no. 5 - Muscle strength test (initial kinesiological examination)

X - contraindicated movement

3.3.11. Isometric strength assessment according to Lewit

Movement	Right	Left
Flexion of shoulder via biceps brachii caput longum	No pain	No pain
Abduction	No pain	No pain
External rotation	*X*	No pain
Internal rotation	No pain	No pain

Table no. 6 - Isometric strength assessment (initial kinesiological examination)

X - contraindicated movement

3.3.12. Examination of reflex changes

Scar: The scar is located on the anterior aspect of the cranial part of the right humerus. It is approximately 15 cm long and has a physiological color. The stitches were

removed, the scar is clean and there are no remaining blood clots in the area. Upon palpation, the scar is immobile throughout its whole length and especially in the cranial part. The skin is dragged inward and there is a strong barrier felt when trying to drag the scar into all directions. The skin cannot be moved independently without the subskin and fascia; the scar is 'glued' deeply into the tissue.

Skin: The skin of the right upper extremity in the area of the scar is considerably less mobile than on the contralateral hand. It is also warm upon palpation which is further confirmed by the visible swelling in the caudal parts of the right humerus. There is also lack of mobility of the skin about the right pectoral muscle group, right deltoid and right trapezius.

Subskin: Decreased subskin mobility in the area of the right shoulder and humerus. The subskin in the area of the scar sticks to the skin and fascia - the layers cannot be separated. When compared to the left upper extremity, the contralateral hand seems physiological.

Fascia: Pathological barrier on the right pectoral fascia, right fasciae of the humerus, shoulder joint and elbow. Decreased fascial movement also in both trapezius as well as in the thoracodorsal regions.

Muscles: Trigger points and muscle hypertonicity found in the right m. pectoralis major (horizontal and caudal fibers), right m. pectoralis minor, right m. subscapularis, right m. latissimus dorsi, right m. infraspinatus, right m. supraspinatus and right m. teres major et minor. Significant muscle hypotonus of the right m. deltoideus (all fibers), right m. biceps brachii and right m. triceps brachii. Bilateral hypertonicity of m. trapezius and m. levator scapulae. Pain upon palpation in the region of the insertion of m. biceps brachii caput longum as well as in the region of the right subaxillar muscle group.

3.3.13. Joint play assessment according to Lewit

Joint	Direction	Right	Left
Glenohumeral	Ventro-dorsal	X	Physiological
	Latero-lateral	X	Physiological

	Caudal	X	Physiological
Sternoclavicular	Ventro-dorsal	Blocked	Blocked
	Craniocaudal	Blocked	Blocked
Acromioclavicular	Ventro-dorsal	Blocked	Blocked
	Caudal	Blocked	Blocked
Humeroulnar (medial springing)	Medial	Blocked	Physiological
Humeroradial (lateral springing)	Lateral	Blocked	Physiological
Radioulnar (distally)	Dorso-palmar	Blocked	Blocked
Radiocarpal	Dorsal	Blocked	Blocked
Carpometacarpal	Palmar	Blocked	Blocked

Table no. 7 - Joint play assessment (initial kinesiological examination)

X - contraindicated movement

3.3.14. Hand grip test according to Novák

Grip	Result	
	Left hand	Right hand
Pinch (štipec)	2	2
Pincer (špetka)	2	2
Lateral grip (klíčový)	2	2
Spherical (kulový)	2	2
Hook (háček)	2	2
Cylinder (válcový)	2	2

Table no. 8 - Hand grip testing (initial kinesiological examination)

3.3.15. Neurological examination

Deep Tendon Reflexes		
Reflex	Left	Right
Upper extremity - bicipital	Physiological	Physiological

Upper extremity - tricipital	Physiological	Physiological
Upper extremity - flexor	Physiological	Physiological

Table no. 9 - Examination of deep tendon reflexes (initial kinesiological examination)

The following superficial sensation tests have been done in all dermatomes of both upper extremities. The deep sensation testing was carried out in the elbow joint, wrist joint and metacarpophalangeal joints.

Superficial sensation testing		
Test	Left	Right
Tactile sensation	Physiological	Physiological
Temperature sense	Physiological	Physiological
Nociception	Physiological	Physiological
Deep sensation testing		
Test	Left	Right
Position sense	Physiological	Physiological
Movement sense	Physiological	Physiological

Table no. 10 - Sensation examination (initial kinesiological examination)

Testing of stereognosis: without pathological findings.

3.3.16. Examination conclusion

The kinesiological examination above corresponds with the patient's diagnosis. Although she is now allowed to carry out active movements in the shoulder joint (except for contraindicated movements), the entire joint is still heavily limited and the post-operative condition is noticeable.

To begin with, the static segmental assessment showed that the patient is still holding the operated upper extremity in the flexed position; it is almost as if she was still used to wearing the sling and did not want to extend it into a neutral normal position. Both shoulder joints are held in a protracted position as well. Apart from that, the operated region still shows signs of swelling underneath the scar - this is further confirmed by the anthropometric measurements, which showed greater circumferences

in the area of the biceps and elbow on the right upper extremity. The skin around the scar appears to be in higher tension and dragged inward. This was then also visible during the scar assessment, which also showed decreased mobility of the skin, subskin and fascia of the entire region, suggesting that the scar is still in the 'acute' stage and will need great care to mobilize it.

Goniometric measurements showed that the operated shoulder joint itself is extremely immobile both in the active and passive movements. The patient was not able to achieve almost any active movement in the direction of flexion and abduction; this, however, coincides with the recovery stage of the patient as she is at the very start of her rehabilitation. The low mobility of the joint also corresponds to the decreased muscle strength. The right shoulder joint movement strength was almost all graded on level 1, the elbow was slightly stronger graded on level 3 and the wrist is relatively normal compared to the contralateral hand.

Further muscle assessment showed that the patient also has hypertonic as well as shortened muscles. There is bilateral shortness of m. trapezius, m. sternocleidomastoideus, and m. levator scapulae and all of these muscles are undoubtedly connected to the patient's diagnosis. There is further hypertonicity of the right rotator cuff muscles, pectoralis major, as well as the right axillary muscle fold: another typical finding in patients post shoulder replacement surgery. As expected, there was also evident atrophy of the m. deltoideus, m. biceps brachii and m. trapezius, which is, again, quite usual in this condition.

Joint play assessment is also another point of specific interest in this condition. Almost all joints of the right shoulder girdle and right upper extremity showed joint blockages. This, again, could be expected as the shoulder was immobilized for a prolonged period of time (almost 5 weeks) and there was thus almost no movement allowed in these joints.

Finally, neurological examination showed no pathological findings and the hand-grip testing was also normal. This is a positive result as it shows that no nerve roots or endings were damaged during the patient's traumatic injury or subsequent surgery. Based on this conclusion, we can overall say that the patient's therapeutic plan will be mainly based on joint mobility, muscle strength and muscle energy adjustment rather than neurological rehabilitation. Although there were relatively a lot of

pathological findings in the kinesiological examination, all of these findings are, as mentioned, normal and it can be expected that they will be resolved throughout the therapeutic process.

3.4. Short-term and long-term rehabilitation plans

Based on the initial kinesiological examination, the following plans and goals were set up.

3.4.1. Short-term rehabilitation plan

- Reduce swelling in the area of the right shoulder joint and operated region
- Improve scar mobility
- Improve fascia flexibility in the surrounding regions of the operated joint
- Affect hypertonic/hypotonic muscle activity
- Increase range of motion in the right shoulder, elbow and wrist joint
- Increase muscle strength
- Affect joint blockages and improve joint play
- Increase shoulder stability; joint centration
- Reeducation of movement stereotypes.

3.4.2. Long-term rehabilitation plan

- Restore or maximize range of motion
- Improve posture during stance and movement
- Re-education of movement stereotypes within the context of activities of daily living
- Fall prevention.

3.5. Day-to-day therapy

3.5.1. Individual physiotherapy no.1 (18.1.2024)

Status praesens:

- *Subjective*: patient claims to feel nervous before our first session. She is very careful about her shoulder and fears the pain that may come with physiotherapy.
- *Objective:* patient holds the right upper extremity in a flexed position. There is almost no active movement allowed by the joint. Edema and swelling persists in the area of the operated region.

Goal of today's therapeutic unit:

- Carry out entry kinesiological examination.
- Reduce swelling in the area of the right shoulder joint and around the scar.
- Increase fascia flexibility.
- Increase passive range of motion in the right shoulder joint

Proposed therapy for today's unit:

- Anamnesis of the patient
- Kinesiological examination
- Soft-ball techniques
- Soft tissue techniques
- Passive movements

Procedure (description of therapy unit):

- Patient asked about medical history, including family history, pharmacological needs, and previous injuries.
- Kinesiological examination carried out with emphasis on the current diagnosis of the patient and possibly related pathologies.
- Soft-ball techniques (according to Jebavá) of the whole right upper extremity with greater emphasis on the swollen regions - patient supine.
- Soft tissue techniques on the pectoral fascia in the latero-medial direction and cranio-caudal direction - patient supine. Further soft tissue treatment on the scar tissue via Kibler's fold and scar stretching treatment - patient supine.

- Passive movements of the shoulder joint into flexion and abduction (patient supine):
    - Flexion of maximum 50º degrees achieved - 2 sets of 15 repetitions.
    - Abduction of maximum 75º achieved - 2 sets of 15 repetitions.

Result of therapeutic unit:

- Anamnesis and kinesiological examination successfully carried out with good cooperation with the patient (see anamnesis and kinesiological examination above).
- Increased flexibility of fascia in the pectoral region.
- Increased soft tissue mobility in the region of the operated shoulder and around the scar.
- Decreased resistance during passive movements into flexion and abduction.
- Increased pain upon palpation after soft-tissue techniques; scar is still relatively painful and soft-tissue techniques irritate this nociception.

3.5.2. Individual physiotherapy no.2 (19.1.2024)

Status praesens:

- *Subjective*: patient claims to be looking forward to our session. No significant subjective changes from yesterday.
- *Objective:* identical to previous therapeutic session - patient holds the right upper extremity in a flexed position. There is almost no active movement allowed by the joint. Edema and swelling persists in the area of the operated region.

Goal of today's therapeutic unit:

- Reduce swelling in the area of the right shoulder joint and around the scar
- Improve scar mobility
- Release trigger points in hypertonic muscles
- Increase passive and active range of motion
- Release joint blockages
- Increase muscle strength and adjust scapula and shoulder girdle position by muscle activation.

Proposed therapy for today's unit:

- Soft-ball techniques
- Soft tissue techniques
- Trigger point treatment by acupressure
- Mobilization of the scapula
- Passive movements
- Isometric muscle strengthening
- Active-assisted movements

Procedure (description of therapy unit):

- Soft-ball techniques (according to Jebavá) of the whole right upper extremity with greater emphasis on the swollen regions - patient supine.
- Soft tissue techniques on the skin, subskin and fascia of the scar; scar treatment and stretching - patient supine.
- Trigger point treatment via acupressure of the horizontal and vertical fibers of the m. pectoralis major, anterior and posterior fibers of the m. deltoideus, muscle fibers of the m. subclavius, m. trapezius (cranial part), m. biceps brachii (caput longum et caput breve), m. subscapularis - patient supine. Further trigger point treatment via acupressure of the muscle fibers of m. infraspinatus, m. teres major, m. latissimus dorsi and mm. rhomboidei - patient prone.
- Mobilization of the scapula via passive PNF diagonals with decreased emphasis on anterior elevation (due to contraindicated movement).
- Passive movements of the shoulder joint into flexion and abduction (patient supine):
    - Flexion of maximum 50º degrees achieved - 3 sets of 12 repetitions.
    - Abduction of maximum 75º achieved - 3 sets of 12 repetitions.
- Isometric muscle strengthening:
    - Elbow flexion with the forearm supinated (patient supine) - 1 set of 8 repetitions
    - Elbow flexion with the forearm in neutral position (patient supine) - 1 set of 8 repetitions
    - Elbow flexion with the forearm in pronation (patient supine) - 1 set of 8 repetitions
    - Shoulder abduction (patient supine) - 1 sets of 10 repetitions

- Active-assisted movements:
    - Shoulder flexion (patient supine) - 1 set of 10 repetitions
    - Scapula depression (patient supine) - 1 set of 10 repetitions

Result of therapeutic unit:

- Increased soft tissue mobility in the region of the operated shoulder and around the scar.
- Release of palpable trigger points in the region of the m. pectoralis major, m. trapezius and m. biceps brachii. Still noticeable trigger points in the m. infraspinatus, m. teres major, m. latissimus dorsi, m. subscapularis.
- Decreased end-feel barrier through passive movements - the barrier released during exercise and more range of motion was allowed gradually.
- Increase of visible muscle engagement in the isometric muscle activation of shoulder abduction.
- Scapula and shoulder girdle still in a protracted and elevated position; without improvement.

3.5.3. Individual physiotherapy no.3 (22.1.2024)

Status praesens:

- *Subjective*: patient claims that the shoulder was tired after our last therapy. However, she claims to have made some progress during the weekend in terms of range of motion.
- *Objective:* swelling and edema around and under the operated region decreased since our last session. The upper extremity is still held in a flexed position. The shoulder girdle is still protracted and elevated.

Goal of today's therapeutic unit:

- Improve scar mobility
- Improve fascia flexibility
- Release trigger points in hypertonic muscles
- Increase passive and active range of motion
- Improve postural position of the scapula and shoulder girdle
- Implement self-therapy exercises

Proposed therapy for today's unit:

- Soft tissue techniques
- Trigger point treatment via acupressure
- Trigger point treatment via stretching
- Mobilization of the scapula
- Passive movements
- Proprioceptive neuromuscular facilitation (PNF)
- Self-therapy education

Procedure (description of therapy unit):

- Soft tissue techniques on the skin, subskin and fascia of the scar; scar treatment and stretching - patient supine.
- Stretching of the pectoral fascia in the latero-medial direction and cranio-caudal direction - patient supine.
- Trigger point treatment via acupressure of the horizontal and vertical fibers of the m. pectoralis major, anterior and posterior fibers of the m. deltoideus, muscle fibers of the m. subclavius, m. trapezius (cranial part), m. biceps brachii (caput longum et caput breve), m. subscapularis - patient supine. Further trigger point treatment via acupressure of the muscle fibers of m. infraspinatus, m. teres major, m. latissimus dorsi and mm. rhomboidei - patient prone.
- Further stretching of the right m. pectoralis major by using the allowed shoulder abduction and slight rotation - patient supine. Bilateral stretching of the m. trapezius by lateroflexion of the cervical spine and fixation of contralateral shoulder - patient supine.
- Mobilization of the scapula via passive PNF diagonals with decreased emphasis on anterior elevation (due to contraindicated movement).
- Passive movements in accordance with PNF diagonals:
    - First flexion diagonal - 3 sets of 15 repetitions
    - Second flexion diagonal with decreased external rotation - 3 sets of 15 repetitions
- Active-assisted movements in accordance with PNF diagonals with greater emphasis on scapular movement and position:
    - First flexion diagonal - 4 sets of 5 repetitions
    - Second flexion diagonal - 4 sets of 5 repetitions

- Self-therapy education:
    - Assisted shoulder flexion while holding a stick: patient lies supine and holds a stick with both hands on either side. She then raises the stick to 50º of shoulder flexion. While most of the movement is carried out thanks to the force exerted by the left upper extremity, the patient was instructed to engage the muscles of her right upper extremity as much as possible.
        - The exercise was instructed to be carried out twice-a-day for 2 sets of 10 repetitions until instructed to discontinue.

Result of therapeutic unit:

- Decreased soft-tissue resistance in and around the scar; however with increased redness of this region.
- Release of palpable trigger points in the region of the m. pectoralis major, m. trapezius and m. biceps brachii. Still noticeable trigger points in the m. infraspinatus, m. teres major, m. latissimus dorsi, m. subscapularis.
- Improved end-feel barrier throughout passive PNF exercises; the movement gradually became more fluent and there was a slight increase in range of motion while carrying out the technique.
- Improved scapular mobility.
- Improved scapular position; caudalization of scapula was taught through the active-assisted PNF movements and there was a subsequent improvement of the postural positioning of the scapula after the therapy.
- Increased muscle co-activity through active-assisted PNF exercises.
- Subjectively, the patient considered the PNF exercises difficult but no pain was experienced throughout the therapy.

3.5.4. Individual physiotherapy no.4 (23.1.2024)

Status praesens:

- *Subjective*: patient sees no difference between yesterday's and today's condition of the shoulder.
- *Objective:* no significant difference from previous therapeutic unit; upper extremity is still held in a flexed position, scapula and shoulder girdle is still elevated and protracted.

Goal of today's therapeutic unit:

- Improve scar mobility
- Improve fascia flexibility
- Release trigger points in hypertonic muscles
- Increase passive and active range of motion
- Improve postural position of the scapula and shoulder girdle

Proposed therapy for today's unit:

- Soft-ball techniques
- Trigger point treatment via acupressure
- Trigger point treatment via stretching
- Mobilization of the scapula
- Passive movements
- Proprioceptive neuromuscular facilitation (PNF)

Procedure (description of therapy unit):

- Soft-ball techniques (according to Jebavá) of the whole right upper extremity with greater emphasis on the swollen regions - patient supine.
- Soft tissue techniques on the skin, subskin and fascia of the scar; scar treatment and stretching - patient supine.
- Trigger point treatment via acupressure of the horizontal and vertical fibers of the m. pectoralis major, anterior and posterior fibers of the m. deltoideus, muscle fibers of the m. subclavius, m. trapezius (cranial part), m. biceps brachii (caput longum et caput breve), m. subscapularis - patient supine.
- Further stretching of the right m. pectoralis major by using the allowed shoulder abduction and slight rotation - patient supine. Bilateral stretching of the m. trapezius by lateroflexion of the cervical spine and fixation of contralateral shoulder - patient supine.
- Mobilization of the scapula via passive PNF diagonals with decreased emphasis on anterior elevation (due to contraindicated movement).
- Passive movements in accordance with PNF diagonals:
    - First flexion diagonal - 3 sets of 15 repetitions

    - Second flexion diagonal with decreased external rotation - 3 sets of 15 repetitions
- Active-assisted movements in accordance with PNF diagonals with greater emphasis on scapular movement and position:
    - First flexion diagonal - 4 sets of 5 repetitions
    - Second flexion diagonal - 4 sets of 5 repetitions

Result of therapeutic unit:

- Decreased soft-tissue resistance in and around the scar; however with increased redness of this region.
- Release of palpable trigger points in the region of the m. pectoralis major, m. trapezius and m. biceps brachii.
- Improved scapular mobility.
- Increased muscle-coactivity throughout the PNF movements and the patient was today, compared to yesterday, able to provide more force to assist the diagonal movements.

3.5.5. Individual physiotherapy no.5 (24.1.2024)

Status praesens:

- *Subjective*: patient sees no difference in condition from yesterday. She is in a good mood and asks for, if possible, a change in exercises to make her rehabilitation more diverse.
- *Objective:* improvement in swelling and decrease in size of the hematoma under the patient's operated shoulder. No other significant changes noticeable.

Goal of today's therapeutic unit:

- Increase passive and active range of motion
- Increase mobility of the scapula and thorax
- Increase muscle strength
- Improve joint centration

Proposed therapy for today's unit:

- Passive and active-assisted movements
- Scapula mobilization

- Muscle strengthening in closed kinematic chains
- Joint centration and postural education in different kinesiological positions

Procedure (description of therapy unit):

- Passive movements of the shoulder joint into flexion and abduction (patient supine):
    - Flexion of maximum 80º degrees achieved - 3 sets of 10 repetitions.
    - Abduction of maximum 90º achieved - 3 sets of 10 repetitions.
- Mobilization of the scapula via passive PNF diagonals with decreased emphasis on anterior elevation (due to contraindicated movement). Gradually implementing active-assisted movement.
- Standing with arms leaning on the bed: patient was instructed to stand next to the bed and place her arms on it to support her (almost as if in a push-up position). She was told to bear some weight on the upper extremities so that it is tolerable for the operated shoulder. Proper position of the upper extremity and scapula was then educated: slight external rotation of the shoulder joint, slight flexion in the elbow, weight equally distributed through the arms and, most importantly, scapula caudalization and centration of the whole shoulder girdle.
    - This was repeated in 3 sets of approximately 20 second holds.
- Arm support with gentle movement: the patient was instructed to achieve the same position as in the previous exercise with the same emphasis on the educated position of the upper extremities. She was then told to take a step away from the arms, thus increasing flexion in the shoulder joints. The repetition was completed by taking a step back towards the bed.
    - This was repeated in 3 sets of 6 reps.
- Ladder walks: the patient was instructed to stand in front of a gymnastic ladder and place her both arms on the level of the ladder which is tolerable by the operated arm. She was then instructed to lift the operated arm a level higher with the help of her healthy upper extremity and hold in that position. This was repeated until the patient could not reach a higher level with the operated arm.
    - This exercise was carried out twice.
- Ladder flexion: the patient was instructed to stand in front of a gymnastic ladder and place both arms on the level of the ladder which is tolerable by the operated

arm. She was then instructed to step back and carry out forward flexion of the trunk, thus increasing flexion in the shoulder joints.

- This was repeated for 2 sets of 10 repetitions.

Result of therapeutic unit:

- As mentioned in the procedure, passive flexion and abduction were allowed to 80º and 90º respectively, which shows great improvement.
- At the start, the patient had significant difficulty holding the shoulder girdle in the correct position when performing the 'standing with arms leaning on the bed' exercise. After repeated correction and a couple of repetitions, this was improved.
- Greater muscle activity of the shoulder girdle muscles in a static and support position; joint centration.
- Increased passive range of motion in the 'ladder flexion' exercise - the patient was able to carry out greater trunk flexion with each repetition.

3.5.6. Individual physiotherapy no.6 (25.1.2024)

Status praesens:

- *Subjective*: patient claims she feels more tired today. She says that the shoulder is more painful from this morning and claims it might be caused by yesterday's different and perhaps more difficult form of exercise. However, she wants to continue with this form of therapy.
- *Objective:* No significant changes from our last session.

Goal of today's therapeutic unit:

- Improve scar mobility
- Release trigger points in hypertonic muscles
- Improve fascia flexibility
- Increase active and passive range of motion
- Remove joint blockages

Proposed therapy for today's unit:

- Soft tissue techniques
- Scar treatment

- Trigger point treatment via acupressure
- Trigger point treatment via stretching
- Active, active-assisted and passive movements
- Mobilization techniques

Procedure (description of therapy unit):

- Soft tissue techniques on the skin, subskin and fascia of the scar; scar treatment and stretching - patient supine.
- Stretching of the pectoral fascia (bilaterally) - patient supine.
- Trigger point treatment via acupressure of the horizontal and vertical fibers of the right m. pectoralis major, anterior and posterior fibers of the m. deltoideus, muscle fibers of the m. subclavius, m. trapezius (cranial part), m. biceps brachii (caput longum et caput breve), m. subscapularis - patient supine. Further trigger point treatment via acupressure of the muscle fibers of m. infraspinatus, m. teres major, m. latissimus dorsi and mm. rhomboidei - patient prone.
- Further stretching of the right m. pectoralis major by using the allowed shoulder abduction and slight rotation - patient supine. Bilateral stretching of the m. trapezius by lateroflexion of the cervical spine and fixation of contralateral shoulder - patient supine. Stretching of the external rotators of the right shoulder girdle by forward protraction and gravity-induced traction - patient prone and right upper extremity freely hanging off of the bed.
- Mobilization of the scapula according to Lewit - unspecific mobilization of the scapulothoracic junction by the use of scapula movement with patient side-lying. Further mobilization of the sternoclavicular joint - according to Lewit. Mobilization of the sternocostal joints using breathing - patient supine.
- Passive movements into flexion with PIR relaxation at the edge of the barrier to gradually increase range of motion.
- Isometric holds with support of the right upper extremity in 85º flexion with gradual introduction of rhythmic stabilization.
- Active movements of the elbow and forearm:
    - Flexion of the elbow (patient supine) with forearm supination - 1 set of 12 reps.
    - Flexion of the elbow (patient supine) with forearm pronation - 1 set of 12 reps.

    - Flexion of the elbow (patient supine) with forearm in neutral position - 1 set of 12 reps.
- Active-assisted movements of the shoulder joint:
    - Shoulder flexion (patient supine) - 3 set of 8 repetitions
    - Shoulder abduction (patient supine) - 3 sets of 8 repetitions

Result of therapeutic unit:

- Release of restricted soft tissues of the scar and surroundings - increased mobility of the scar in all directions.
- Increased redness of the tissue surrounding the scar as a result of the soft-tissue techniques; still noticeable pain upon palpation.
- Release of palpable trigger points in the region of the m. pectoralis major, m. trapezius and m. biceps brachii. Decreased tonus of these muscles, including the external rotators of the shoulder joint.
- Release of joint blockages in the scapulothoracic region, sternoclavicular joint and increase joint play in the sternocostal joints.
- Increase muscle coactivity of the shoulder-supporting muscles and visible increase of muscle activity especially of m. biceps brachii and m. deltoideus.

3.5.7. Individual physiotherapy no.7 (26.1.2024)

Status praesens:

- *Subjective*: patient feels more rested today. She claims that yesterday's more passive therapy was welcomed.
- *Objective:* Soft tissues around the scar seem less restricted today. The patient is gradually moving away from the flexed posture of the right upper extremity although it still is significant. The size of the hematoma under the scar decreased again and the arm seems less swollen.

Goal of today's therapeutic unit:

- Increase active range of motion
- Decrease tonus of hypertonic muscles
- Remove joint blockages and increase mobility of given segments
- Increase muscle strength
- Improve joint centration

Proposed therapy for today's unit:

- Active and active-assisted movements
- Proprioceptive Neuromuscular Facilitation (PNF)
- Mobilization according to Lewit and nonspecific mobilization
- Muscle strengthening
- Joint centration

Procedure (description of therapy unit):

- Passive muscle stretching of the right m. pectoralis major by shoulder abduction and slight external rotation as tolerated by the patient and respecting the contraindications of the reverse shoulder prosthesis - patient supine. Further stretching of the muscles of the right axilla by shoulder abduction gently over 90º - patient supine. Stretching of m. trapezius bilaterally - patient supine.
- Unspecific mobilization of the shoulder girdle and scapulothoracic junction - according to Lewit. Further unspecific mobilization of the sternocostal joints with the use of breathing.
- Active and active-assisted movements into (patient supine):
    - Active-assisted shoulder flexion to 90º - 3 sets of 10 reps.
    - Active shoulder abduction to 90º - 3 sets of 10 reps.
- Proprioceptive Neuromuscular Facilitation (PNF) diagonals on upper extremity:
    - Active-assisted first flexion and first extension diagonal (to the limit or contraindicated movement of the shoulder joint) - 3 sets of 7 reps.
    - Active-assisted second flexion and second extension diagonal (to the limit or contraindicated movement of the shoulder joint) - 3 sets of 7 reps.
- Proprioceptive Neuromuscular Facilitation (PNF) diagonals on scapula:
    - Active-assisted posterior depression - 3 sets of 10 reps.
- Muscle strengthening by using concentric contractions against therapist's resistance:
    - Elbow flexion with forearm supination - 2 sets of 8 reps.
    - Elbow flexion with forearm in neutral position - 2 sets of 8 reps.
    - Elbow extension - 2 sets of 8 reps.
- Isometric muscle strengthening:

    - Isometric contractions into shoulder abduction - 2 sets of 10 reps.
    - Isometric contractions into shoulder external rotation - 2 sets of 7 reps.
    - Isometric contractions into shoulder internal rotation - 2 sets of 7 reps.
- Standing with arms leaning on the bed: patient was instructed to stand next to the bed and place her arms on it to support her (almost as if in a push-up position). She was told to bear some weight on the upper extremities so that it is tolerable for the operated shoulder. Proper position of the upper extremity and scapula was then educated: slight external rotation of the shoulder joint, slight flexion in the elbow, weight equally distributed through the arms and, most importantly, scapula caudalization and centration of the whole shoulder girdle.
    - This was repeated in 3 sets of approximately 25 second holds.
- Arm support with gentle movement: the patient was instructed to achieve the same position as in the previous exercise with the same emphasis on the educated position of the upper extremities. She was then told to take a step away from the arms, thus increasing flexion in the shoulder joints. The repetition was completed by taking a step back towards the bed.
    - This was repeated in 3 sets of 6 reps.

Result of therapeutic unit:

- Decreased tonus of hypertonic muscles, especially of m. pectoralis major and the muscles under the axilla.
- Improved scapulothoracic mobility of the right scapula.
- Gradual increase of muscle co-activation during shoulder flexion, as well as PNF upper extremity diagonals.
- Improved position of the shoulder girdle and caudalization of the right scapula as a result of PNF scapular posterior depression exercises - improved joint sensation.
- Subjectively there was an increase in pain of the shoulder; the patient, however, describes it as muscular pain, suggesting it is simply due to muscle soreness.

3.5.8. Individual physiotherapy no.8 (29.1.2024)

Status praesens:

- *Subjective*: the patient was allowed to go home for the weekend and claims that the condition of her shoulder has slightly improved. She says that she was not

able to fully engage the right upper extremity in ADL activities over the weekend (such as cooking) but that she tried to use it as much as possible.

- *Objective:* Significant improvement over the weekend - hematoma under the scar is no longer present, almost no swelling around the shoulder and decreased resistance of the soft tissues around the scar. Increased active movement of shoulder flexion - now able to do 30º while lying supine. Still notable muscle hypertonicity around the shoulder (especially m. pectoralis major) and persistence of trigger points.

Goal of today's therapeutic unit:

- Improve scar mobility
- Release trigger points in hypertonic muscles
- Improve active range of motion
- Increase muscle strength
- Improve joint centration
- Improve postural position of shoulder girdle

Proposed therapy for today's unit:

- Soft tissue techniques and scar treatment
- Treatment of trigger points via acupressure
- Treatment of trigger points via passive stretching
- Muscle strengthening exercises
- Proprioceptive Neuromuscular Facilitation
- Muscle strengthening in closed kinematic chains
- Joint centration and postural education in different kinesiological positions

Procedure (description of therapy unit):

- Soft tissue techniques on the skin, subskin and fascia of the scar; scar treatment and stretching - patient supine.
- Trigger point treatment via acupressure of the horizontal and vertical fibers of the right m. pectoralis major, anterior and posterior fibers of the m. deltoideus, muscle fibers of the m. subclavius, m. trapezius (cranial part), m. biceps brachii (caput longum et caput breve), m. subscapularis - patient supine. Further trigger

point treatment via acupressure of the muscle fibers of m. infraspinatus, m. teres major, m. latissimus dorsi and mm. rhomboidei - patient prone.

- Passive muscle stretching of the right m. pectoralis major by shoulder abduction and slight external rotation as tolerated by the patient and respecting the contraindications of the reverse shoulder prosthesis - patient supine. Further stretching of the muscles of the right axilla by shoulder abduction gently over 90º - patient supine. Stretching of m. trapezius bilaterally - patient supine.
- Active and active-assisted movements into (patient supine):
    - Active-assisted shoulder flexion to 90º - 3 sets of 10 reps.
    - Active shoulder abduction to 90º - 3 sets of 10 reps.
- Proprioceptive Neuromuscular Facilitation (PNF) diagonals on upper extremity:
    - Active-assisted first flexion and first extension diagonal (to the limit or contraindicated movement of the shoulder joint) - 3 sets of 7 reps.
    - Active-assisted second flexion and second extension diagonal (to the limit or contraindicated movement of the shoulder joint) - 3 sets of 7 reps.
- Muscle strengthening by using concentric contractions against therapist's resistance:
    - Elbow flexion with forearm supination - 2 sets of 8 reps.
    - Elbow flexion with forearm in neutral position - 2 sets of 8 reps.
    - Elbow extension - 2 sets of 8 reps.
- Isometric muscle strengthening:
    - Isometric contractions into shoulder abduction - 2 sets of 10 reps.
    - Isometric contractions into shoulder external rotation - 2 sets of 7 reps.
    - Isometric contractions into shoulder internal rotation - 2 sets of 7 reps.
- Standing with arms leaning on the bed: patient was instructed to stand next to the bed and place her arms on it to support her (almost as if in a push-up position). She was told to bear some weight on the upper extremities so that it is tolerable for the operated shoulder. Proper position of the upper extremity and scapula was then educated: slight external rotation of the shoulder joint, slight flexion in the elbow, weight equally distributed through the arms and, most importantly, scapula caudalization and centration of the whole shoulder girdle.
    - This was repeated in 3 sets of approximately 25 second holds.

- Arm support with gentle movement: the patient was instructed to achieve the same position as in the previous exercise with the same emphasis on the educated position of the upper extremities. She was then told to take a step away from the arms, thus increasing flexion in the shoulder joints. The repetition was completed by taking a step back towards the bed.
    - This was repeated in 3 sets of 8 reps.
- Ladder flexion: the patient was instructed to stand in front of a gymnastic ladder and place both arms on the level of the ladder which is tolerable by the operated arm. She was then instructed to step back and carry out forward flexion of the trunk, thus increasing flexion in the shoulder joints.
    - This was repeated for 2 sets of 10 repetitions.

Result of therapeutic unit:

- Decreased resistance of soft tissues of the scar and surrounding regions.
- Increased pain upon palpation of the scar - objectively an increase in skin temperature in the region of the scar.
- Release of palpable trigger points in the region of the m. pectoralis major, m. trapezius and m. biceps brachii. Decreased tonus of these muscles, including the external rotators of the shoulder joint.
- Gradual increase of muscle co-activation during shoulder flexion, as well as PNF upper extremity diagonals.
- Increased muscle coactivity and joint centration in closed kinetic chain exercises - scapula is now caudalized and there is an overall improvement in postural position of the right shoulder girdle.
- Gradual decrease of muscle strength during isometric exercises as a result of muscle soreness.
- Greater support and weight-toleration on the affected arm during the closed kinetic chain exercises - increased in strength and stability.

3.5.9. Individual physiotherapy no.9 (30.1.2024)

Status praesens:

- *Subjective*: the patient claims that there is no difference subjectively from yesterday.
- *Objective:* no significant changes since our last therapeutic unit.

Goal of today's therapeutic unit:

- Improve scar mobility
- Release trigger points in hypertonic muscles
- Improve active range of motion
- Increase muscle strength
- Improve joint centration
- Improve postural position of shoulder girdle

Proposed therapy for today's unit:

- Soft tissue techniques and scar treatment
- Treatment of trigger points via passive stretching
- Muscle strengthening exercises
- Proprioceptive Neuromuscular Facilitation
- Muscle strengthening in closed kinematic chains

Procedure (description of therapy unit):

- Soft tissue techniques on the skin, subskin and fascia of the scar; scar treatment and stretching - patient supine.
- Passive muscle stretching of the right m. pectoralis major by shoulder abduction and slight external rotation as tolerated by the patient and respecting the contraindications of the reverse shoulder prosthesis - patient supine. Further stretching of the muscles of the right axilla by shoulder abduction gently over 90º - patient supine. Stretching of m. trapezius bilaterally - patient supine.
- Proprioceptive Neuromuscular Facilitation (PNF) diagonals on upper extremity:
    - Active-assisted first flexion and first extension diagonal (to the limit or contraindicated movement of the shoulder joint) - 3 sets of 8 reps.
    - Active-assisted second flexion and second extension diagonal (to the limit or contraindicated movement of the shoulder joint) - 3 sets of 8 reps.
- Muscle strengthening by concentric and eccentric contractions while holding a 1 kg dumbbell:
    - Elbow flexion with forearm supinated - 2 sets of 10 reps.
    - Elbow flexion with forearm pronated - 2 sets of 10 reps.

- Isometric muscle strengthening:
    - Isometric contractions into shoulder abduction - 1 set of 10 reps.
    - Isometric contractions into shoulder external rotation - 2 sets of 7 reps.
    - Isometric contractions into shoulder internal rotation - 2 sets of 7 reps.
- Shoulder flexion with towel - the patient was sitting in front of a normal kitchen table with her right elbow resting on it. She was then instructed to hold the proper position of the shoulder girdle with emphasis on scapula caudalization and retraction (i.e. posterior depression). By this, proper joint centration was achieved. The patient was then instructed to move her hand forward along the table by dragging the towel on the surface and back while keeping the shoulder girdle and scapula in the proper position.
    - This was done in 3 sets of 6 repetitions.
- Assisted shoulder flexion while holding a stick - we used the previously prescribed home therapy of the assisted shoulder flexion while holding a stick. We, however, modified this exercise today so that the patient is sitting and thus the force of gravity is much higher on the shoulder.
    - This was done in 3 sets of 8 repetitions.

Result of therapeutic unit:

- Subjectively, the patient was satisfied with implementing the 1 kg dumbbell in the exercise today as she feels she is making more progress with the elbow flexion exercises.
- Decrease of muscle tonus in hypertonic muscles, especially of m. pectoralis major and m. trapezius - the patient also complained of greater stiffness in the right m. trapezius.
- Improved shoulder girdle position during the ‘shoulder flexion with towel’ exercise by proper caudalization of scapula and posterior depression of shoulder girdle.
- Gradual increase of range of motion during the assisted shoulder flexion exercise.
- Decreased resistance of soft tissue around the scar - increased mobility of the scar.
- Subjectively, the patient considered the exercise today very exhausting and she also seemed very tired after we finished.

3.5.10 Individual physiotherapy no.10 (31.1.2024)

Status praesens:

- *Subjective*: patient still feels tired and sore after yesterday's unit. She asks for a less demanding session today. I agree.
- *Objective:* no significant changes since our last session. Perhaps only that now the right upper extremity seems to be held in a more neutral position and that the patient is gradually moving away from the flexed posture of the right arm.

Goal of today's therapeutic unit:

- Improve scar mobility
- Release trigger points in hypertonic muscles
- Stretching of shortened muscle groups
- Improve fascia flexibility
- Increase range of motion
- Remove joint blockages

Proposed therapy for today's unit:

- Soft tissue techniques and scar treatment
- Trigger point treatment via acupressure
- Muscle stretching
- Fascia treatment
- Passive and active movements
- Mobilization techniques

Procedure (description of therapy unit):

- Soft tissue techniques and massage of the scar and the surrounding tissue. Application of pressure on the scar throughout its whole length.
- Passive muscle stretching of the right m. pectoralis major by shoulder abduction and slight external rotation as tolerated by the patient and respecting the contraindications of the reverse shoulder prosthesis - patient supine. Further stretching of the muscles of the right axilla by shoulder abduction gently over 90º - patient supine. Stretching of m. trapezius bilaterally - patient supine. Stretching of the external rotators of the right shoulder girdle by forward

protraction and gravity-induced traction - patient prone and right upper extremity freely hanging off of the bed.

- Trigger point treatment via acupressure of the horizontal and vertical fibers of the right m. pectoralis major, anterior and posterior fibers of the m. deltoideus, muscle fibers of the m. subclavius, m. trapezius (cranial part), m. biceps brachii (caput longum et caput breve), m. subscapularis - patient supine. Further trigger point treatment via acupressure of the muscle fibers of m. infraspinatus, m. teres major, m. latissimus dorsi and mm. rhomboidei - patient prone.
- Fascia stretching and release of the pectoral fascia, thoracolumbar fascia and fascia of the scapula.
- Mobilization of the scapula and scapulothoracic junction by nonspecific movements of the scapula while side-lying on the left side. Further mobilization of the sternoclavicular joint, according to Lewit, and nonspecific mobilization of the cervical spine into lateroflexion (patient supine).
- Passive movements into flexion, abduction, and slight horizontal adduction with emphasis on release of the end-barrier. Post-isometric relaxation was implemented at the final ranges of motion to help release these barriers.
- Active movements into flexion and abduction with the patient lying supine with assistance in reaching the greater ranges of motion of flexion.

Result of therapeutic unit:

- Decreased resistance of scar and surrounding soft tissues.
- Increased redness of scar and surrounding soft tissues along with increased pain on palpation in the direct region of the scar.
- Release of trigger points and muscle relaxation of hypertonic muscles, especially m. subscapularis, m. infraspinatus, m. trapezius, m. pectoralis major and m. biceps brachii.
- Decreased fascia resistance in the pectoral, thoracolumbar and scapular region.
- Improved ‘joint-play’ in the thoracolumbar junction, sternoclavicular joint and improved springing in the cervical spine into lateroflexion.
- Improved range of motion by post-isometric relaxation at the barrier into flexion, abduction, and horizontal adduction.

3.6. Final Kinesiological Examination

The final kinesiological examination was carried out on 1.2.2024, one day after our final therapeutic unit.

3.6.1 Static segmental assessment

Front view: No significant changes in the lower portion of the patient's body - the patient still has a very narrow base of support and knee valgosity. The upper body still shows asymmetry in the thoraco brachial triangle; the right one is narrower than the left. Further, the right shoulder is higher in position than the left, being held in an elevated and protracted position. Both upper extremities are physiologically placed along the trunk of the patient's body. The right m. deltoideus and muscles surrounding the right shoulder are less trophic than the contralateral side and both m. trapezius are bulging.

Side view: Both side views still show decreased lumbar lordosis and increased thoracic kyphosis. The right shoulder shows a more protracted position compared to the contralateral side and the head remains in a forward-shifted position as well.

Back view: The back view confirms the findings of the front view - the thoraco brachial triangles are asymmetric and the right shoulder is held in an elevated position when compared to the left. Rotator cuff muscles and muscle prominence around the right scapula still shows signs of atrophy.

3.6.2. Modified stance assessment

Rhomberg I: negative
Rhomberg II: negative
Rhomberg III: positive; instability and laterolateral deviations.
Vele test: positive

3.6.3. Dynamic spine examination

Forward flexion:

- The patient is unable to reach the ground with the fingers.
- Thoracic spine increases its kyphosis but the lumbar spine does not follow and remains straight.

- Head remains extended and does not copy the curvature of the rest of the spine.

Backward extension:

- Almost no extension achieved by the patient.
- Patient is unable to place her right arm behind her back as this is a contraindicated movement.
- No fluency of vertebral movement visible.

Lateral flexion:

- Lateral flexion to the left side is clearly greater than to the right.
- No fluent curvature of the spine - the spine only bends in the region of the Th/L junction.

3.6.4. Gait assessment

The patient walks with a narrow base of support with decreased hip flexion in the step-forward phase. This limits the heel-strike and toe-off parts of the movements and the patient still seems to shuffle her feet along the floor. Arm swing of the left upper extremity is physiological; the right one, however, is limited and there is almost no movement of the arms when walking. The physiological rotations of the trunk when walking are barely visible and the patient maintains a kyphotic position of the thorax even during the gait.

3.6.5 Pelvis palpation

The right iliac crest is higher than the left as well as the right SIAS is higher than the left. The positions of SIPS also confirm this finding; thus lateral pelvic tilt to the left is present.

3.6.6. Spinal distances

Test	Result
Thomayer	24 cm
Schober	2.5 cm
Stibor	6 cm
Čepojev	1.5 cm

Otto	Flexion: 1 cm Extension: 1 cm
Fleche Fostier	0 cm
Lateroflexion	Right: 11 cm Left: 11 cm

Table no. 11 - Spinal distances examination (final kinesiological examination)

3.6.7. Anthropometric measurements

Upper extremity lengths		
Measurement	Right	Left
Upper extremity length	69 cm	69 cm
Length of humerus	28 cm	28 cm
Length of forearm	23 cm	23 cm
Length of hand	17 cm	17 cm
Upper extremity circumferences		
Measurement	Right	Left
Humerus relaxed	30 cm	31 cm
Humerus flexed	32 cm	33 cm
Elbow	28 cm	28 cm
Wrist	19 cm	19 cm
Metacarpals	20 cm	20 cm
Fingers	17 cm	17 cm

Table no. 12 - Anthropometric measurements (final kinesiological examination)

3.6.8. Goniometric measurements

Shoulder joint				
Plane	Right		Left	
	Active	Passive	Active	Passive
S	X-0-30	X-0-85	35-0-165	40-0-170

F	90-0-0	100-0-0	160-0-0	170-0-0
T	X-0-X	X-0-X	10-0-100	20-0-105
R	X-0-25	X-0-30	60-0-50	75-0-75
Elbow joint				
Plane	Right		Left	
	Active	Passive	Active	Passive
S	5-30-100	0-30-110	5-30-115	0-30-120
T	75-0-50	80-0-70	75-0-60	80-0-70
Wrist joint				
Plane	Right		Left	
	Active	Passive	Active	Passive
S	60-0-50	65-0-60	60-0-50	65-0-60
T	10-0-10	10-0-10	10-0-10	10-0-10

Table no. 13 - Goniometric measurements of the upper extremities (final kinesiological examination)

3.6.9. Muscle length test according to Janda

Muscle group	**According to Janda** **(right / left)**
M. Pectoralis major	X / Grade 1
M. Trapezius	Grade 2 / Grade 2
M. Levator scapulae	Grade 2 / Grade 2
M. Sternocleidomastoideus	Grade 1 / Grade 1

Table no. 14 - Muscle length test (final kinesiological examination)

X - Modified position respecting the permitted and tolerable movement in the shoulder joint.

3.6.10. Non-specific muscle strength test

The following table shows a representation of a non-specific muscle strength test based on the analytical movements in each joint. It has been inspired by the muscle strength test according to Janda; rated identically on a scale 1-5.

Shoulder joint		
Movement	Right	Left
Flexion	3	4+
Extension	*X*	4+
Abduction	3	4+
External rotation	*X*	4
Internal rotation	3	4
Horizontal abduction	*X*	4
Extension in abduction	*X*	4
Elbow joint		
Movement	Right	Left
Flexion	4	4+
Extension	4	4
Forearm		
Movement	Right	Left
Supination	4	4
Pronation	4	4
Wrist joint		
Movement	Right	Left
Flexion	4	4
Extension	4	4
Radial duction	4	4
Ulnar duction	3	4

Table no. 15 - Muscle strength test (final kinesiological examination)

X - contraindicated movement

3.6.11. Isometric strength assessment according to Lewit

Movement	Right	Left
Flexion of shoulder via biceps brachii caput longum	No pain	No pain
Abduction	No pain	No pain
External rotation	*X*	No pain
Internal rotation	No pain	No pain

Table no. 16 - Isometric strength assessment (final kinesiological examination)

X - contraindicated movement

3.6.12. Examination of reflex changes

Scar: The scar is located on the anterior aspect of the cranial part of the right humerus. It is approximately 15 cm long and has a physiological color. The scar is not restricted in any direction of motion; it is evident that the individual layers below the scar are freely mobile and that the scar does not restrict any surrounding soft tissue.

Skin: No pathological skin resistance was found in the area of the right shoulder joint and around the operated region. The skin in the area of m. trapezius, however, still remains limited as well as the skin in the area of the sternum.

Subskin: Normal mobility of the subskin in the area of the right shoulder and humerus, as well as the scar. Decreased mobility in the area of m. trapezius and sternum as in the skin assessment.

Fascia: Decreased fascia flexibility in the area of the right pectoral muscle as well as the right m. trapezius.

Muscles: Trigger points and muscle hypertonicity found in the right m. pectoralis major (horizontal and caudal fibers), right m. pectoralis minor, right m. subscapularis, right m. latissimus dorsi, right m. infraspinatus, right m. supraspinatus and right m. teres major et minor. Further bilateral hypertonicity found in m. trapezius, especially in the cranial fibers.

3.6.13. Joint play assessment according to Lewit

Joint	Direction	Right	Left
Glenohumeral	Ventro-dorsal	X	Physiological
	Latero-lateral	X	Physiological
	Caudal	X	Physiological
Sternoclavicular	Ventro-dorsal	Physiological	Physiological
	Craniocaudal	Physiological	Physiological
Acromioclavicular	Ventro-dorsal	Physiological	Physiological
	Caudal	Physiological	Physiological
Humeroulnar (medial springing)	Medial	Physiological	Physiological
Humeroradial (lateral springing)	Lateral	Physiological	Physiological
Radioulnar (distally)	Dorso-palmar	Blocked	Blocked
Radiocarpal	Dorsal	Blocked	Blocked
Carpometacarpal	Palmar	Blocked	Blocked

Table no. 17 - Joint play assessment (final kinesiological examination)

X - contraindicated movement

3.6.14. Hand grip test according to Novák

Grip	Result	
	Left hand	Right hand
Pinch (štipec)	2	2
Pincer (špetka)	2	2
Lateral grip (klíčový)	2	2
Spherical (kulový)	2	2
Hook (háček)	2	2
Cylinder (válcový)	2	2

Table no. 18 - Hand grip testing (final kinesiological examination)

3.6.15. Neurological examination

Deep Tendon Reflexes		
Reflex	Left	Right
Upper extremity - bicipital	Physiological	Physiological
Upper extremity - tricipital	Physiological	Physiological
Upper extremity - flexor	Physiological	Physiological

Table no. 19 - Examination of deep tendon reflexes (initial kinesiological examination)

The following superficial sensation tests have been done in all dermatomes of both upper extremities. The deep sensation testing was carried out in the elbow joint, wrist joint and metacarpophalangeal joints.

Superficial sensation testing		
Test	Left	Right
Tactile sensation	Physiological	Physiological
Temperature sense	Physiological	Physiological
Nociception	Physiological	Physiological
Deep sensation testing		
Test	Left	Right
Position sense	Physiological	Physiological
Movement sense	Physiological	Physiological

Table no. 20 - Sensation examination (final kinesiological examination)

Testing of stereognosis: without pathological findings.

3.6.16. Examination conclusion

The patient is now 52 days post reverse shoulder arthroplasty of her right shoulder and is prepared to depart from the rehabilitation department. She will continue further care as an outpatient after dispatching.

The static segmental examination showed that the patient has bilateral knee joint valgosity as well as protraction of both shoulder girdles with elevation of the right one.

There is a long scar on the anterior aspect of the cranial part of the right upper extremity that is, compared to the first examination, not accompanied by any swelling or hematoma. The muscles of the right shoulder and arm also appear atrophic when visually comparing them to the contralateral. Compared to the entry kinesiological examination, however, both hands are now held almost symmetrically and there is no flexed posture of the right upper extremity.

The gait assessment as well as the pelvic palpation showed further pathologies in the patient's posture. Firstly, even when walking, the patient remains in a kyphotic position of the thoracic spine with the shoulders protracted and elevated. This does not allow physiological movement of the trunk and the gait thus heavily deviates from normal. Additionally, the pelvis is held in a laterally tilted position to the left side as has been confirmed by palpation.

Anthropometric measurements show that the circumferences of the upper extremities almost evened out with a present difference of only 1 cm in the area of the humerus (around the m. biceps brachii). Goniometric measurements show an improvement in passive range of motion; the patient is now able to tolerate up to 85º of passive shoulder flexion in the operated joint along with 100º abduction passively. In terms of active motion, the patient is now able to do full 90º of active abduction but only 30º of active flexion. Rotations, both passively and actively, are still contraindicated. These results are further confirmed by the muscle strength test as the patient was rated by score 3 both in flexion and abduction as he is able to carry out the movement against gravity but not against any additional resistance. The elbow joint movements are now rated by grade 4 by the muscle strength test.

Examination of reflex changes showed no pathological resistance of the scar, its subskin, and fascia around. Decreased fascia mobility prevails in the right pectoral fascia as well as the fasciae of m. trapezius. Trigger points and palpable muscle hypertonus is present in the right m. pectoralis major, right m. pectoralis minor, right m. subscapularis, right m. latissimus dorsi, right m. infraspinatus, right m. supraspinatus and right m. teres major et minor. Bilateral muscle hypertonicity remains in the m. trapezius, especially in its cranial fibers.

Joint play assessment showed joint blockages in the distal parts of both upper extremities, that is in the distal radioulnar joint, radiocarpal and carpometacarpal joints.

Apart from that, neither hand grip testing nor neurological assessment showed any pathological findings.

3.7. Evaluation of the effect of therapy

Overall, the comparison between the entry and final kinesiological examinations shows some objective improvement in the patient's condition in given aspects. Firstly, there is undoubtedly a major improvement in the postural position of the right upper extremity - the patient no longer keeps the arm in a flexed position as if she was still wearing the sling but places it now physiologically along her body. This suggests improvement in the appropriate muscle tonus that are responsible for the extremity's position. Secondly, there was a significant improvement in the tolerated passive range of motion, indicating that pathological barriers in the joint were removed throughout the therapy. Active movements, primarily into flexion, still remain a point of concern as there is still not enough strength to carry it out into more than 30º, which may be problematic in terms of using the hand during daily tasks.

Another positive effect of therapy is the improvement in soft tissue condition and the scar flexibility. This means that the soft tissue techniques used throughout our units yielded a positive effect and that it was the correct approach for scar treatment in the absence of physical therapy modalities such as a laser. Edema and swelling was also reduced during the 10 sessions, suggesting that soft-ball techniques were the correct choice of treatment as well.

Although the goals of the short-term therapy plan were generally met, I cannot consider this therapeutic intervention fully successful. The lack of active shoulder flexion perhaps means that the exercises prescribed to do independently were not chosen correctly or maybe even not carried out by the patient at all. This coincides with the moderate improvement of muscle strength as the movements in the shoulder joint only improved by 1 grade. It is possible that muscle strengthening was not carried out optimally or in the right dosage throughout our therapy and did not allow the patient to gain as much strength. Independent exercises are another key factor in progress and improvement of condition; this raises a further question whether the patient actually carried out the independent exercises or whether the individual exercises prescribed were found entertaining and attainable by the patient.

4. Discussion

As mentioned in the evaluation of the therapy, there was an overall improvement in the strength, range of motion, soft tissue and scar flexibility as well as joint play of the respective joints. When comparing the results achieved with the given physiotherapeutic approaches mentioned in the theoretical part of this paper, the practical effect of proprioceptive neuromuscular facilitation could be seen. It was theoretically discussed that this technique is effective in increasing ROM as well as in recruiting muscle contractions. The implementation of this technique in the case study yielded the expected results and thus proves the practical use of the method. Same can be discussed in regard to the general guidelines of RSA rehabilitation discussed in the theoretical section; the therapeutic plan in the practical part aimed to follow these general guidelines and the overall improvement of the patient's condition combined with the absence of greater complications confirm that these guidelines are suitable for such a condition.

On the other hand, there is a lack of use of other physiotherapeutic methods mentioned in the theoretical part. For example, low intensity laser therapy or Bioptron light therapy could have been implemented into the program if they were available at the workplace. These modalities of physical therapy could reduce pain and improve the healing process and would subsequently yield a more positive overall therapeutic effect (Bahrami et al., 2023). Same could be argued about the use of continuous passive motion machines. They, too, were not available at the workplace but their use would definitely be beneficial to the patient, especially in the early stages of rehabilitation when passive movement is indicated primarily (Schulze et al., 2021). Similarly, the use of dry needling for scar treatment was not implemented into the rehabilitation plan. Although acupuncture needles were available at the workplace, my supervisor advised me not to use such a technique for two main reasons - firstly, I lack the clinical experience as well as the in-depth knowledge necessary regarding dry needling and secondly, the use of dry needling is legally controversial in the Czech Republic as physiotherapists are technically not allowed to “disrupt the skin integrity” with their treatment. I accepted this fact however the question of to what extent would this technique help the patient with the restricted and painful scar prevails. Perhaps

implementing such a technique would be more effective than using traditional manual scar treatment and soft tissue techniques (Rozenfeld et al., 2020).

One aspect of the physiotherapeutic treatment that remains unresolved is the rate of progression of the patient, i.e. how fast the patient was making progress. Although the patient objectively made progress when comparing the initial with the final kinesiological examination, the individual increments of progress were not periodic. Also, the active range of motion still remains an issue for her as the arm is definitely not fully ready to integrate itself within activities of daily living. The debate is then on the topic of what exactly causes this delay of progress. One aspect that has to be taken into account is the patient's age and that rapid improvement can simply not always be expected upon the elderly population. The mechanism of injury also plays a significant role - not only was there a proximal humerus fracture, the patient's humeral head twisted 180º in the joint. She also waited a significant period of time for surgery and the arm was immobilized for weeks leading up to the operation. All of these aspects could be a factor in the decreased rate of progress in rehabilitation and it cannot be precisely identified whether it was the rehabilitation plan itself or these uncontrollable instances that caused the treatment to be time-ineffective.

5. Conclusion

The aim of this paper was to present the physiotherapy treatment of a patient after reverse shoulder arthroplasty. In the theoretical part, the kinesiological function of the shoulder girdle was discussed as well as the relevant anatomy and problems of the joint. The consequent sections of the theoretical background focused on reverse shoulder arthroplasty directly, addressed its biomechanics and discussed modern up-to-date physiotherapeutic approaches that could potentially be used in the treatment of a patient with this diagnosis.

When working out the respective parts of the paper, I was forced to process a lot of high-quality literary work which allowed me to deeply understand shoulder problematics. As my great field of interest in physiotherapy is orthopedics, I am glad to have selected this topic and have broadened my knowledge thanks to it. Not only that, I also underwent a shoulder surgery myself and although it was of different character, the theoretical background of this paper gave me even greater insights about my personal condition.

Another aspect of this paper I found exceptionally useful was the section of up-to-date physiotherapeutic treatment. Thanks to this section, I gained relevant information about approaches that I personally find interesting but did not yet have the space to research them in detail. As physiotherapy offers a tremendous spectrum of therapeutic interventions, including this section is more than useful in gaining perspectives in fields which are perhaps not discussed that often in the academic studies.

Finally, in regard to my work with the patient, the cooperation with her was always above standards and it allowed me to conduct structured therapy sessions and monitor progress appropriately. Even in the face of pain and other challenges, the patient always remained motivated and ready to work in every therapeutic unit. It is mainly thanks to her that I have managed to complete the aim of this paper.

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7. Appendices

7.2. Informed consent

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Předloha pro kazuistiky fyzioterapeutické/ortotické/protetické péče o pacienty ve smluvních klinických zařízeních

Žlutě zvýrazněný text tvoří instrukce, které vymažte
Červený text/tučky jsou místa, která je třeba doplnit/upravit, poté začernit.
Černý text ponechte v současné podobě

Předloha 1: Informovaný souhlas

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, nařízením Evropské Unie č. 2016/679 a zákonem č. 110/2019 Sb. – o zpracování osobních údajů a dalšími obecně závaznými právními předpisy (jakož jsou zejména Helsinská deklarace, přijatá 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013); Zákon o zdravotních službách a podmínkách jejich poskytování (zejména ustanovení § 28 odst. 1 zákona č. 372/2011 Sb.) a Úmluva o lidských právech a biomedicíně č. 96/2001, jsou-li aplikovatelné), Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe ..... (uveďte, na kterém pracovišti), kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření, průběh Vaší terapie, případně anonymizované relevantní informace Vaší anamnézy budou publikovány v rámci bakalářské práce na UK FTVS, s názvem ..... (napište název práce)

Cílem této bakalářské práce je .....

Získané údaje, průběh a výsledky terapie, případně fotodokumentace či videu, budou uveřejněny v bakalářské práci v anonymizované či pseudonymizované podobě. Osobní data nebudou zveřejněna a budou uchována v anonymní podobě, nebo smazána nejdéle do 1 týdne po jejich převzetí. Budou-li pořízeny fotografie, budou anonymizovány do 1 dne po pořízení; bude-li pořízen videozáznam, bude anonymizován do 1 týdne po pořízení. V maximální možné míře zajistím, aby získaná data nebyla zneužita.

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

Jméno a příjmení osoby, která provedla poučení* ..... Podpis:.....

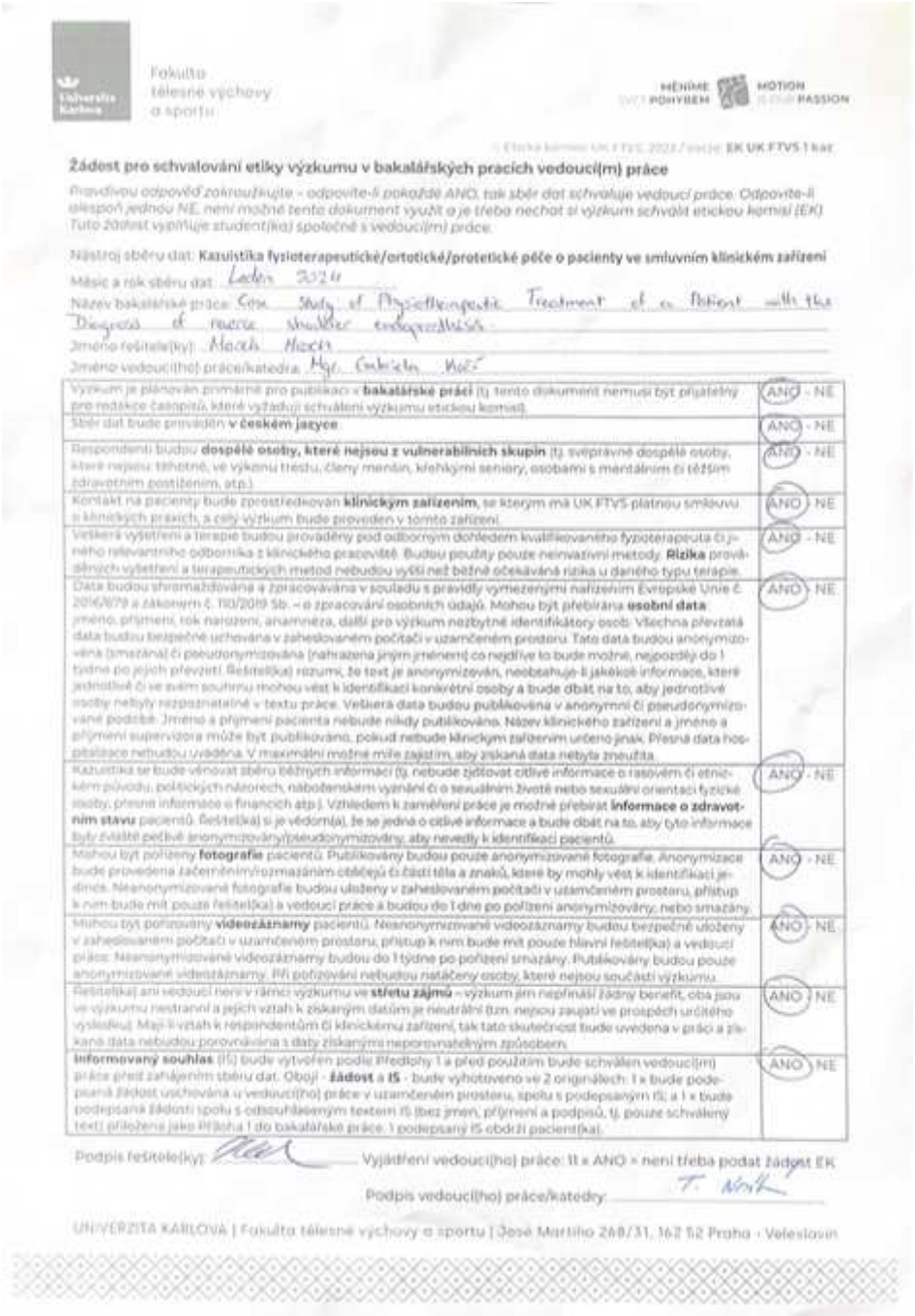
Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném 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. Dále potvrzuji, že mi byl předán jeden originál vyhotovení tohoto informovaného souhlasu.

Místo, datum .....

Jméno a příjmení pacienta(ky) ..... Podpis pacienta(ky): .....

* Je-li řešitel s pacientem v závislém postavení, poučení provádí jiná příslušně kvalifikovaná osoba

7.3. 11-Question Survey



Fakulta tělesné výchovy a sportu

MĚNÍME SVĚT POHYBEM — MOTION IS OUR PASSION

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Žádost pro schvalování etiky výzkumu v bakalářských pracích vedoucí(m) práce

Pravdivou odpověď zakroužkujte – odpovíte-li pokaždé ANO, tak sběr dat schvaluje vedoucí práce. Odpovíte-li alespoň jednou NE, není možné tento dokument využít a je třeba nechat si výzkum schválit etickou komisí (EK). Tuto žádost vyplňuje student(ka) společně s vedoucí(m) práce.

Nástroj sběru dat: **Kazuistika fyzioterapeutické/ortotické/protetické péče o pacienty ve smluvním klinickém zařízení**

Měsíc a rok sběru dat: Leden 2024

Název bakalářské práce: Case Study of Physiotherapeutic Treatment of a Patient with the Diagnosis of rupture shoulder endoprosthesis

Jméno řešitele(ky): Macek Marek

Jméno vedoucí(ho) práce/katedra: Mgr. Gabriela Nič

Výzkum je plánován primárně pro publikaci v **bakalářské práci** (tj. tento dokument nemusí být přijatelný pro redakce časopisů, které vyžadují schválení výzkumu etickou komisí).	ANO - NE
Sběr dat bude prováděn **v českém jazyce**.	ANO - NE
Respondenti budou **dospělé osoby, které nejsou z vulnerabilních skupin** (tj. svéprávné dospělé osoby, které nejsou těhotné, ve výkonu trestu, členy menšin, křehkými seniory, osobami s mentálním či těžším zdravotním postižením, atp.).	ANO - NE
Kontakt na pacienty bude zprostředkován **klinickým zařízením**, se kterým má UK FTVS platnou smlouvu o klinických praxích, a celý výzkum bude proveden v tomto zařízení.	ANO - NE
Veškerá vyšetření a terapie budou prováděny pod odborným dohledem kvalifikovaného fyzioterapeuta či jiného relevantního odborníka z klinického pracoviště. Budou použity pouze neinvazivní metody. **Rizika** provádějících vyšetření a terapeutických metod nebudou vyšší než běžně očekávaná rizika u daného typu terapie.	ANO - NE
Data budou shromažďována a zpracovávána v souladu s pravidly vymezenými nařízením Evropské Unie č. 2016/679 a zákonem č. 110/2019 Sb. – o zpracování osobních údajů. Mohou být přebírána **osobní data**: jméno, příjmení, rok narození, anamnéza, další pro výzkum nezbytné identifikátory osob. Všechna převzatá data budou bezpečně uchována v zaheslovaném počítači v uzamčeném prostoru. Tato data budou anonymizována (smazána) či pseudonymizována (nahrazena jiným jménem) co nejdříve to bude možné, nejpozději do 1 týdne po jejich převzetí. Řešitel(ka) rozumí, že text je anonymizován, neobsahuje-li jakékoli informace, které jednotlivě či ve svém souhrnu mohou vést k identifikaci konkrétní osoby a bude dbát na to, aby jednotlivé osoby nebyly rozpoznatelné v textu práce. Veškerá data budou publikována v anonymní či pseudonymizované podobě. Jméno a příjmení pacienta nebude nikdy publikováno. Název klinického zařízení a jméno a příjmení supervizora může být publikováno, pokud nebude klinickým zařízením určeno jinak. Přesná data hospitalizace nebudou uváděna. V maximální možné míře zajistím, aby získaná data nebyla zneužita.	ANO - NE
Kazuistika se bude věnovat sběru běžných informací (tj. nebude zjišťovat citlivé informace o rasovém či etnickém původu, politických názorech, náboženském vyznání či o sexuálním životě nebo sexuální orientaci fyzické osoby, přesné informace o financích atp.). Vzhledem k zaměření práce je možné přebírat **informace o zdravotním stavu** pacientů. Řešitel(ka) si je vědom(a), že se jedná o citlivé informace a bude dbát na to, aby tyto informace byly zvláště pečlivě anonymizovány/pseudonymizovány, aby nevedly k identifikaci pacientů.	ANO - NE
Mohou být pořízeny **fotografie** pacientů. Publikovány budou pouze anonymizované fotografie. Anonymizace bude provedena začerněním/rozmazáním citlivých částí těla a znaků, které by mohly vést k identifikaci jedince. Neanonymizované fotografie budou uloženy v zaheslovaném počítači v uzamčeném prostoru, přístup k nim bude mít pouze řešitel(ka) a vedoucí práce a budou do 1 dne po pořízení anonymizovány, nebo smazány.	ANO - NE
Mohou být pořizovány **videozáznamy** pacientů. Neanonymizované videozáznamy budou bezpečně uloženy v zaheslovaném počítači v uzamčeném prostoru, přístup k nim bude mít pouze hlavní řešitel(ka) a vedoucí práce. Neanonymizované videozáznamy budou do 1 týdne po pořízení smazány. Publikovány budou pouze anonymizované videozáznamy. Při pořizování nebudou natáčeny osoby, které nejsou součástí výzkumu.	ANO - NE
Řešitel(ka) ani vedoucí není v rámci výzkumu ve **střetu zájmů** – výzkum jim nepřináší žádný benefit, oba jsou ve výzkumu nestranní a jejich vztah k získaným datům je neutrální (tzn. nejsou zaujati ve prospěch určitého výsledku). Mají-li vztah k respondentům či klinickému zařízení, tak tato skutečnost bude uvedena v práci a získaná data nebudou porovnávána s daty získanými neporovnatelným způsobem.	ANO - NE
Informovaný souhlas (IS) bude vytvořen podle Předlohy 1 a před použitím bude schválen vedoucí(m) práce před zahájením sběru dat. Obojí - **žádost a IS** - bude vyhotoveno ve 2 originálech: 1 x bude podepsaná žádost uschována u vedoucí(ho) práce v uzamčeném prostoru, spolu s podepsaným IS; a 1 x bude podepsaná žádost spolu s odsouhlaseným textem IS (bez jmen, příjmení a podpisů, tj. pouze schválený text) přiložena jako Příloha 1 do bakalářské práce. 1 podepsaný IS obdrží pacient(ka).	ANO - NE

Podpis řešitele(ky): _____ Vyjádření vedoucí(ho) práce: 11 x ANO = není třeba podat žádost EK

Podpis vedoucí(ho) práce/katedry: _____

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7.4. List of figures

7.5. List of tables