**MEDICAL REHABILITATION WITH COMPREHENSIVE GERIATRIC ASSESMENT IN PATIENT WITH RESTABILIZATION THORACAL SPINE**

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**ABSTRACT** : The elderly have an increased incidence of osteopenia and osteoporosis affecting approximately 52 million people in the United States. Low bone density in older adults increases risks of hand/wrist, hip, and vertebral body frac­tures, which can result in significant pain, immobility, and loss of functional independence. Osteoporotic compression fractures are important to diag­nose, both because they are a significant source of morbid­ity and can herald the risk for subsequent fractures, particularly hip fractures, which have high mor­bidity and mortality rates. Osteoporosis requires treatment with a combination of medication, lifestyle modification, and exercise. Physical therapy and exercise are useful to reduce disability, improve movement, lower risk of falls, and increase bone density with weight-bearing activity.

**ABSTRAK** : Orang tua memiliki peningkatan insiden osteopenia dan osteoporosis yang mempengaruhi sekitar 52 juta orang di Amerika Serikat. Kepadatan tulang yang rendah pada orang dewasa yang lebih tua meningkatkan risiko patah tulang tangan/pergelangan tangan, pinggul, dan tulang belakang, yang dapat mengakibatkan rasa sakit yang signifikan, imobilitas, dan hilangnya kemandirian fungsional. Fraktur kompresi karena osteoporosis penting untuk didiagnosis, baik karena merupakan sumber morbiditas yang signifikan dan dapat menimbulkan risiko patah tulang berikutnya, terutama patah tulang pinggul, yang memiliki morbiditas dan angka kematian yang tinggi. Osteoporosis memerlukan pengobatan dengan kombinasi obat-obatan, modifikasi gaya hidup, dan olahraga. Terapi fisik dan olahraga bermanfaat untuk mengurangi kecacatan, meningkatkan gerakan, menurunkan risiko jatuh, dan meningkatkan kepadatan tulang dengan aktivitas menahan beban.

**INTRODUCTION**

The elderly have an increased incidence of osteopenia and osteoporosis affecting approximately 52 million people in the United States. Low bone density in older adults increases risks of hand/wrist, hip, and vertebral body frac­tures, which can result in significant pain, immobility, and loss of functional independence. Bone mineral density measurements with dual energy x-ray absorptiometry (DEXA) scans are typically used to diagnose and track low bone density and osteoporosis. Osteopenia is defined as bone mineral density with a T score between −1.0 and −2.5 where the normal young adult level is −1 or greater, and osteoporosis is present if the T score is −2.5 or less. Low bone density occurs in both genders, but is more common in postmenopausal women and increases risk of fractures. Risk factors for osteopenia and osteoporosis include increasing age, family history, glucocorticoid therapy, and smoking. Recent data suggest that the prevalence of osteoporosis and vertebral fractures in patients with AS is 25% and 10%, respectively. Approximately 65% of fractures are associated with a neurologic deficit.1

Vertebrae are the most commonly fractured bones among elderly people with osteoporosis. The type of vertebral fracture is related to BMD loss and the pattern of loading, but is also influenced by the position of the spine at the time of injury. In osteoporotic vertebrae, the load-bearing capacity of the body changes, since it loses bone faster from trabeculae than from the cortex. Vertebral body trabeculae tend to be denser and in the posterior aspect of the vertebral body compared with the anterior. Likewise, trabeculae are denser in the inferior half compared with the superior half, possibly because they are reinforced by trabecular arcades from the pedicles. The typical osteoporotic vertebral fracture leads to a height loss in the anterior vertebral body, often leaving the posterior vertebral wall intact. This wedge-shaped deformity of a single fractured vertebra usually leads to a local increase in kyphosis.6

The geriatric population has an increased risk of debilitat­ing postural changes because of several factors, the two most apparent being a greater prevalence of osteoporosis and an involutional loss of functional muscle motor units. Development of kyphotic posture not only can predispose to postural back pain but can also increase the risk of falls. Several other factors can also contribute to the risk for falls. Chronic back pain secondary to osteoporosis is related to postural changes resulting from vertebral fractures. Strong back muscles contribute to good posture and skel­etal support. Compression fractures can be a significant cause of pain and are generally the reason that there is a higher incidence of back pain in older adult women compared with men. Pain is especially prevalent if three or more fractures are present. These individuals have twice as much back pain as those without compression fractures. Fractures can be asymptomatic or can present with sudden onset of severe pain. Pain can radiate anteriorly and usually gradually improves over several weeks.3

Up to 30% of those with osteoporotic compression fractures have secondary osteoporosis. Common causes of secondary osteoporosis are use of oral steroids, hyperthy­roidism, metastases, and multiple myeloma. Any underly­ing causes should always be ruled out. Bone mineral density measurements are useful to confirm the diagnosis of osteoporosis and to assess the efficacy of treatment.3

**CASE REPORT**

**INITIAL PRESENTATION**

A 65 years old female come to the PMR department on June 15th 2019 referred from Surgery Department Prof. dr. R. D. Kandou Manado hospital with post restabilization posterior thoracal T9 ec osteoporotic fracture. The patient complains of Pain at upper back and difficult to move. Felt worsening pain at upper back pain since June 2017, and she felt her back a little bend when stand upright. Since then she felt pain at her back intermittently, appear when she had a long walk or flexing her trunk. The pain was worsening after 4 months later, she unable to stand up right, because of the pain, and she also stated that her trunk was more bend forward and lower height than previously. No trauma to her back, the pain was locally at her upper back, there is no radiating pain to the chest or lower extremity. No weakness at lower extremities experienced by the patient. She has difficulty on climbing stair or walking in distance because the pain will emerge when she walked in distance. She was referred to orthopedic surgeon, diagnosed with osteoporotic fracture of her thoracic spine and got operated on December 2017. After the operation, she was instructed to the physical rehabilitation department but she refused because she was too afraid to move her spine. After the operation she was doing her daily activites, such as washing dishes, washing laundries, sitting and walking.

On April 2019, she suddenly experienced a great pain again just like before the operation, and she heard some snap sound from her back, no trauma on her back. She could not move, just lying down on her bed ever since. She was consulted again to the orthopedist and stated that the implant on her spine was moved because her bone was osteoporotic. She was scheduled to got operated again, and this time the operation will involve a bigger area to make sure that the bone have enough anchor to hold the implant in its place.

On 14th June 2019 she was operated at Kandou Hospital. After the operation she felt pain on her back, she has difficulty when moving on bed, she must be assisted to change from lying supine to side lying, and she was unable to sit because the pain. There was no history of severe weight loss, night sweat, fever, and prolonged cough. Urinating and defecation was normal.

From the examination we found the Visual Analog Scale was 8, General Status was in normal range, Local Status of Thoracolumbosacral region there was Erythema (+), wound cover (+) from T2 to T12, drain(+) , feel Warmth on low back, Prosesus spinosus straight in the middle from upper to lower back, Tenderness (+) at T2-T12 processus spinosus, Spasm on trapezius, paralumbal muscle. Patient’s posture was forward head posture, thoracal kyphotic, no lumbal hyperlordosis, Craniovertebral angle 32o, Gait examination can’t be exam because the patient can’t stand or walk due to pain on her back. Neuromuscular status was normal, myotome C6-S1 and dermatome C6-S5 was normal, proprioseptif was normal range.

For Functional Examination, Mobility activities : Supine to side-lying was dependent, Lying to sitting was dependent, Shifting on sitting was dependent, unable Sitting to standing, unable Shifting on standing, unable Walking (gait pattern), Barthel Index Scoring was 20 (*total dependent*).

Table 1. Examination of Range Of Motion of trunk & Lower Extremities

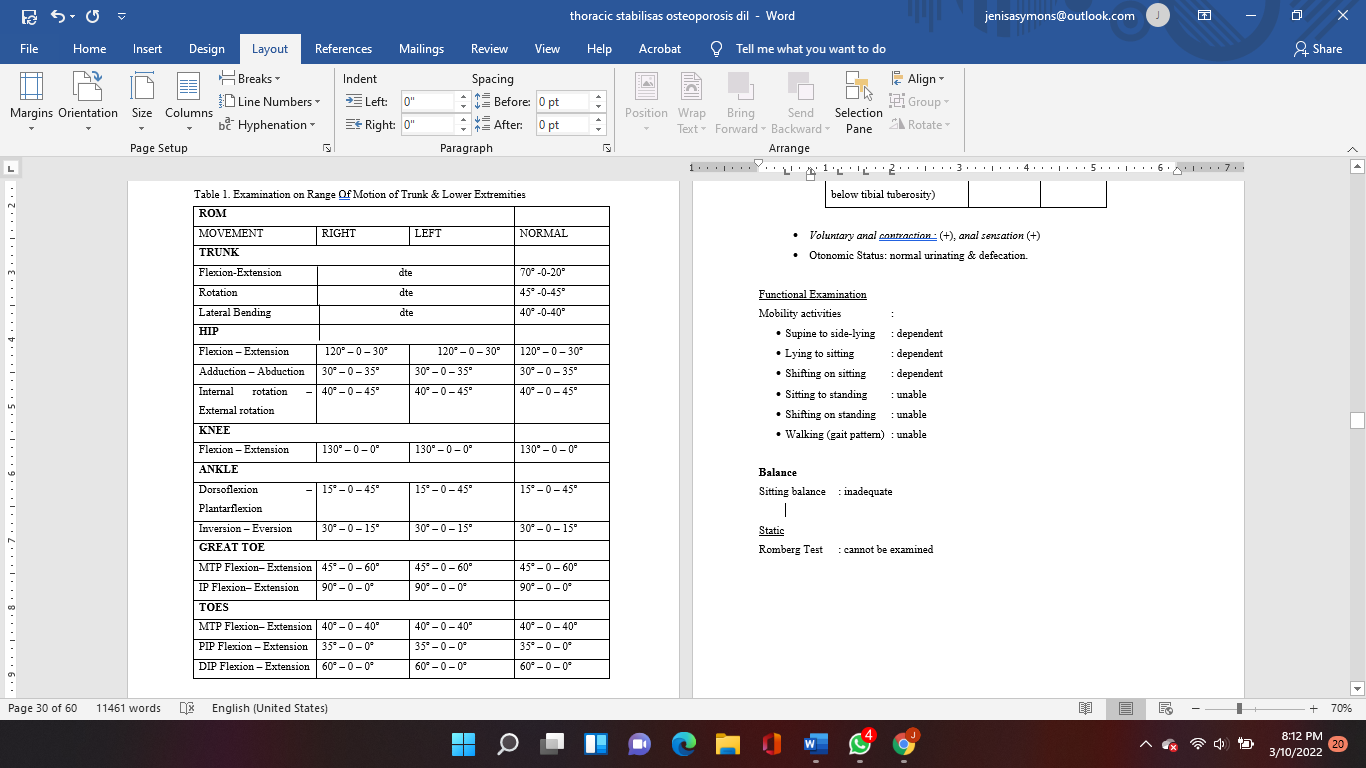


Figure 1. X-ray thoracolumbal lateral after 2nd operation, fixated instrument at T2-T12, Cobb Angle 28o

Frail Scale was 5/5 (frailty), Physical Frailty Phenotype was 5/5 (frailty), IADL Lawton score was between 1-9, Risk Fall Assesment In Patient Inward was 12 (high-risk intervention), Fatigue Severity Scale was 52 (fatique), *Geriatric Depresion Scale was 4,*  Norton Scale was 18 (no risk of decubitus), MMSE was 26 (good).

In medical diagnosis, the clinical diagnosis is Post restabilization posterior ec thoracal osteoporotic compression fracture T9. Patien’s problems are Pain on upper back (NPRS=8/10), limitation trunk range of motion , spasm on trapezius, paravertebral muscle, forward head posture, thoracic kyphotic, disturbance in gait, mobility,transfer and stability, limitation in activity due to disability (dressing, bathing, toileting), disturbance in vocational and social life, and anxiety about her condition post operation.

**REHABILITATION TREATMENT PLAN**

**The Goal Rehabilitation** :

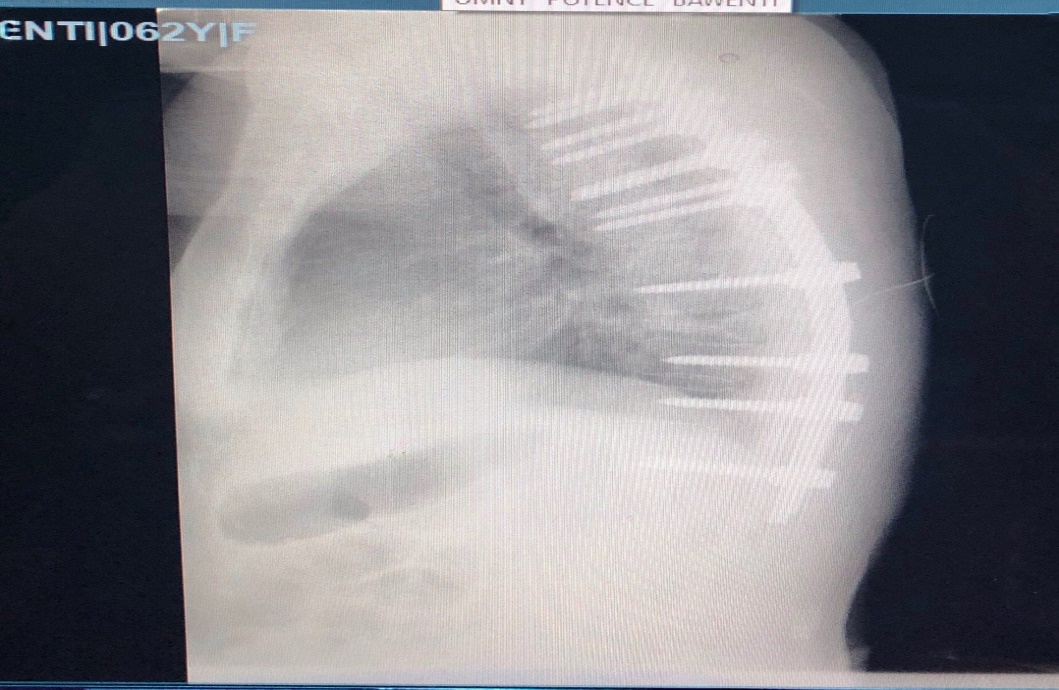
Short term goal :

1. Decrease the pain of her back.
2. Increase the function of mobility and transfer
3. Increase trunk range of motion
4. Improve gait and posture stability.
5. Maintain endurance.
6. Motivate the patient to rehabilitation program

Long term goal :

1. Back to social life as such as previous conditions.
2. Have habitual of exercise to prevent further effect of osteoporosis
3. Posture correction

**Rehabilitation** Program :

* + - 1. TENS 80µs, frequency 100 pps, 20 minutes at T2-T12 region
      2. Proper bed positioning, mobility bed training
      3. Breathing exercise
      4. Active range of motion upper extremity exercise and lower extremity, 15 minutes each set.
      5. Activation muscle transversus abdominis and multifidus in supine lying position, 10 seconds, 3 sets of 10 contractions.10
      6. Thoracolumbosacral Orthosis.11
      7. Give an education about the problem that patient face at this time and cognitive behavioral therapy to reduce anxiety. Education : Avoid prolonged sitting, lifting, bending, and twisting.

**DISCUSSION**

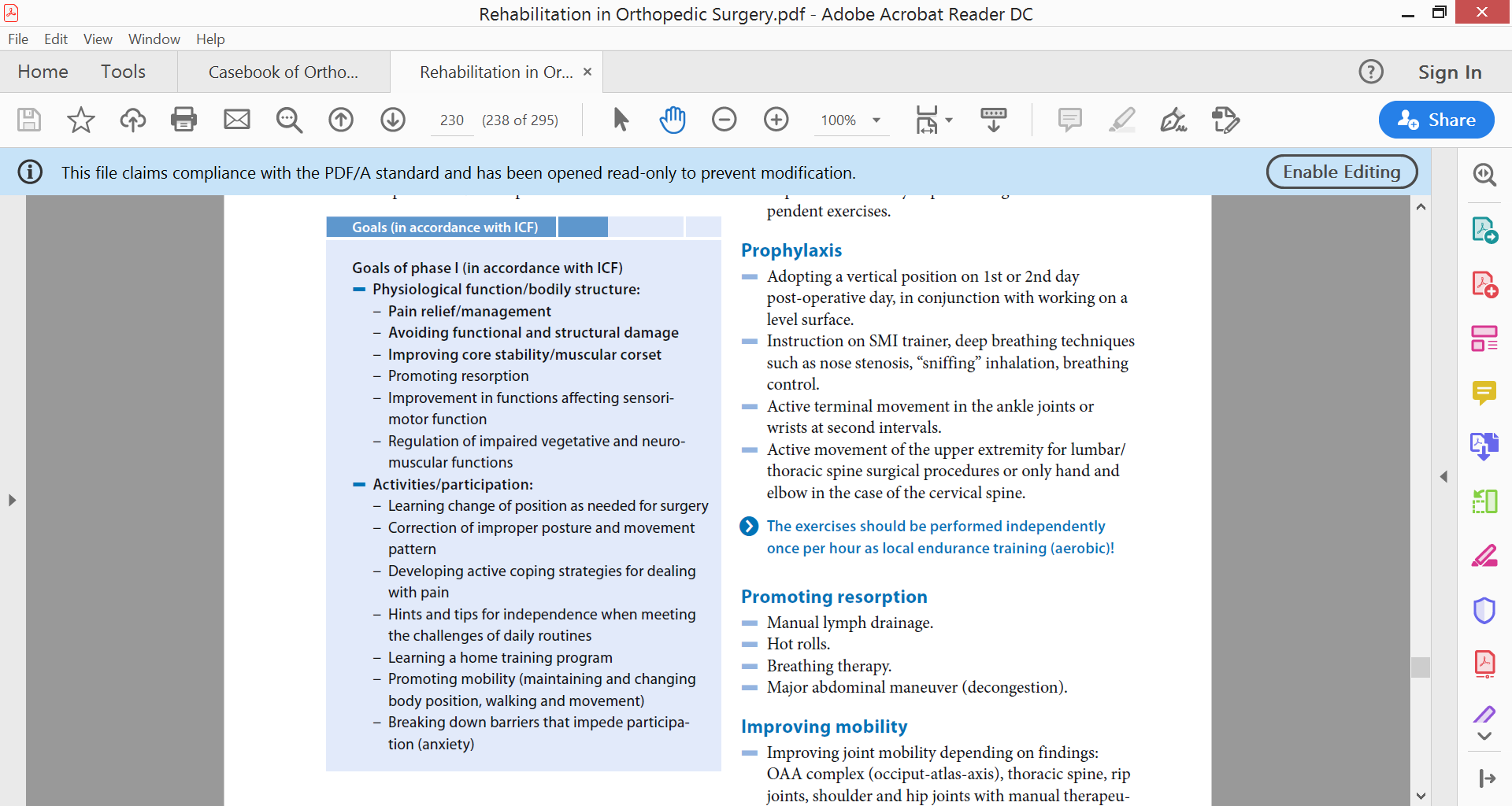
According to the anamnesa, physical examination and additional examination, clinical diagnosis for this patient was restabilization posterior ec thoracal osteoporotic compression fracture Th 9. Presentation symptoms of pain that arise at the vertebrae that fractured. It may be severe ,sharp, exacerbated with movement, and decreased with rest. Severe pain may last 2 to 3 weeks and then decrease during 6 to 8 weeks, but pain may persist for months. Acute fractures in osteoporosis, however, may result in little discomfort or poor localization. Tenderness with palpation or percussion over the affected region of the thoracic vertebrae is the primary finding on physical examination. Spinal movements also produce pain. Kyphotic deformity, loss of height, and impingement of the lower ribs on the superior iliac crest may be present in the patient who has had multiple prior compression fractures. Neurologic examination below the level of the fracture is recommended to assess for presence of reflex changes, pathologic reflexes such as Babinski sign, and sensory alterations. Sacral segments can be assessed through evaluation of rectal tone, volitional sphincter control, anal wink, and pinprick if there is concern about bowel and bladder function.14 It is also important to assess the patient’s gait for stability.

Comorbid neurologic and orthopedic conditions may contribute to gait dysfunction and fall risk. In this patient the complication of fractured vertebrae which can irritate and / or compress of neurological structures, namely the spinal cord and nerve fibers is not found. There is height loss of the vertebra more than 50%, but no compression of the spinal cord. No weakness in the lower extremity, no disturbance in sensory over thorax, abdomen, and lower extremity. Compression fractures in the thoracic vertebrae are commonly seen in osteoporosis with decreased bone mineral density. They may be asymptomatic and diagnosed incidentally on radiography. Such fractures may occur with trivial trauma and are usually stable. In osteoporotic fractures, the mid and lower thoracic vertebrae are typically affected.14

The patient also experienced forward head posture and kyphotic thoracal, with Cobb angle before correction is 40o , potential problems in patient with forward head posture and kyphotic thoracal22 :

* 1. Mobility impairment in the muscles of the anterior thorax (intercostal muscles), muscles of the upper extremity originating on the thorax ([Pectoralis major](https://www.physio-pedia.com/Pectoralis_major) and [minor](https://www.physio-pedia.com/Pectoralis_Minor), [Latissimus dorsi](https://www.physio-pedia.com/Latissimus_Dorsi_Muscle), [Serratus anterior](https://www.physio-pedia.com/Serratus_Anterior)), muscles of the cervical spine and head that attached to the [scapula](https://www.physio-pedia.com/Scapula) and upper thorax ([Levator scapulae](https://www.physio-pedia.com/Levator_Scapulae" \o "Levator Scapulae), [Sternocleidomastoid](https://www.physio-pedia.com/Sternocleidomastoid), [Scalene](https://www.physio-pedia.com/Scalene), [upper Trapezius](https://www.physio-pedia.com/Trapezius)), and muscles of the suboccipital region ([Rectus capitis](https://www.physio-pedia.com/Rectus_Capitis_Anterior) [posterior major](https://www.physio-pedia.com/Rectus_Capitis_Posterior_Major) and [minor](https://www.physio-pedia.com/Rectus_Capitis_Posterior_Minor), [Obliquus capitis inferior](https://www.physio-pedia.com/Obliquus_Capitis_Inferior) and [superior](https://www.physio-pedia.com/Obliquus_Capitis_Superior)).
  2. Impaired muscle performance due to stretched and weak lower cervical and upper thoracic erector spinae and scapular retractor muscles ([Rhomboids](https://www.physio-pedia.com/Rhomboids), middle [Trapezius](https://www.physio-pedia.com/Trapezius)), anterior throat muscles (suprahyoid and infrahyoid muscles), and capital flexors ([Rectus capitis anterior](https://www.physio-pedia.com/Rectus_Capitis_Anterior) and [lateralis](https://www.physio-pedia.com/Rectus_Capitis_Lateralis), [superior oblique Longus colli](https://www.physio-pedia.com/Longus_Colli), [Longus capitis](https://www.physio-pedia.com/Longus_Capitis)).

Diagnosis of osteoporosis made on the basis of typical clinical presentation and with imaging such as MRI, the low signal on T1-weighted images on vertebral bodies is an early sign of osteoporosis. On radiographic examination in a thoracic compression fracture, the height of the affected vertebrae is reduced, generally in a wedge-shaped fashion, with anterior height less than posterior vertebral height. In osteoporosis, biconcave deformities can also be noted on spinal radiographs.15

 Invasive procedures are generally not necessary. Percutaneous vertebroplasty or kyphoplasty with use of polymethyl methacrylate may be helpful to reduce fracture pain, to reinforce thoracic vertebral strength, and to improve function;with kyphoplasty, some potential restoration of vertebral height has been reported. Patients with imaging evidence of an acute or a subacute thoracic fracture who have correlating pain, who fail to improve with conservative management, and who are without contraindications may be candidates for such interventional procedures. In two randomized controlled trials, no beneficial effect was noted in vertebroplasty versus sham.15  The patient underwent spinal stabilization surgery at thoracal region because limitation of medical devices that can be provided in Manado. The surgery went twice, 1st surgery was done at December 2017 at T7-T11, with implant failure because the bone was osteoporotic. The 2nd operation was done at June 2019, with the level T2-T12 considering vertebral body that has adequate bone density.

Strong indication for surgical intervention :

* + 1. Bladder and bowel involvement (cauda equine syndrome)
    2. Progresive neurologic deficit

Relative indication for surgical intervention :

* + - 1. Failure to respond an active conservative treatment for at least 6 weeks.
      2. Severe, incapacitating pain that eludes all forms of medicinal and physical pain control, Significant neurologic deficit

After surgery, physiatrist found that patient had several problem such as pain at back (NPRS=8), difficulty in transfer and bed mobility, spasm on paravertebral muscle, limitation in activity due to disability (dressing, bathing, toileting, walking), disturbance in vocational and social life , and worried about the illness**.** Physiatrist make rehabilitation programs for this patient according to the guidelines after post stabilization surgery, with some modification (adapted to the patient’s condition) . The guidelines are as shown in the table below :6

In Phase I:

* Postoperative precautions
  1. Bed mobility and transfers
  2. Initial postoperative exercises : upper extremity exercise and activation of tranversus abdominis muscle and multifidus muscle
  3. Gait training with any necessary assistive devices
  4. Donning and doffing any required braces
  5. Wound care
  6. General overview and prognosis of the postoperative rehabilitation process.

Generally a callus should form within 6 to 8 weeks; the surgeon monitors this by radiograph and usually does not refer to outpatient therapy before a callus has formed. The physiatrist also must know the surgical approach and the levels fused. After a motion segment is fused, increased stress is placed on the levels above and below the fusion. This creates risk for acceleration of the degenerative cascade at the adjacent levels.

Figure 2. Guideline Phase I post posterior stabilization thoracal 16

Obviously the more levels that have been fused, the greater the stress placed on the remaining segments. When the fusion includes the T2-T12 motion segment, abnormal forces are then translated to the cervicothoracic and thoracolumbar joints. To minimize these forces, the physiatrist must be sure that normal motion exists at all remaining segments, including the thoracic spine, shoulders, and lower extremities (LEs).16

During a posterior fusion, the multifidi are retracted from the spine. This partially tears the dorsal divisions of the spinal nerves, resulting in partial denervation of the multifidi. The incision passes through the obliques, also partially denervating them. For this reason the physiatrist should teach the patient the proper way to recruit the transverse abdominis (TA), multifidi, and pelvic floor muscles and watch for any substitution patterns to promote proper spinal stabilization.

In the program, the physiatrist prescribed proper bed positioning, bed mobility training, transfer training, gradual mobilization, TENS (Transcutaneus Electrical Nerve Stimulation), active range of motion exercise on lower limb. To activate the transverse abdominal muscle, starting in supine position. Explain position and have patient “relax abdominal wall completely”. Begin by perceiving abdominal respiration. Palpation (tactile initiation), transverse abdominal muscle 1-2cm medially to the anterior superior iliac spine – by physiatrist or patient. To activate the multifidus muscle. Starting position prone position. Explanatory model for the building of tension: The vertebral bodies represent three blocks lying on top of each other, with the middle block being pulled 1mm ventrally. Tactile stimulus on the transverse processes or laterally between the spinous processes deeply, support with middle and index finger (slightly tilted position). The patient should develop tension paravertebrally/symmetrically against the gentle pressure. Begin outside of the surgical, scar or discomfort area, then slowly work towards the problem area.

Proper bed positioning done with the purpose of maintaining alignment of the body position and comfort, providing sensory stimulation, motor and cognitive, prevent injuries and pressure sores and contractures. Proper bed positioning is accompanied by changing the position every 2 hours, by turning.16 Gradual mobilization given to the patient because of immobilization (bedrest more than 5 days) and to prevent the occurance of orthostatic hypotension.

Transcutaneus Electrical Nerve Stimulation (TENS) was given after operation. TENS is a form of electrical current that is useful to reduce pain by gate control mechanism or by releasing endorphin. In gate control mechanisms, TENS will stimulate nerve fiber A-Beta which block pain transmission from nerve fiber A- Delta and C. This mechanism can be conducted when TENS was set to 100-150 pulse per minute with 50-80 μs duration. When the TENS set on 2 – 10 pulse per minute with 200 – 300μs duration, the endorphin will be released. According to journal of health science study the successful results of conventional TENS in post laminectomy patient occurred in 17.14% after 2 hours and 22.8% after 48 hours.17

Range of Motion exercise was given to this patient with a primary goal to reduce the complications that can occur as a result of prolonged immobilization, such as cartilage degeneration, adhesion or contractures. Another benefit is to perform active range of motion exercise that will produce the active muscle contraction. Specifically, the goal of active range of motion exercise are: maintaining the physiological elasticity and contractility of the muscles involved, provide sensory feedback from muscles to contract, provide the stimulus for bone and joint integrity, improve circulation and prevent thrombus formation, improving coordination and motor skills for functional activity. This patient was given exercises perpetually active range of motion on upper extremity and actively assisted on lower extremity because patient can actively contract muscles and move the body parts with or without assistance. The literature also mentions an indication of ROM exercises to achieve the optimal

physical fitness.18 Each ROM exercise should be repeated 3 to 5 times and perfomed 1 to 2 times daily for at least three times per week. Patterns in ROM exercises can be done through the anatomical planes of motion (frontal, sagittal, transversal), combined patterns of motion, or functional patterns.18

Patient have weakness on the lower limb due to lumbar pain, so strengthening exercise was given to solve this problem. There are 3 types of strengthening exercise, isometrics., isotonic and isokinetic exercises. In the presence of muscle inflammation and pain (first week after operation) isometric exercises may be done gently, after that we gave isotonic exercise, 3-4 times a week. Isotonic excercise was given to the patient in order to improve the strength, power and endurance of muscle. This exercise was given after inflammation began to subside and there was no unstable joint.

In orthotic and prosthetic unit, the physiatrist prescribed a thoracolumbosacral orthosis. The TLSO is made of velcro. It is indicated for a patient with thoracolumbar pain, spondylolisthesis, excessive lordosis, spondylosis, spinal stenosis, degenerative disc disease, lumbal strain, compression fracture, herniated nucleus pulposus, and immobilization following lumbar surgery. Post operative TLSO is necessary to facilitate healing when applied within 8 weeks following a surgical procedure on the spine or related soft tissue. A post operative TLSO is used to immobilize the spine following laminectomy with or without fusion and metal screw fixation is considered medically necessary. This orthosis also restricts motion in the spine, increases intra-abdominal pressure to support the spine, and helps induce good posture while allowing back muscles to relax producing a decrease in pain. 11

On subunit occupational therapy (OT) the purpose of OT is to teach the patient how to do routine/daily activites while following back precautions. The occupational therapist will teach the patient how to use tools (adaptive equipment) to bathe and get dressed without hurting his back. Additionally, she will be taught how to use proper body mechanics to complete the routine things she does everyday. Using proper body mechanics everyday from now on is a necessity. To measure the functional of this patient, we use Barthel Index. There was improvement of Barthel Index when the patient first admitted to hospital, and when she was off admitted from hospital.

Patient has anxiety due to her condition, so for psychological issues we give a support mental & Cognitive Behavioural Therapy. Mental support here was designed to support the patient in dealing with the condition she had. Hopefully, by this effort the anxiety of patient would reduce and make this patient focus on her treatment. Cognitive behavior therapy (CBT) is a type of psychotherapeutic treatment that helps patients understand the thoughts and feelings that influence behaviors. Most patients have negative statement inside their mind about their disease.. An example is changing a negative thought, such as “I can’t do anything anymore,” to a more positive thought, such as “I dealt with this before and I can do it again”17.

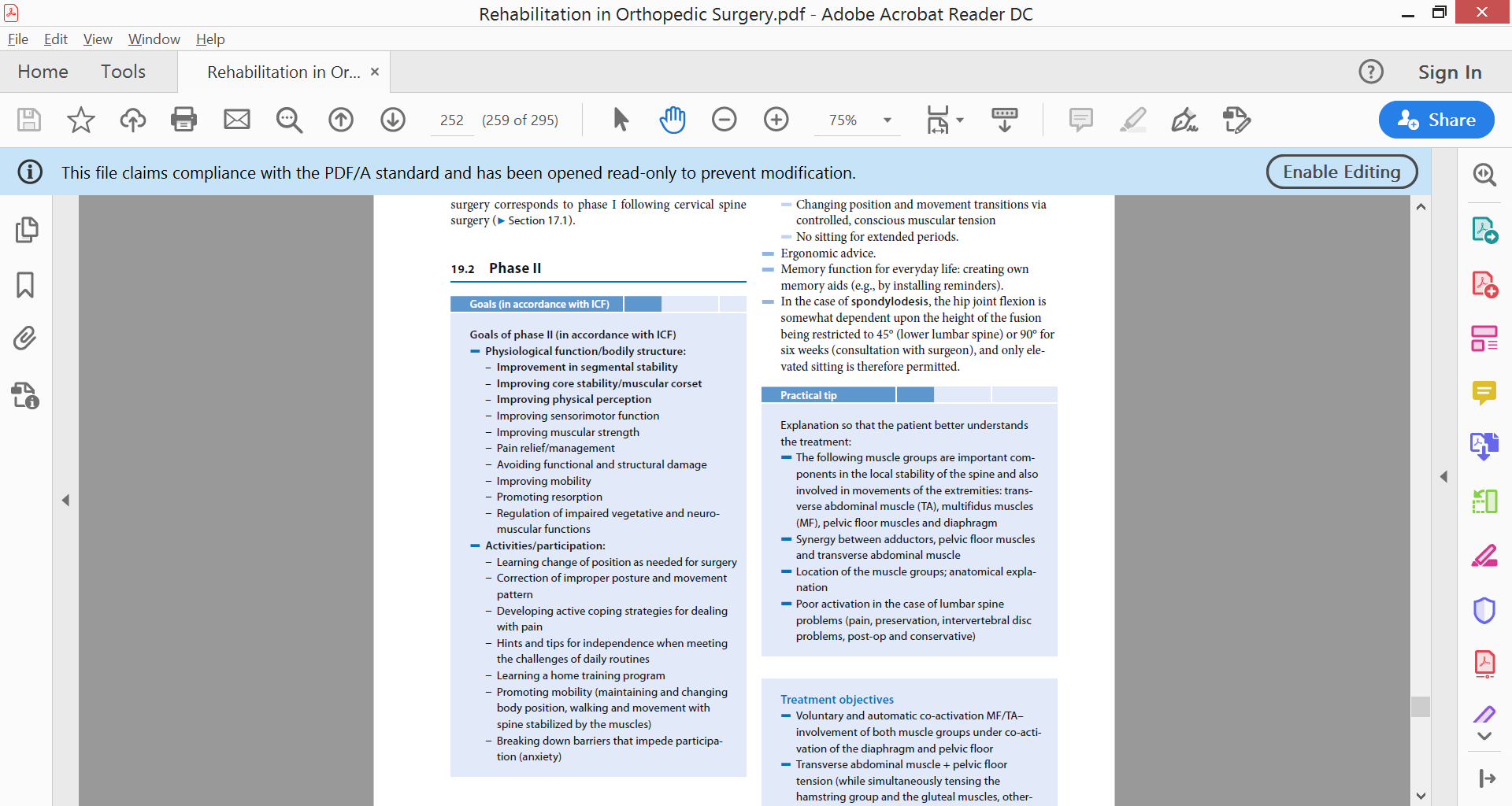
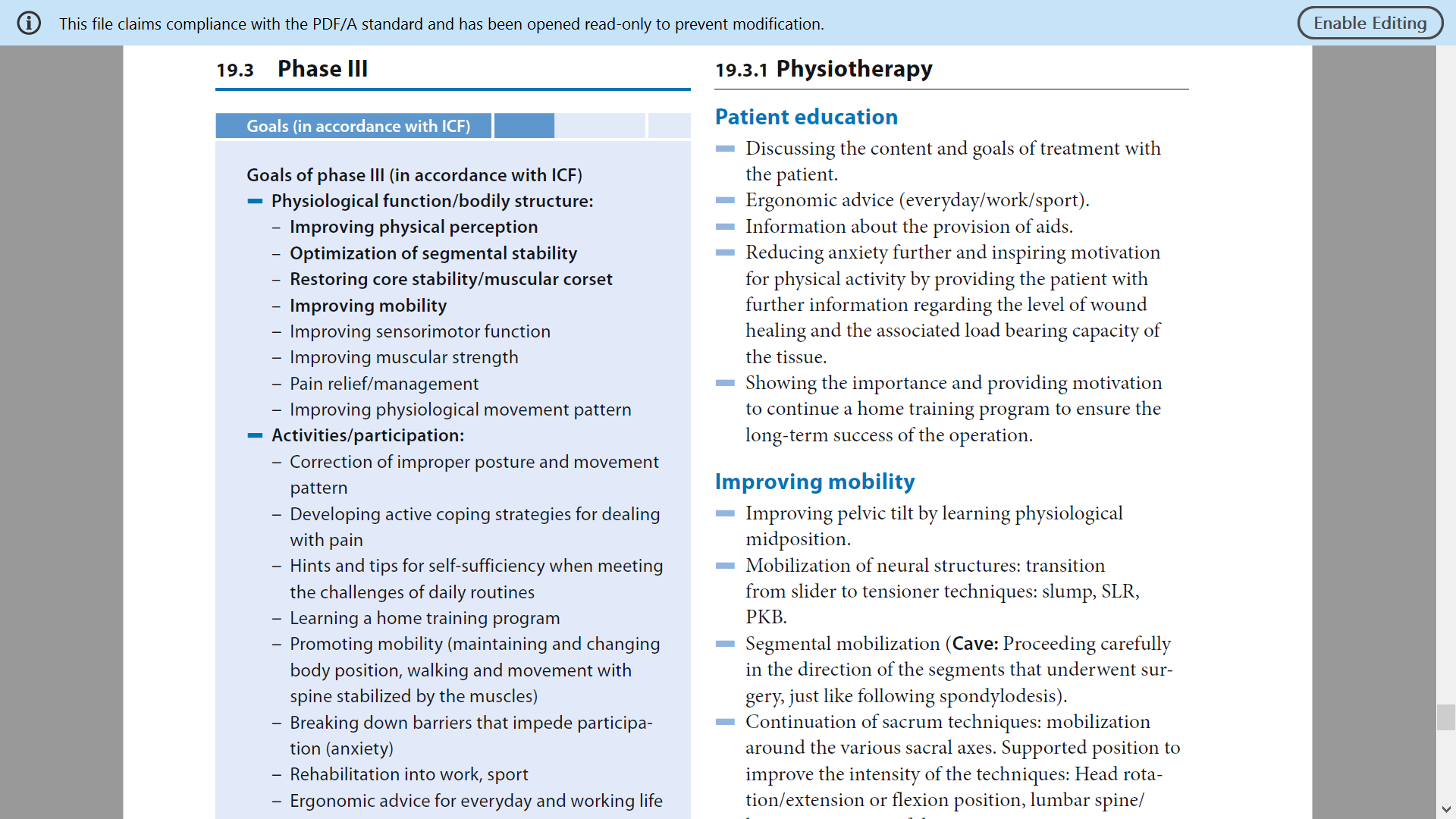
In Phase II :

Figure 3. Phase II guideline post posterior stabilization thoracal 16

Although many previous studies employed high-load power training to increase bone mass density in osteoporosis patients, some studies have found that maximal power output is achieved at 30–70% of 1 RM, suggesting that similar power output can be generated with a lighter load. A previous study found that peak power during light-load (35% of 1 RM) power training was comparable to or even larger than that of high-load (70% of 1 RM) power training. It seems that even though the generated force output was smaller, the lighter load allowed subjects to move more quickly, resulting in greater power output. Light-load power training with a weighted vest in older postmenopausal women has been shown to increase hip BMD, demonstrating its effectiveness in preventing significant bone loss. Therefore, with regard to preventing bone loss, light-load power training would likely serve as a better form of exercise training than high-load power training. Taken together, low-repetition and light-load power training would increase BMD, reducing significant bone loss in postmenopausal women who are at risk for osteoporosis.19 Low-load high-repetition resistance training has been shown to improve maximal strength, balance, and functional task performance in older populations, with improving effect on BMD when very low loads (30 % 1RM) and very high repetitions are used.20

In Phase III:

At this time she should be independent with self-care duties and also with a moderately challenging home exercise program. The use of proper body mechanics should be becoming a habit but will need to be continually reinforced during specific activities. Exercises that address functional movement may be a great time to reinforce those principles. More strenuous stabilization activities, such extension thoracic using foam roll and kneeling with alternating hand and foot.

Figure 4. Phase III post stabilization posterior thoracal 16

The craniovertebral angle on this patient decrease from 31o to 28o, in the long term the forward head posture and kyphotic could precipitate recurrence in muscle pain in upper back area and could result in compression fracture. The strengthening and stretching of the upper back muscle, upper extremity, and pectoralis muscle results in improvement of her back pain and her posture. Extension exercise­ given to the patient increase her improvent in posture and also good for prevent further osteoporosis of her vertebrae.

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