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REHABILITATION OF VERTEBRAL FRACTURE BY COMPRESSION OF THE LUMBAR SPINE: A DESCRIPTIVE REVIEW

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Abstract: The spine is a structure responsible for stabilizing the entire body segment, carrying out movements and protecting the spinal cord, extending from the cervical to the coccyx region. Its fracture is constantly associated with histological issues and abrupt movements, which compromise its bone constitution. With increasing life expectancy, more and more patients are affected by compressive fractures, mainly caused by bone fragility. In this context, it is essential to conduct studies related to the rehabilitation process of compressive fractures of the lumbar spine, understanding the approaches that can be used in different types of treatment, in addition to the protocols used in this process, aiming to reinsert the patient into their usual activities., prior to the injury. To this end, a descriptive review was carried out, through the analysis of original articles, collected in the main databases, such as SciELO, PubMed and Google Scholar, in Portuguese, English and Spanish, over the last 43 years, with the purpose of checking greater veracity to the information presented during the study. Thus, it is understood that the majority of patients affected by vertebral fractures receive conservative intervention, through the use of orthopedic braces, which eliminates, in most cases, surgical invasion. Non-conservative practice proved to be necessary only in cases where there is neurological involvement, defined by a series of clinical and anatomical criteria of the injury, in addition to nerve compression or other systemic pathological effects. Therefore, after the primary intervention process, the rehabilitation period is essential to reestablish regional mechanics, through the recovery of flexion, extension and rotation movements, strengthening local muscles, maximizing body support, in addition to improving the quality of life expectancy of patients affected by the fracture, with potential disabling and

morbidity and mortality, which predicts lower life expectancy.
Keywords: Lumbar spine; Physiotherapy; Compressive fracture; Vertebral fracture; Rehabilitation.

INTRODUCTION

The spine corresponds to a flexible anatomical structure, composed of 33 vertebrae, 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 coccygeal vertebrae, arranged, in this respective order, in a cranio-caudal direction. This segment's function is to protect the spinal cord, promote mobility, as well as absorb the load, which provides greater body support (QUINTANILHA, 2002; PUDLES; DEFINO, 2014). Intervertebral stability, which helps maintain the support of the spine, is due to the junction of joints, ligaments and muscles, responsible for absorbing the impact of load more frequently. When the stability of this system is disrupted, countless damages can be generated, such as pain, herniations, fractures and inability to perform activities of daily living (ADL), mainly caused by poor posture, bone wear and trauma (SEDREZ, 2015; MOORE; DALLEY; AGUR, 2019).

Fracture of the vertebral segment requires important attention from health services, as it generates exorbitant expenses during the treatment process, as well as leading to temporary or permanent disability, with the thoracolumbar segment being one of the most frequently affected by injuries (RIOS, 2006; PEREIRA, 2009; DE CARVALHO CAVALCANTE, 2012). Fracture-type injuries in the spine can be classified according to their clinical presentation into four types: compression, explosion, flexion-distraction and fracture-dislocation, with compression being the most recurrent, responsible for, approximately 40% of general cases (DENIS, 1983; OLIVEIRA; PIRES; BORGES FILHO, 1996).

In compressive fractures, there is commonly a collapse of the bone body, with a decrease in the length and expansion of the width of the bone. This fracture most frequently occurs in the vertebrae and lower limbs, and can be of traumatic or non-traumatic origin. Fractures of non-traumatic origin are associated with diseases related to tissue fragility, such as osteoporosis and bone metastasis (QUEIROZ, 2014). Furthermore, these injuries are of fundamental clinical importance, since, in addition to increasing the prediction of new fractures, they have a significant impact on morbidity and mortality (RODRIGUES, 2003; FRIGHETTO-PEREIRA et al., 2014).

As a therapeutic measure, in the face of compressive fractures, there is surgical and conservative intervention, being chosen according to the characteristics of the clinical picture (QUEIROZ, 2014). Conservative action occurs in situations with lower systemic repercussions and low risk of serious injuries, with the help of plaster casts and spinal stabilizing vests. Surgical intervention is performed mainly in cases of nerve compression or injuries with a high potential for systemic complications, with indications being vertebroplasty, percutaneous fixation and open surgery. Furthermore, in all cases, analgesic therapy is indicated to reduce pain, as well as postoperative physiotherapy, in order to assist with stability, muscle strength and recovery of mobility in the spine (GARFIN et al., 2006; ALEXANDRU; SO, 2012; ISIDORO, 2022).

In this context, given the prevalence of compressive fractures in the spine, mainly of non-traumatic origin, as well as the exponential costs generated by public health, resulting from their treatment, their high disabling potential, in addition to the increase in associated morbidity and mortality, the present study is justified, which aims to describe the rehabilitation process resulting

from vertebral fracture due to compression of the lumbar spine. From the descriptive review, it becomes possible to evaluate the main rehabilitation methods used, in an associated way, such as physiotherapy and bodybuilding, which aim for a more effective recovery of the patient, faster healing of the injury, in addition to restoring mobility. and reduction of pain, inevitably increasing the quality of life of those affected by the injury.

METHODOLOGY

For the development of the present study, original articles were collected, published in the last 43 years, in Portuguese, English and Spanish, collected in the main bibliographic databases, such as SciELO, PubMed and Google Scholar, using the terms "as keywords". Lumbar spine", "Physiotherapy", "Compressive fracture", "Vertebral fracture" and "Rehabilitation", which helped in the selection of research. This way, it was important to include studies directly related to the theme addressed in the project, and published in reference databases, in order to provide greater veracity to the information cited throughout the text and reliability to the data presented.

BIBLIOGRAHIC REVIEW

LUMBAR SPINE

The spine is a structure whose function is to protect the spinal cord and spinal nerves, support the weight of the body, carry out extension, flexion, lateral extension and flexion movements, and rotation, in addition to acting on body posture and assisting in locomotion. It normally consists of 33 vertebrae arranged in 5 regions: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 coccygeal, respectively, in the cranio-caudal direction. It is worth noting that, as the spine approaches the sacrum, the vertebrae become larger and thicker, providing greater capacity to support the weight of the body, thinning, again, in the coccygeal region (QUINTANILHA, 2002; PUDLES; DEFINO, 2014).

The lumbar spine is located between the thoracic and sacral regions, composed of 5 vertebrae, the vertebral foramina, 2 transverse processes, 2 articular processes and 1 spinous process, which act in conjunction with the other structures to provide greater stability to the upper region of the body and to the movements that are performed. The lumbar vertebrae are, characteristically, thicker, occupying most of the lower region of the trunk, in the median plane (MOORE; DALLEY; AGUR, 2019).

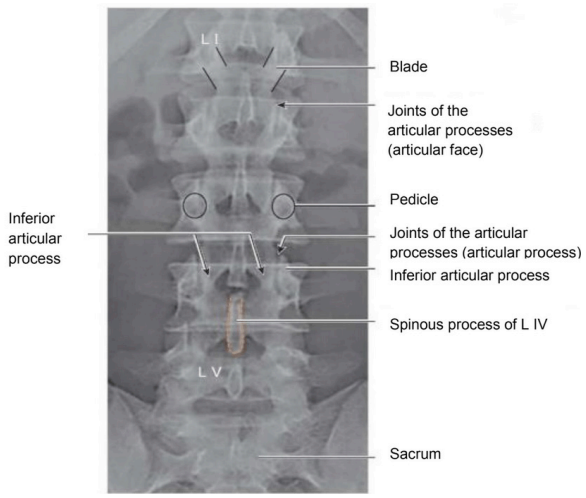

Figure 01: Anteroposterior radiography of the lumbar spine.

Source: Adapted from MOORE; DALLEY; AGUR, 2019.

The dorsal muscles are separated into two groups, namely: extrinsic and intrinsic. The first is made up of thoracoappendicular muscles, which fix the axial and upper appendicular skeleton, being more proprioceptive than motor. Despite being arranged on the back, they are innervated by the anterior branches of the cervical nerves. The second is formed by muscles of the back itself, arranged in 3 categories, namely:

superficial, intermediate and deep layers, which act directly in maintaining posture and controlling spinal movements. They are innervated by the posterior branches of the spinal nerves (CODEA; VINCENTINI, 2015).

<table>
<tr><th rowspan="2">Extrinsic Muscles</th><th colspan="3">Músculos Intrínsecos</th></tr>
<tr><th>Superficial</th><th>Intermediate</th><th>Deep</th></tr>
<tr><td rowspan="2">Trapezium</td><td rowspan="7">Splenius</td><td rowspan="2">Iliocostalis</td><td>Transversos-pinals</td></tr>
<tr><td>Semispinatus</td></tr>
<tr><td rowspan="2">Latissimus dorsi</td><td rowspan="2">Extremely long</td><td>Multifidus</td></tr>
<tr><td>Short and long rotators</td></tr>
<tr><td rowspan="2">Rhomboids</td><td rowspan="2">Spinal</td><td>Interspinal</td></tr>
<tr><td>Intertrans-versaries</td></tr>
<tr><td>Scapula lifters</td><td>Erector Spinae</td><td>Rib Lifters</td></tr>
</table>

Table 01: Muscles involved in moving and stabilizing the spine.

Source: Adapted from CODEA; VINCENTINI, 2015.

VERTEBRAL COMPRESSION FRACTURE

Vertebral fractures constitute one of the main causes of disability and immobilization, currently being important causes of morbidity and mortality (FERNANDES et al., 2012). They can occur through different mechanisms, varying in their etiology, however the main causes of fractures are of osteoporotic origin (BORGES et al., 2015). In this context, fractures can be classified as: compression, explosion, fracture-dislocation and flexion-distraction.

Burst fractures are defined as injuries affecting the anterior, middle and posterior vertebral column, which mostly occur after falls or automobile accidents, involving high kinetic energy (JACOB JUNIOR et al., 2012). Fractures of the fracture-dislocation type, in turn, present misalignment of the spine associated with bone injury, being considered unstable and the most serious involving the spine, related to traumatic injuries (PEREIRA et al., 2008). Furthermore, flexion-distraction type fractures commonly involve automobile accidents, in which there is an acceleration movement and, after, a sudden deceleration reaction, generating instability and ligament injury, in addition to bone damage (OFENHEJM GOTFRYD; FRANZIN; HARTL, 2016).

Compressive fractures, finally, can occur for two different reasons. The first of these occurs due to abrupt movements, in which the intervertebral joint is compressed from two opposite directions, simultaneously, leading to the crushing of the vertebral body, or due to primary pathologies, such as multiple myeloma, osteolytic metastases and primary and secondary osteoporosis. All the diseases described generate histological changes in bone constitution, leading to a decrease in the microarchitecture of bone tissue and trabecular collagen, which already occurs naturally in the aging process, in addition to changes in the molecular orientation of proteoglycans, making bones more fragile. This leads to compression of the vertebrae, due to bone fragility, even due to the patient's own body structures or functional aspects, such as poor posture (VELLOSO, 2005; RIOS et al., 2006).

The thoracolumbar area is the place most prone to these fractures, due to the transition from a more fixed area (thoracic vertebrae) to a more mobile area (lumbar vertebrae). It is worth noting that, once a compression fracture occurs, the bone density acquired after the injury will not prevent a second fracture from occurring, because, after the first, the chances of a new injury increase by around 5 times (LINDSAY et al, 2001; QUEIROZ et al., 2014).

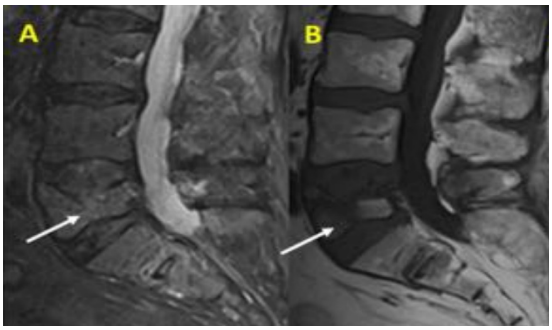

Figure 02: STIR-T1 sagittal lumbar spine insufficiency fracture.

Source: Adapted from PERNAS et al., 2018.

CONSERVATIVE TREATMENT

The type of treatment that will be used to correct the injury is based on the stability criteria of the vertebral segment. It is defined by: loss of ability to withstand physiological loads; loss or deformation during injury consolidation; or by progressive neurological injury with compression of the nervous structures that involve the injured region of the spine, corresponding to the posterior and anterior branches of the spinal nerves (WHITE; PANJABI, 1981; TIMMONS; TALLITSCH, 2009). The force vector must also be considered, since instability can arise in specific movements, such as compression, distraction, flexion, extension or rotation (DEFINO et al., 2000).

The conservative approach is constantly associated with the use of orthoses, orthopedic braces. These devices are applied externally to the body, with the potential to treat injuries, illnesses, congenital problems or problems resulting from the aging process. The action of the equipment varies according to the patient's objectives, being able to immobilize or stabilize, correct or prevent deformities, protect against injury or stimulate healing (GONÇALVES; FRANCISCO, 2011; GRADIM; PAIVA, 2018).

The 3 main types of existing orthopedic devices can be used in the rehabilitation of the spine, namely: Cervico-Thoraco-Lombo-Sacral Orthosis (OCTLS); Thoraco-Lumbo-Sacral Orthosis (OTLS); and the Lumbosacral Orthosis (OTLS). All devices mentioned are custom-made and perform the functions previously described. The supports counterbalance the anterior compressive forces of the spine which, in line with kinesiotherapy, proves to be an effective strategy for the conservative treatment of vertebrae fractures. The selection criteria for the type of brace that will be used are: location of the vertebral fracture and the patient's level of functionality before the injury, which concerns their daily activities (AVAZIM et al., 2009; ARES, 1997).

Figure 03: Milwaukee vest, corresponding to OCTLS.

Source: Adapted from JUNIOR, 2022.

SURGICAL TREATMENT

Surgical treatment is the preferred approach when dealing with highly severe injuries or those that lead to nerve compression, bringing prominent clinical signs and symptoms (HÜBNER et al., 2011). Among the main techniques used in the repair of lumbar vertebral compression fractures are Kyphoplasty and Arthrodesis.

Balloon Kyphoplasty (BKP) corresponds to a procedure in which a cannula is introduced into the body of the vertebra, associated with the insertion of a balloon that elevates the upper vertebral part. This elevation creates a deformity in the spinal

canal, where orthopedic surgical cement will be inserted, which will help fill the canal and support the portion injured by the fracture (BARSOTTI et al., 2013). This technique, in addition to being minimally invasive, being performed percutaneously, is relevant for reducing pain, restoring the conformation of the spine, reducing damage resulting from the injury, improving regional function and, consequently, increasing the quality of life of patients affected by the fracture (BELKOFF et al., 2001; GARFIN; YUAN; REILEY, 2001; HALPIN; BENDOK; LIU, 2004).

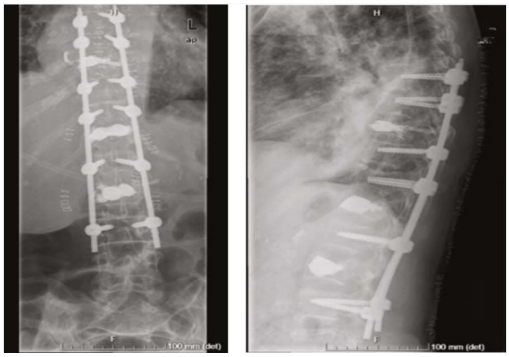

Figure 04: Post-operative radiograph of Kyphoplasty for correction of D9, D12 and L2.

Source: Adapted from MARQUES; MOURA; LOURENÇO, 2021.

Another therapeutic option that can be applied in the context of compressive fractures of the lumbar spine is arthrodesis. This technique can be performed via an open transforaminal or minimally invasive route, with the latter generating lower morbidity, better recovery and shorter hospital stays. The objective of the surgical intervention is to remake the bilateral constructions with screws and rods and, after this, an autologous bone graft is performed, as well as the insertion of the interbody spacer, which restructures the spinal canal and provides the return of stability to the segment (MENEZES, 2009). However, although with good clinical results, this intervention has shown, according to some studies, a reduction in the physical fitness of patients post-operatively (GOTFRYD; HENRIQUES; POLETTO, 2012; AMARAL et al., 2017).

Figure 05: Preoperative MRI indicating degenerative disc disease at L5-S1.

Source: Adapted from MENEZES et al., 2009.

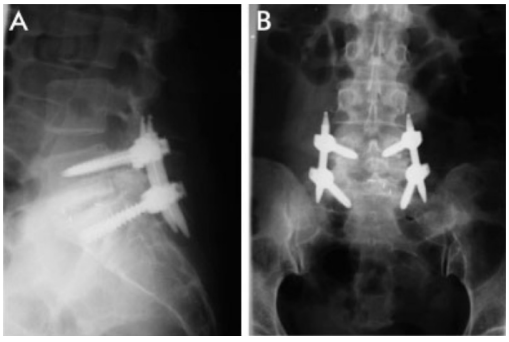

Figure 06. Radiograph of a patient undergoing minimally invasive arthrodesis

Source: Adapted from MENEZES et al., 2009.

REHABILITATION

PHYSIOTHERAPY

Before defining the approach that will be used to treat the injury, the physiotherapist must carry out anamnesis and a physical-functional assessment, to define the best path to follow to achieve the goals. The objective of the anamnesis is to collect didactic information about the person's condition, such as: healing phase and type of fracture, nutritional status, treatment used, type of fixation, time since

surgery, age of the individual, smoking and type of surgical treatment (conservative or closed), in addition to considering subjective aspects. From a physical perspective, pain intensity, disability, lumbar flexibility and amplitude, changes in muscle tone, strength assessment, neurological examination, and the Laségue Sign test must be measured (ALEXANDRE; MORAES, 2001; BAZANELLA et al, 2017; BARBOSA; SILVA, 2021).

The rehabilitation of compressive rupture will be divided into an inflammatory, repair and bone remodeling period (SCHUBERT, 2011; BARBOSA; SILVA, 2021). The first phase will aim at analgesia, with the purpose of reducing inflammation and muscle atrophy. The use of cryotherapy is essential in the first phase, as tissue cooling reduces metabolic activity and directly influences the nervous system, reducing the speed of nerve conduction and reaching sensory receptors, which have a direct influence on the sensation of pain., enabling pain-free exercises to be performed (SA PIMENTA et al, 2012).

After controlling the edema, the physiotherapist must begin to stimulate the muscle groups that act directly or indirectly on the spine. Use isometric exercises, where there is no overload on injured joints, strengthening muscle groups without greater risk of injury, as an adjunct to electrotherapy (TENS), which encourages muscular activity without the need for the patient to move (COHEN; ABDALLA, 2003; LOURENÇO; BATISTELLA, 1994). In order to continue muscular work without compromising static and dynamic posture, hydrotherapy can be used, which acts to aid movement due to the absence of gravity, while training strength due to constant water resistance (BIASOLI; MACHADO, 2006).

In order to improve range of motion and gain flexibility, during the repair period, the patient is inserted into Pilates, in which the exercises used involve isotonic and isometric contractions, using the centers of muscular strength, which correspond to the lumbar paravertebral, gluteal and abdominal muscles (SILVA; MANNRICH, 2009). During this period, it is still recommended that the patient undergo joint mobilization of the lumbar spine, using the Schober, Sit and Reach tests and the lumbar dynamometer, which demonstrate significant gains, after completion, in both mobility and flexibility (OLIVEIRA, 2022).

Figure 07: *The Hundred with a focus on spinal stabilization.*

Source: Adapted from MOURRAHY; NIELSEN, 2016.

The last period, of remodeling, aims to intensify bone calcification through the mechanical tension generated in bodybuilding. The patient will continue with the work he did previously, however, he must be monitored by a physical education professional so that he can seek hypertrophy and strength gains in a more specific way, respecting all the limitations of his injury (BATISTELLA, 1994).

BODYBUILDING

The final phase of rehabilitation is called remodeling, which consists of a process of gaining bone mineral density (BMD). Taking physiological aspects into consideration, we have a mechanism called "mechanotransduction", a process in which cells identify and translate the mechanical

signal into chemical energy. In line with the piezoelectric effect, electrical responses are generated in the stressed area, stimulating cellular activity and leading to the deposition of ores in the region, which, therefore, increases BMD and, consequently, the gain in bone mass, the main device in the period of spinal remodeling. Mechanical stress will be obtained through weight training, performing resistance exercises, respecting all the patient's limitations due to the injury (CARDORE et al, 2006; REBELO; BAUMGARTH, 2014).

Bodybuilding work must begin with strengthening the spine. There are two systems that act in this stabilization, the global one, which acts by generating torque and movement, composed of muscles that are not directly connected to the spine, namely: the rectus abdominis; the thoracic portion of the lumbar iliocostalis; and the external oblique. The local system, on the other hand, has muscles that connect directly to the vertebrae, whose action is to maintain movements, consisting of the multifidus and quadratus lumborum, transversus abdominis and the posterior fibers of the internal oblique. The deeper muscles are best worked with the use of isometric exercises; however, dynamic actions must not be disregarded (FRANÇA et al, 2008; REINEHR et al, 2017).

FINAL CONSIDERATIONS

From the present study, it was clear that lumbar compression fractures require immediate and appropriate intervention, due to their disabling potential and associated morbidity and mortality, especially in the elderly population. This intervention can be carried out conservatively or even surgically. After surgery, effective rehabilitation is essential, combining physiotherapy, to recover mobility and readaptation, and weight training, in order to strengthen the adjacent muscles, which will support the body. These practices, when combined, favor the recovery process, improving the outcome and the individual's functional capacity, contributing to minimizing damage, in addition to improving the patient's quality of life.

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