Archives of Radiology

ISSN: 2638-521X

Volume 2, Issue 2, 2019, PP: 28-33

The Importance of Magnetic Resonance and Computed Tomography in the Diagnosis of Spondylolisthesis

Jordana Alves Pereira, Christiana Vargas Ribeiro

Faculdade IPEMED de Ciências Médicas, Brazil.

christiana.ribeiro@ipemed.com.br

***Corresponding Author:** Christiana Vargas Ribeiro, Faculdade IPEMED de Ciências Médicas, Brazil.*

Abstract

Spondylolisthesis consists of a disorder of the spine where there is anterior slippage of the L4-L5 or L5-S1 segments, caused by a progression of spondylolysis. This condition can develop at any age and the main risk factors are activities involving lumbar hyperextension or some congenital disorder of the spine. Mechanical low back pain is the most common clinical manifestation and may resemble muscle spasm, which may cause spinal and muscle stiffness, causing changes in posture. Treatments can be conservative and/or surgical, depending on the degree of the condition, and the best prevention is stabilization exercises. Imaging tests assist in the diagnostic process, and radiography allows an initial diagnosis by verifying vertebral displacement. In contrast, magnetic resonance imaging and computed tomography provide more details about this slide. To deepen the knowledge on this subject, this paper aims to emphasize the importance of magnetic resonance and computed tomography in the diagnosis of spondylolisthesis, determining the advantages and disadvantages found in the two imaging exams for the diagnosis of this disease, explain the effects generated. in the motor system and correlate low back pain with the diagnosis of spondylolisthesis. The methodology used was a bibliographic review, using databases, and selected articles in Portuguese and English between 2008 and 2014. Studies have shown that magnetic resonance and computed tomography are the most indicated exams for the study. spondylolisthesis diagnosis, since they allow a better visualization of the sliding of the L4-L5 or L5-S1 segments compared to radiography, which allows only the initial diagnosis, but with a smaller visualization.

Keywords: *spondylolisthesis; diagnosis; magnetic resonance; computed tomography; radiography.*

Introduction

According to Tebet (2014), spondylolisthesis is a disease characterized by vertebral slippage, caused by a progression of spondylolysis, which is characterized by a stress fracture in the vertebral region. High-resolution imaging exams such as magnetic resonance imaging (MRI) and computed tomography (CT) are used to diagnose these conditions.

Spondylolisthesis is a disease that can develop at any age, but for every age group there is a cause. However, children and young people are part of the risk group due to the activities they develop. Low back pain also differs according to age group, but pain is frequent in most cases (FERRO, 2012).

Spondylolisthesis may in some cases be asymptomatic and in cases of severity of symptoms an accurate diagnosis by a specialist is required for appropriate treatment. Changes related to this condition can be recognized by radiography, computed tomography and magnetic resonance imaging. Radiography demonstrates gliding in small proportions, while magnetic resonance imaging highlights functional information and provides information on the likely cause of low back pain. Computed tomography is used in case of doubt after the use of MRI and for the study of bone changes (RODRIGUES, 2014).

For the diagnosis it is necessary to know the patient's clinical history and the imaging exams contribute to a better visualization of the pathology. Therefore, the present study aims to highlight the importance of magnetic resonance imaging and computed tomography in the diagnosis of spondylolisthesis,

determining the advantages and disadvantages found in these imaging exams, and explaining the effects generated by this pathology on the motor system, correlating pain. lumbar spine with proper diagnosis of spondylolisthesis.

Material and Methods

The research has a qualitative character, through bibliographic review, using the databases, PubMed and Google Scholar. The indicators used for the research were spondylolisthesis, magnetic resonance imaging and computed tomography. Portuguese and English language articles were selected between 2008 and 2014. The inclusion criteria were articles related to the proposed theme, which contained MRI and CT as diagnostic tests. Articles indexed before the selected period, in other languages, containing other imaging exams and not related to the pathology studied were excluded from the research.

Discussion

Spondylolisthesis Concept

Spondylolisthesis is a disease involving vertebral slippage. This dislocation is characterized by a progression of spondylolysis, which consists of a stress fracture in a vertebral region and causes lumbar, sciatic, paresthetic pain, among others, which can interfere with motor coordination and ambulation (TEBET, 2014).

Incidence of Disease

According to the Brazilian Society of Traumatology and Orthopedics (SBOT), this condition affects about 5% of the population, being more frequent in males, in an approximate ratio of 2: 1, and does not occur at birth. In children up to 6 years old, the incidence is approximately 2.6%, while in adults it is 5.4%. In case of degenerative spondylolisthesis, the most common cases are in women under 40 years, due to lumbar lordosis (FREITAS and NEVES, 2012).

According to Tebet (2014), this disease can develop at any age, but for some age groups there are some specific causes, such as changes in the spine caused by aging, vertebral defect in children and adolescents, and young people who practice physical activities. Degenerative spondylolisthesis is more common in the elderly, while congenital spondylolisthesis is common in early childhood.

In a study by Tebet (2014), it was observed that all patients had slippage in segment L4-L5 or segment L5-S1. Although less common, spondylolisthesis exists at other lumbar levels. Of those with slipping in the L4-L5 segment, 48% are women, aged 36 to 75 years, and 52% are men, between 27 and 67 years. Similarly, of the patients with L5-S1 damage, 48% are women, aged 34 to 71 years, and 52% are men, aged 22 to 69 years. Thus, the authors concluded that men have the disease in a younger age group and are the most affected in relation to women.

Risk Factors

Freitas and Neves (2012) highlight as risk factors for this disease: growing children and young people, because during this period, there is a greater advance of the condition; young sports practitioners such as gymnasts, soccer players and weightlifters; stress from recurrent trauma; people who engage in physical activities that include lumbar hyperextension; athletes who practice repetitive activities; people who have undergone any spinal surgery; fracture at the back of the spine; and trauma caused by falls and accidents.

Some physical activities such as gymnastics, soccer, diving, wrestling and weightlifting are considered risk factors, because the impact that the body has on lifting weight can cause various trauma due to repetitive stress (FREITAS and NEVES, 2012).

Classification

Wiltse, Newman and Macnab (apud Jassi et al., 2010) classified spondylolisthesis into five categories: dysplastic, isthmic, degenerative, traumatic and pathological, highlighting the main causes.

Another type of classification is proposed by Marchetti and Bartolozzi (apud Freitas and Neves, 2012) to facilitate the definition of prognosis and the choice of treatment. This classification was established according to etiology, differentiating the pathological processes that lead to the disease. There are two main categories: acquired spondylolisthesis and developmental spondylolisthesis.

Mac-Thiong and Labelle (2006), with the objective of assisting in the evaluation and treatment, divided the spondylolisthesis into: low degree, when a vertebral slip occurs less than 50%, and in high degree, when this slip is greater than 50%. According to this degree of slip, the pelvic incidence (PI), pelvic balance (PT) and sacral inclination (SS) are the main indicators for the surgical treatment of this pathology.

Pelvic incidence is the angle formed between the perpendicular line and the center of the sacral end plate, and the intersection of a line drawn from the center of the femoral head toward the midpoint of the sacral end plate. The pelvic balance is an intersection of the midpoint of the sacral terminal plate and the vertical reference line originating at the center of the femoral head, while the sacral tilt is the intersection of the terminal plate with the horizontal reference line. Sacral inclination is related to pelvic balance and pelvic incidence because it shares a common reference line along the sacral plate (FREITAS and NEVES, 2012).

Another classification used is the one proposed by Meyerding (apud Oliveira et al., 2010) which uses the ratio between the sacral anterosuperior diameter and the anterior slip space of L5 to calculate the degree of slip. Thus, there is grade I - between 25% or less; grade II - between 25% and 50%; grade III - between 50% and 75%; and grade IV - greater than 75%.

Clinical Manifestations

The symptoms of spondylolisthesis differ between children and adults. Children may have abdominal pain, back pain, pelvic pain, irritability and refusal to settle or ambulate (MARCDANTE; KLIEGMAN, 2016).

In adults, the most characteristic symptom is mechanical low back pain, which begins slowly. High-grade spondylolisthesis presents vesico-sphincter alterations and root involvement. In this degree, pain is more frequent in lumbar spine hyperextension (RIBEIRO; MARQUES, 2015).

One of the first warning signs of spondylolisthesis occurrence is the hyperlordosis found from shortening of the hamstring muscles. The patient will develop a typical posture due to this shortening. In symptomatic cases, the most common complaint is mechanical low back pain. The degree of slippage may or may not be related to the severity of the pain. Radiculopathy is less frequent, but progressive vertebral translation is observed when instability occurs. S1 radiculopathy is less frequent than L5 radiculopathy and pain may increase with spinal extension and improve with rest (TEBET, 2014).

In adults, low back pain with or without lower limb irradiation is considered normal and needs to be differentiated from discogenic low back pain, worsening when sitting or flexing the spine. Other symptoms are lower extremity pain, weakness associated with sitting posture or walking, and paraesthesia. Pain is predominant in 94% of cases (JACOBS et al., 2011).

Diagnosis

The diagnosis of spondylolisthesis should start with a clinical history that takes into consideration the patient's symptoms and be complemented with imaging exams such as magnetic resonance imaging and computed tomography (MARCDANTE; KLIEGMAN, 2016).

Radiography is the simplest exam for this diagnosis, as it shows a change in the lamina region between the upper and lower articular facets, but does not detect early and acute lesions and does not regularly reveal spondylolisthesis, requiring more advanced exams that will be more useful in diagnosis, such as magnetic resonance imaging and computed tomography (MARCDANTE; KLIEGMAN, 2016).

Magnetic resonance imaging has a high capacity to differentiate soft tissues, such as cartilage and muscle, and the application spectrum extends to various parts of the body, exploring functional and anatomical aspects. This test is widely used for the detection of lumbar spine injuries and is indicated when the patient has radiated pain to the lower limbs or associated neurological deficit. It has a high cost and does not expose individuals to ionizing radiation (OLIVEIRA et al., 2010).

In evident cases of high-grade spondylolisthesis, magnetic resonance imaging is advised to assess the condition of adjacent discs and relationships with the nervous system. This type of exam may also be performed whenever there is neurological impairment or signs of radiculopathy to identify intraspinal anomalies and nerve roots. In addition, it allows the visualization of bone edema, favoring the evaluation of the lesion, besides visualizing the foramen, the state of the adjacent vertebral discs, and the disc degeneration, which may contribute to the determination of the extreme upper limits of the fusion. Resonance visualizes the disc according to the degree of deformity, contributing to determine other abnormalities that may favor the occurrence of low back pain (ANDERSON et al., 2009; Ângelo, 2012).

Tebet (2014) points out that, after performing magnetic resonance imaging, if there is doubt about the diagnosis of spondylolisthesis, the use of

computed tomography is recommended. This exam is useful because it presents reconstructions and cuts that can be performed in 3 planes. Sagittal and coronal visualization allows identification of bone internally and externally to the vertebral canal and compression of nerve roots by soft tissues, as well as a better evaluation of the pars interarticularis lesion, which consists of the small bone segment that joins the facets of a vertebra, and the evaluation of the consolidation potential in low-grade listhesis.

An interesting detail about CT is that, even though it is a great exam to visualize the pars defect, that is spondylolysis, if it is performed in coarse sections and especially in anterosferior to posterosuperior axial sections, and without sagittal reconstruction, spondylolysis may not be visualized, leading to a false negative result (TEBET, 2014).

Tomography is a high-resolution exam that allows you to visualize the spinal anatomy clearly and contributes to the evaluation of spondylolisthesis. It also provides more detailed information, such as the actual conditions of the vertebral body and pedicles, and acts accurately, helping to identify anomalies. Although not invasive, it has a disadvantage because it uses ionizing radiation, which may cause DNA changes and the appearance of tumors. It is important to emphasize that these negative effects appear after long periods of exposure to this radiation, and not simply if the patient has a CT scan (FERRO, 2012).

Uribe, Gallegos and Ramirez (2014) conducted a study in 2011 with 20 spondylolisthesis patients enrolled in the spine outpatient clinic. They underwent radiography, magnetic resonance imaging and computed tomography, and their identity was omitted during the study. These examinations were previously analyzed by three consultants: one radiologist and two orthopedists. The consultants performed a comparative evaluation between the examinations, as well as the quality of the images and the presence or absence of alterations suggestive of the disease. All examinations were considered of good quality. The authors pointed out that radiography, even being a simpler exam, helps in the initial identification of the disease. Magnetic resonance imaging and tomography are highly sensitive imaging exams, with MRI with moderate specificity and CT with more complex specificity for spondylolisthesis. These two tests have a high diagnostic value when this disease is suspected, however, they should be requested and evaluated by professionals. The authors concluded that although MRI detects the disease, CT is the most sensitive and specific method and is the best imaging method for the detection of spondylolisthesis.

Minguetti and Ferreira (2011) conducted a prospective study with 30 patients with degenerative spondylolisthesis who underwent X-ray and computed tomography examinations between 2009 and 2010. The examinations were analyzed by three volunteer radiologists. The authors' objectives were to verify the effectiveness of radiography and CT in the diagnosis of this disease and to compare the sensitivity between these two exams. Thirteen men and 17 women aged 35 to 77 years were evaluated. All patients underwent radiographic evaluation (anteroposterior spine X-ray, profile, hyperflexion profile and hyperextension). By comparing the image of the two exams, the authors concluded that CT has a high level of sensitivity. They point out that computed tomography is very effective because it reveals morphological details perfectly correlated with the real anatomy of the lower back. Compared to conventional radiography, CT stands out for providing some formatting with different filters, better planning, and better diagnostic and surgical guidance for spondylolisthesis or any type of spine pathology.

A retrospective descriptive study by Matos and Gusmão (2008) evaluated 30 patients with degenerative spondylolisthesis at level L4-L5. All of them underwent radiography and magnetic resonance imaging during 2007. The evaluation was performed by two radiologists who did not have access to the patients' clinical information, only the examinations performed. The reading of the exams was performed through the E-film program. The observed results confirm that radiography is not an accurate system for identification or diagnosis of the disease, presenting only the pars interarticularis defect in small proportion. Already with MRI, it was possible to visualize, in addition to the pars interarticularis defects, the acute and chronic complete defects such as: reactional alteration of the pedicles' signal intensity, wedge of the posterior vertebral body and increase of the anteroposterior diameter of the vertebral canal at the level of the isthmus defect. The authors concluded that, compared with radiography, MRI presents high sensitivity and favors a better identification of lumbar spine alterations, helping in the diagnosis, as it presents more functional information.

Treatment

Conservative treatment is one of the initial choices and is recommended for pain reduction, stabilization and strengthening of paravertebral muscles and restoration of range of motion, and consists of the use of drugs recommended for analgesia and physical rehabilitation (MOOLER, 2010).

Conservative treatment with physical therapy through the use of manual therapies will have beneficial effects on the patient's functional improvement and involves manipulation of the cervical, lumbosacral, thoracic and sacroiliac joints, as well as stretching of affected muscles (JASSI et al., 2010).

Freitas and Neves (2012) point out that conservative treatment is indicated for slips of less than 30 to 50% in growing children and larger slips in adolescents, and suggest promoting activity restrictions, rehabilitation of abdominal, spinal muscles. and the trunk, as well as the use of orthoses for pain reduction.

For treatment, Panjabi (2010) pointed out that patients with chronic low back pain demonstrated that strengthening muscle groups partially relieves pain, as well as hamstring stretching and hip flexor strengthening.

Regarding surgical treatment, Wald (2013) states that the goal is to join the smallest possible number of moving spinal segments, enabling the restoration of the vertical sagittal axis, sacrum and lumbar spine in their normal position. This therapeutic intervention is recommended for asymptomatic children with slippage greater than 50%, for asymptomatic patients with slippage greater than 75% who have skeletal maturity, and for symptomatic patients who do not respond to conservative treatment. Surgical treatment with arthrodesis and root decompression is indicated for cases in which conservative treatment did not respond well, or when there is a progressive neurological deficit.

According to Matsunaga et al. (2012), the main objective of surgical procedures is the decompression of all compromised nerve tissues through bone ablation and some soft tissues that contribute to the stenosis of the lateral recesses and central spinal canal.

Prevention

Freitas and Neves (2012) highlight that the best way to prevent this disease is through exercises that stabilize the spine and the adoption of simple measures in the routine, such as muscle strengthening and weight loss.

Another recommended method that has been used as prevention and treatment is pilates. The practice of these exercises stimulates the increase of muscle strength that help stabilize the spine and promotes greater muscular endurance of the whole body (PUPPIN, 2014).

Conclusion

Magnetic resonance imaging and computed tomography are the most appropriate exams for the diagnosis of spondylolisthesis, since they allow a better visualization of the L4-L5 or L5-S1 segments slippage compared to radiography, which allows only the initial diagnosis, but with a better diagnosis. view to a lesser extent. Magnetic resonance allows the detection of lumbar spine injuries and functional details and computed tomography allows visualization of the anatomical details of the spine that contribute to the evaluation of spondylolisthesis. Importantly, tomography has as disadvantage the use of ionizing radiation that, with continuous use, can cause damage to patients.

References

[1] ANDERSON, K; CONWAY, JJ; LOGUE, ES; SCHAFER, MF. **Quantitative assessment with SPECT imaging of stress injuries of the pars interarticularis and response to bracing.** Journal of Pediatric Orthopaedics, p. 28-33, 2009.

[2] ÂNGELO, B. **Pilates no tratamento da Espondilolistese**. Disponível em: http://fisioterapiarenatabs.blogspot.com.br/2012/12/pilates-no-tratamento-da.html. Acesso em 15 abr. 2019.

[3] FERRO, WM. **Espondilólise e Espondilolistese**: Um Estudo de Caso. 2012.

[4] FREITAS, M; NEVES, N. **Espondilolistese do desenvolvimento**. Revista Portuguesa de Ortopedia e Traumatologia. v. 20, p.399-413, 2012.

[5] JACOBS WC, KLEUVER M. **Fusion for low-grade adult isthmic spondylolisthesis**: a systematic review of the literature. Euro Spine J. 2011.

[6] JASSI, FJ. *et al*. **Terapia manual no tratamento da espondilólise e espondilolistese**: revisão de literatura. Fisioterapia e Pesquisa, São Paulo, v.17, n.4, p.366-71,2010.

[7] MAC-THIONG, JM; LABELLE, H. **Reliability and development of a new classification of lumbosacral spondylolisthesis**. Scoliosis. 2006.

[8] MARCDANTE, K; KLIEGMAN, R. **Nelson Princípios de Pediatria**. Tradução 7ed, Elsevier, 2016.

[9] MATOS, MA; GUSMÃO, MS. **Diagnostic significance of magnetic resonance in low back pain.** Revista de Salud Pública. v.10, 2008.

[10] MATSUNAGA, S, IJIRI, K, HAYASHI, K. **Non surgically managed patients with degenerative spondylolisthesis**: a 10 to 18 year follow-up study. J. Neurosurg. 93(2 Suppl):2012.

[11] MINGUETTI, G; FERREIRA, MV. **Tomografia computadorizada da coluna lombar:** análise de três casos de metástase**.** Revista Neuro-Psiquiatra. v.38, n.4, p.404-410, 5ª edição, 2011.

[12] MOOLER, LM. **Dor Lombar Aguda Inespecífica.** 2010.

[13] OLIVEIRA, SF de; JÚNIOR, RS; GOUVÊA, PRPS. **Espondilolistese e olistese degenerativa: escolhendo o melhor termo a ser usado**. Revista Científica do Hospital Central do Exército. Ano III, n.2. 2010.

[14] PANJABI, MM. **The stabilizing system of the spine Part I. Function, dysfunction, adaptation, and enhancement**. Journal of Spinal Disorders. 2010.

[15] PUPPIN, MAFL. **Alongamento muscular na dor lombar crônica inespecífica**: Uma estratégia do método GDS. Revista Fisioterapia e Pesquisa, São Paulo, v.18, n.2, p.166-121, 2014.

[16] RIBEIRO, JL; MARQUES, CC. **Análise laboratorial de marcha em pacientes portadores de lombalgia após aplicação do método pilates**. São José dos Campos, SP, 2015.

[17] RODRIGUES, P. Espondilolistese. **Revista Textos e Contextos**, Porto Alegre, v.9, n.2, p. 345-357, 2014.

[18] TEBET, MA. **Conceitos atuais sobre equilíbrio sagital e classificação da espondilólise e espondilolistese.** Jundiaí, SP. Revista Brasileira de Ortopedia. 2014.

[19] URIBE, EV; GALLEGOS, JL; RAMIREZ, LG. **Traumatic Lumbar Espondylolisthesis:** a case report. Coluna, 2014.

[20] WALD, RLP. Classification of spondylolisthesis as a guideline for treatment. In: Bridwell KH, Hammerberg, KW, editors. **The textbook of spinal surgery.** 2ed. Philadelphia: Lippincott-Raven; 2013.

[21] ZONER, *et al*. **Contribuição dos Métodos de Diagnóstico por Imagem na Avaliação da Espondilólise.** São Paulo, SP. Revista Brasileira de Reumatologia. v.46, n.4, p.287-91, 2006.

Citation: **Jordana Alves Pereira, Christiana Vargas Ribeiro**. *The Importance of Magnetic Resonance and Computed Tomography in the Diagnosis of Spondylolisthesis. Archives of Radiology. 2019; 2(2): 28-33.*