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ADULT LUMBAR SCOLIOSIS

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ABSTRACT

Scoliosis in the adult is a disorder that involves a convergence of deformity and degenerative disease in the spine. It can be defined as a coronal deformity with Cobb angle of more than 10 degrees in mature patients. The treatment of adult lumbar scoliosis deformity requires a multidisciplinary approach and preoperative planning, and to be extended to the development of new treatment methods in the future along with the expected life expectancy. It often manifests with low back pain. Etiology of the disease is related with primary degeneration or continuation of a deformity from adolescence. The main objective of surgical management is to decide which patient is to be treated with surgical treatment, to evaluate the general condition and to analyze the comorbidities of the patient and to draw a treatment scheme considering the patient's expectations.

Key words: Adult scoliosis, De novo scoliosis, Degenerative scoliosis, Adult idiopathic scoliosis, surgical management

Level of Evidence: Review article, Level V

INTRODUCTION

Adult lumbar scoliosis is defined as coronal spinal curvature with Cobb angle >10° in skeletally mature patients [(1)]. It is a three-dimensional deformity, often accompanied by the sagittal and rotational component [(18)]. Compensatory thoracic curve may also be accompanied [(3)]. Adult scoliosis is mainly seen as two types; degenerative and idiopathic. Adult degenerative scoliosis is also known as de novo scoliosis. The majority of patients are older than 60 years and more common in women [(15)]. Asymmetric disc degeneration and facet hypertrophy, ligament laxity, osteoporosis, compression fractures play role in the etiology of the disease [(22)]. The degree of curvature is less than 20 degrees in most patients. Adult idiopathic scoliosis is an advanced presentation of adolescent scoliosis [(4)]. It occurs at younger ages and the degree of curvature is generally higher [(2)].

CLINICAL ASSESSMENT

The most important clinical manifestation of adult degenerative scoliosis is low back pain [(16)]. It is usually seen as a combination of axial back pain and radicular leg pain. Pain may be due to spinal instability, facet joint arthropathy, disc degeneration or foraminal stenosis [(2)]. In adult idiopathic scoliosis, degenerative changes are less due to young age. The main complaint of these patients is their cosmetic appearance rather than low back pain. With the aging process, the pain complaint due to degenerative changes gradually increases. During the patient's examination, detailed sensory and motor neurological examination should be performed and the gait of the patient should be examined. In patients with neurological deficits, bilateral lower extremity electromyography (EMG) should be used to determine the degree of radicular involvement.

RADIOLOGIC ASSESSMENT

The treatment plan of adult scoliosis is possible by radiological analysis of the curvature. As in all deformity cases, radiological evaluation starts with X ray. At this stage, not only the lumbar region

but the entire vertebral column should be evaluated. For this purpose, standing scoliosis anteroposterior (AP) and lateral radiographs is the standard method. Global spinal balance should be evaluated and the size of both structural and compensatory curves should be determined. Then, bending X-rays are taken to evaluate the flexibility of the curvature [5]. In order to detect instability in degenerative scoliosis, lateral lumbar dynamic radiographs should be taken. Computed tomography (CT) provides detailed evaluation of bone structure. Detection of spinal canal or foraminal stenosis, facet joint degeneration, presence and location of osteophytes are evaluated with CT during the surgical plan. The status of neural structures is examined by Magnetic Resonance (MR). Especially in cases with neurological deficits, soft tissue pathologies, condition of cord and nerve roots, presence of disc degeneration and ligament hypertrophy should be evaluated by MRI and the strategy of neural decompression should be determined during surgery. Finally, bone density measurements should be made with Dual-energy x-ray absorptiometry (DEXA) in osteoporotic patients, and necessary precautions should be taken to increase the implant strength during the operation [12].

NONOPERATIVE TREATMENT

There is no consensus-based treatment method for conservative treatment of adult scoliosis. Anti-inflammatory and analgesic drugs, bracing, physical therapy and steroid injections are the most commonly used methods. Currently, conservative treatment is more common in patients who have mild symptoms or need to be not operated because of comorbid risk factors.

SURGICAL TREATMENT

Operative goals for adult spinal deformity include restoration of sagittal and coronal plane alignment, stabilization via instrumentation, and decompression of neural elements. Although surgical treatment of adult scoliosis is very useful, some studies reported complications up to 80 % [6]. Risk factors for complications include advanced age, comorbidities, long segment instrumentation, osteotomy and revision. Major complications occurring in the perioperative period include, for example, vascular injury, excessive blood loss, deep vein thrombosis, nerve root injury, and deep wound infection as well as life-threatening complications such as sepsis, myocardial infarction, pulmonary embolism, and catastrophic neurologic injury.

To avoid these complications, blood loss control, hypotensive anesthesia, autologous blood donation, use of antifibrinolytic agents, intraoperative neurophysiologic monitoring is required. In addition, it should be noted that surgical procedure is the work of team especially in this age group. If possible, the complication risk decreases even more with two experienced surgeons working in harmony with each other [11].

Determining the levels necessary for central and foraminal decompression is decided by a combination of clinical and radiographic findings. For example, if the patient demonstrates signs of neurogenic claudication and has corresponding significant lumbar central stenosis, then laminectomies and decompression should be incorporated into the surgical plan in addition to correction of the deformity. Similarly, if the patient has signs of a particular radiculopathy and corresponding foraminal stenosis on imaging, then the surgeon should be conscientious about decompressing those nerve roots in the surgical plan either through direct or indirect decompression methods. The surgeon must also be careful during the reduction of the deformity across osteotomy levels as nerve compression may result from iatrogenic narrowing of the neural foramen or of the spinal canal [14]. For elderly patients with osteoporosis and for patients requiring advanced correction maneuvers, cement augmentation should be considered to advance the attachment and strength in bone-screw interface (Figure-1).

Decompression of the neural elements may be achieved by direct laminectomy and/or facetectomy or indirectly via interbody grafts or other devices that increase foraminal height and/or canal diameter [16].

The methods of interbody device placement include anterior (anterior lumbar interbody fusion [ALIF]), anterolateral (oblique lumbar interbody fusion [OLIF] and lateral lumbar interbody fusion [LLIF]), and posterolateral (transforaminal lumbar interbody fusion [TLIF] and posterolateral lumbar interbody fusion [PLIF]) techniques (Figure-2).

In recent years, minimally invasive surgery (MIS) techniques have been used in the surgical treatment of adult scoliosis. The most common method is minimally invasive surgery for transforaminal lumbar interbody fusion (MIS-TLIF) technique. MIS-TLIF showed less blood loss and shorter hospital stay than the open surgery. There was no significant difference in fusion rates. Increased radiation exposure and prolonged operation time due to long learning curve are disadvantages [10].

Correction of the deformity is one of the main goals in the surgical treatment of adult scoliosis. The lumbar curvature in the coronal plane does not have to be corrected fully. An excellent cosmetic appearance is usually a secondary goal in this population. Recently, the sagittal plane has gained a lot of emphasis. The sagittal plane deformities appear to be more painful and poorer outcomes on health-related quality of life

questionnaires [7]. When the lumbar scoliosis is corrected, one has to pay special attention to obtain adequate lumbar lordosis. There is nothing worse than a lumbar scoliosis that is diffuse without adequate lumbar lordosis leading to a very flat rigid lumbar spine resulting in a flat back posture. These patients usually end up requiring a pedicle subtraction osteotomy so they can stand up straight [8].

Correction of deformity in adult scoliosis is more difficult than adolescent idiopathic scoliosis. Because the curvature of these patients is rigid. The disc spaces are narrow and stiff due to the advanced degenerative disc disease. There are osteophytes present at the degenerated levels that are frequently bridging across the disc space over time. At times, the facet joints are hypertrophied and almost ankylosed. Often, in order to correct the spinal deformity, one has to release the disc space by cutting the entire annulus, removing the disc, and distracting the disc space manually.

The intradiscal release provides the ability to change coronal and sagittal alignment. Resecting the facet joints posteriorly also provides the ability to mobilize the spine to gain segmental correction. All these release and resections increase the flexibility of the rigid curvature and facilitate the correction. However, in patients with solid fusion, the correction can only be achieved by osteotomy. The most commonly used osteotomies are Smith Peterson and pedicle subtraction osteotomies.

Figure-1. 65 years old female patient. Adult degenerative scoliosis with coronal and sagittal imbalance is obvious in preoperative radiological assessment. The global spinal balance restored by T10-S1 posterior instrumentation with fenestrated pedicle screws, cement augmentation and distal iliac fixation.

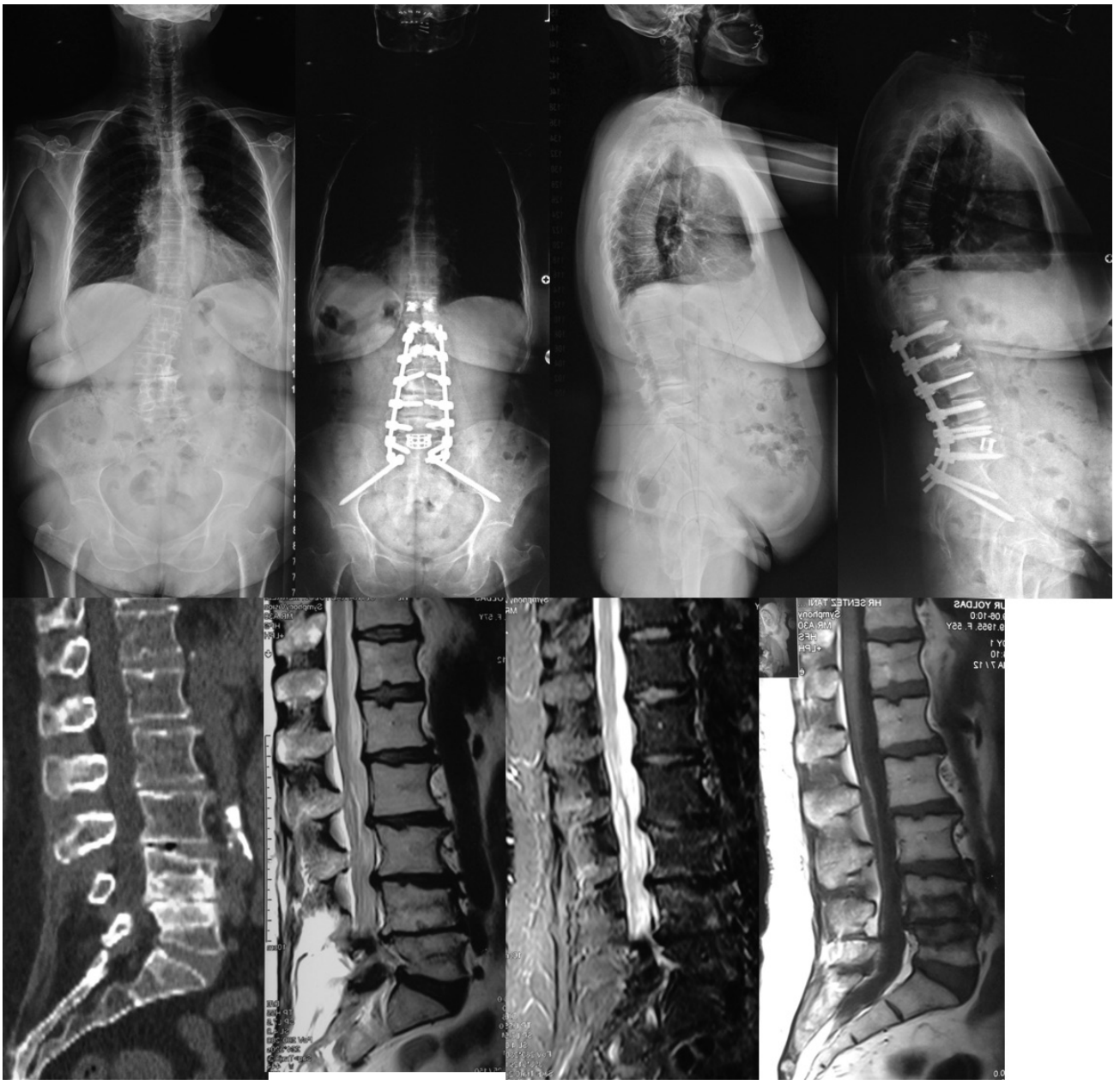

Figure-2. 74 years old female patient. Lumbar spinal stenosis and degenerative de novo scoliosis. Posterior L1-Iliac instrumentation and TLIF at L5-S1 level were performed.

These osteotomies are mainly used to correct sagittal alignment. However, with the biplane pedicle subtraction osteotomy, coronal and sagittal plane correction is possible.

Pelvic fixation should be considered and utilized when there are greater biomechanical stresses expected than S1 screws can withstand. An inability to achieve adequate fixation strength through sacral screws only can lead to an unacceptably high risk of implant loosening, pseudarthrosis, and failure. In this regard, the primary goal of pelvic fixation is to ensure a stable foundation for the construct and allow for maintenance of the deformity correction and solid arthrodesis [13]. Indications of pelvic fixation are high grade spondylolisthesis (Meyerding Grade 3-4), long fusions to sacrum (extends L2 vertebra or more proximal), the use of corrective osteotomies and osteoporosis that effects the pullout strength of the S1 pedicle screws.

COMPLICATIONS FOLLOWING SURGERY

Numerous studies have reported the incidence of complications of adult scoliosis surgery. Early surgical complications are

iatrogenic neurologic injury (27.8 %) [19], dural tear (2.2 %) [21], surgical site infections (4.1 %) [17] bleeding and hematoma (8.9 %) [16]. Most of the late complications are related with implant related complications include breakage, malposition, migration/dislodgement, and pain/prominence (32 %) [20]. There is also medical complications consist of death, myocardial infarction, ileus, deep vein thrombosis (DVT) and urinary tract infections. Despite the relatively high rates of associated complications and adverse events, multiple studies have demonstrated the potential of surgical treatment of adult spinal deformities including scoliosis to provide significant improvement in health-related quality of life measures.

CONCLUSION

Adult scoliosis is a complex, heterogeneous disease that encompasses a vast array of pathology and symptoms. Non-operative management runs the gamut from benign neglect to more invasive interventions such as epidural steroid injections.

Similarly, operative management can range from minimally invasive surgery and smaller open procedures to much larger operations addressing multiple levels of the spine. Traditional open surgery and minimally invasive surgery appear to benefit the patient, so long as the appropriate procedure is chosen. Emphasis on alignment goals and achieving a balanced spine are critical for patient improvement. Surgeons must understand the spinal deformity and the needs and goals of the patient in order to achieve a good outcome [9].

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