REVIEW ARTICLE

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IN MEMORIAM: PROF. DR. EMİN ALICI - A PERSPECTIVE ON OSTEOTOMIES IN SPINAL DEFORMITY SURGERY

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ABSTRACT

Spinal deformity is a condition that can arise at any age, from early childhood to advanced age, and may result from a wide range of causes (congenital, neuromuscular, etc.). Spinal deformities can affect the entire spine, causing dysfunction at a young age; however, when they occur later in life, they can lead to progressive asymmetric degeneration, resulting in clinical problems ranging from axial back pain to neurological deficits. Advances in implant technology and surgical techniques have enabled more effective treatment of spinal deformities. While spinal alignment can be achieved with standard methods in flexible deformities, vertebral osteotomies are required to obtain the correction necessary for clinical improvement in rigid cases. Generally, osteotomies can be categorized into three main types: posterior column osteotomies (PCO), including Smith-Petersen osteotomy (SPO) and Ponte osteotomy; pedicle subtraction osteotomies (PSO); and vertebral column resections (VCR)/posterior VCR (PVCR). A single-level PCO achieves 10-20 degrees of correction for kyphotic deformities. When surgical experience is insufficient to permit more extensive osteotomies, PCOs (SPO and Ponte) are considered the least complex procedures available. PSO is a three-column osteotomy in which the pedicles and portions of the vertebral body are resected to form a wedge. With maximal bone resection, PSO typically provides approximately 30 degrees of correction at the lumbar level. Bone-disc-bone osteotomy can be considered an extended osteotomy within this group, in which bone sections are removed from both the upper and lower regions at the disc level. Generally, this technique corrects deformities between 35° and 60°. Domanic osteotomy, a type of total wedge osteotomy, involves the resection of the posterior and middle columns, terminating at the anterior cortex while preserving the anterior longitudinal ligament. With Domanic osteotomy, a maximum correction of 65 degrees can be achieved in a single procedure.

VCR/PVCR involves the aggressive removal of one or more vertebral bodies. These osteotomies are the most powerful posterior osteotomy methods, enabling successful correction of severe and complex deformities. Because these surgeries are technically demanding and carry a high risk of complications, it is recommended that they be performed only by experienced teams.

Keywords: Osteotomies, spine deformity, deformity correction

In Memory

Spine surgery in our country, as in the rest of the world, was initiated and advanced by outstanding mentors whose contributions are irreplaceable. Among these esteemed teachers, our beloved mentor Prof. Dr. Emin Alıcı, whom we lost recently and remember with gratitude, holds a foremost place.

Two key moments involving our great mentor, Prof. Dr. Emin Alıcı, played an important role in my own entry into spine surgery. The first occurred during my residency when I watched him narrate a cervical procedure on TRT 1. The patient improved so remarkably that, when instructed to move the neck slowly, the patient replied, "I am fine; I can even do it firmly", and moved the neck with confidence.

The second moment came when Prof. Dr. Emin Alıcı, at the invitation of Prof. Dr. Ünal Kuzgun, visited University of Health Sciences Türkiye, Şişli Hamidiye Etfal Training and Research Hospital, where I was a resident. Without hesitation and tirelessly, he spoke to us about the establishment and foundations of spine surgery in our country, its evolution up to

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that time, and the outcomes achieved with the Alıcı implants he had developed and used in various operations.

In the following years, we continued to follow our mentor closely, sustaining our excitement by watching his spirited yet affectionate exchanges with another of our great teachers, Prof. Dr. Ünsal Domaniç. I was fortunate to take my associate professorship examination at the Orthopedics and Traumatology Department of Dokuz Eylul University, where Prof. Dr. Emin Alıcı served as rector and head of the clinic, and to have the honor of receiving my associate professor's gown from his hands.

His guidance was also my compass on the illuminated path that ultimately led me to the presidency of the Turkish Spine Society, which he founded.

Dear mentor, your determination, your working methods, and your boundless contributions to spine surgery in our country will continue to illuminate us. We will persist in being steadfast advocates and practitioners of spine surgery on this path. I am certain that your spirit continues to watch over us and that your light continues to guide our way. As your students, we pledge to follow this bright path and continue serving our patients, our country, and humanity.

INTRODUCTION

Spinal deformity is a condition that can arise from a wide range of causes (congenital, neuromuscular, etc.) from early childhood to advanced age. Spinal deformities may involve the entire spine in the coronal, sagittal, and axial planes and can lead to substantial functional impairment. Deformities that present later in life (adult scoliosis) may cause progressive asymmetric degeneration of spinal elements, creating clinical problems ranging from axial back pain to neurologic deficits[1,2].

With the emergence of pedicle screw-rod constructs and an improved understanding of spinal anatomy, complex posterior-only vertebral osteotomy techniques have become increasingly popular in recent years for the correction of coronal and sagittal spinal deformities[3].

Alongside advances in medicine and technology, global life expectancy has increased, leading to a growing elderly population and, compared with the past, shifting expectations regarding what constitutes a satisfactory quality of life[4].

Although advances in surgical instrumentation and deformity correction techniques are frequently used during spine surgery to restore alignment, patients with fixed deformities often require vertebral osteotomies to achieve the degree of correction necessary for meaningful clinical improvement. Long-term outcomes for newer technologies and developments are still limited; therefore, this remains a continual learning process. Each vertebral osteotomy has advantages and disadvantages that must be carefully considered during preoperative planning. This review aims to discuss the surgical techniques and clinical outcomes of the major osteotomy methods used in spinal deformity[4].

Osteotomies in Spinal Deformity

Spinal deformities are complex structural changes arising from disruption of normal alignment in the sagittal and coronal planes. Although these deformities can be encountered at any age from childhood to advanced years, their clinical manifestations vary depending on age, deformity type, and rate of progression. In pediatric patients, cosmetic concerns and postural disturbance often predominate, whereas in adults, pain, loss of mobility, impaired balance, fatigue, and reduced functional capacity are more prominent. The primary goal of surgical treatment is to restore balanced alignment and improve quality of life while preventing progression and recurrence.

Severe spinal deformities may occur in conditions such as Scheuermann kyphosis, neuromuscular disorders, congenital and degenerative diseases, and severe rheumatologic disorders such as ankylosing spondylitis. Osteotomies occupy a critical place in the surgical treatment of spinal deformity. A spinal osteotomy is a surgical procedure in which a portion of bone is resected to correct spinal alignment. Conceptually, osteotomy refers to restoring mechanical harmony by the controlled removal of a defined spinal segment.

Spinal osteotomy can markedly improve symptoms caused by deformity. By reducing pain and restoring balance, it allows the patient to stand upright without the need to flex the hips or knees. It improves cosmetic appearance, restores horizontal gaze, and may also lead to improvement in visceral organ function.

In rigid and advanced deformities, instrumentation and ligamentous releases alone are insufficient. Severe deformities can be corrected only with osteotomies; therefore, bony structures must be removed in a controlled manner, and the spine must be brought into a new alignment. Selection of osteotomy depends on many factors, including deformity rigidity, location, the amount of correction required, and the surgeon's experience. Spinal deformities are often multiplanar, involving components of flexion-extension, rotation, and translation; therefore, the corrective maneuver must also be multidirectional[5].

SRS-Schwab Classification Based on Resected Anatomical Structures[6]

I. Grade 1: Partial facet joint resection (inferior facet and joint capsule).
II. Grade 2: Complete facet joint resection (resection of ligamentum flavum and facet joints).
III. Grade 3: Pedicle and partial vertebral body (partial wedge resection of the posterior vertebral body and posterior elements).
IV. Grade 4: Pedicle, partial vertebral body, and disc (wider wedge resection of the posterior vertebral body, posterior elements, and a portion of more than one endplate and the intervertebral disc).
V. Grade 5: Complete vertebra and both adjacent discs.
VI. Grade 6: Multiple vertebrae and discs.

Main Types Of Osteotomy

Goals of Deformity Correction:

a. To re-establish global sagittal balance.
b. To align the position of the head and trunk.
c. To reduce biomechanical loading that causes pain.
d. To increase functional capacity and walking endurance.

In general, osteotomies can be considered under three main headings:

a. Posterior column osteotomies (PCO) [Smith-Petersen osteotomy (SPO) and Ponte osteotomy]
b. Pedicle subtraction osteotomy (PSO)
c. Vertebral column resection (VCR)

During surgical planning, the expected correction achievable with the chosen osteotomy is compared with the target ideal alignment. While PCOs may be sufficient for lower-grade flexible deformities, more aggressive techniques such as PSO or VCR are required for high-grade rigid kyphotic deformities.

PCO (SPO and Ponte)

PCO (Figure 1A-B) are based on resection of posterior elements to allow opening through the disc space[7]. Mobility of the disc is required for these osteotomies. Because correction is achieved through the disc space, this osteotomy is considered an anterior column lengthening procedure. The resected structures include the facet joints, laminae, and posterior ligaments (supraspinous, interspinous ligaments, and ligamentum flavum).

SPO was first described in 1945 by Smith-Petersen et al.[8]. In general, SPO corresponds to grade 1 in the SRS-Schwab classification, whereas the Ponte osteotomy is classified as grade 2. Historically, SPOs were performed in the lumbar spine for ankylosing spondylitis. In 1984, Ponte described a very similar PCO[9]. The Ponte osteotomy is used for aggressive posterior resection of the thoracic spine, most commonly in kyphotic deformities. When performed asymmetrically, both SPO and Ponte osteotomies can also contribute to coronal correction. When surgical experience does not permit more extensive osteotomies, PCOs (SPO and Ponte) are the least complex procedures that can be performed.

PCO can be performed at multiple levels, enabling harmonious restoration of sagittal balance. Typically, a single-level PCO provides 10-20 degrees of kyphosis correction. It has been suggested that approximately 1 mm of resection may yield about 1 degree of correction (Figure 2).

This is ideal for conditions such as Scheuermann kyphosis, where gradual and staged correction is required. If necessary, they can be performed sequentially or at alternating levels. PCOs may also be used as adjunctive procedures at additional levels during more comprehensive correction[10-13].

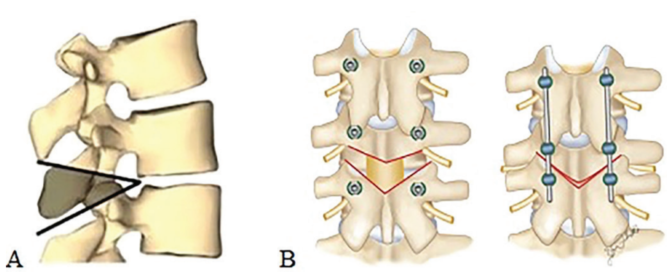

Figure 1. A) Schematic sagittal diagram of PCO. **B)** Smith Petersen osteotomy. PCO: Posterior column osteotomies

PSO

PSO is a three-column osteotomy in which the pedicles and portions of the vertebral body are resected in a wedge shape (Figure 3). Similar to SPO, it involves resection of posterior elements and facet joints, and additionally includes removal of part of the vertebral body together with the pedicles. It was first described in 1985 by Thomasen[14] and by Heining[15], with minor technical differences. Thomasen removed bone using an osteotome, whereas Heining preferred decancellation of the vertebral body using the 'eggshell' technique[14,15].

PSO involves all three spinal columns (posterior, middle, and anterior). When the osteotomy is closed and compressed, the posterior spine is shortened, and neural tissues are relatively decompressed/relaxed. It is also philosophically similar to closed wedge osteotomies used for the correction of deformities in the extremities. This corresponds to a grade 3 resection in the SRS-Schwab classification. An extended PSO corresponds to grade 4.

PSO is highly suitable for patients with marked, rigid sagittal imbalance[7]. Etiologies of fixed sagittal plane deformity include ankylosing spondylitis, flatback syndrome, and iatrogenic causes. Lumbar kyphosis can be caused by congenital anomalies, trauma and pathological fractures, infections, metabolic or neoplastic diseases. Patients with type 2 sagittal deformities with sagittal vertical axis >12 cm, those with sharp kyphosis, and those with 360-degree fusion in multiple segments who cannot undergo SPO can be considered ideal candidates for PSO. When PSO is performed asymmetrically, it can be a

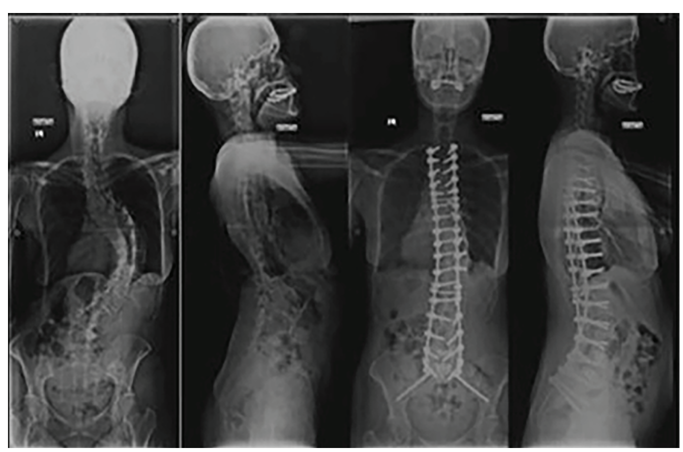

Figure 2. Adult scoliosis deformity, 58-year-old female patient. Correction in sagittal and coronal planes with multiple asymmetric SPO (From Prof. Dr. Azmi Hamzaoğlu archive). SPO: Smith-Petersen osteotomy

solution for type 1 coronal and type 2 sagittal imbalances. In these cases, osteotomy can be evaluated between a standard PSO and VCR[16]. With maximal bone resection, PSO typically provides approximately 30 degrees of correction at lumbar levels and is most beneficial when performed at the apex of the deformity.

Although primarily defined in the lumbar spine, it can be used in all regions of the spine, including the cranial or caudal aspects of the conus medullaris, as well as the cervical and thoracic regions. It is best performed at the apex of a sharp deformity. It provides greater correction of lordosis compared to SPO. In some cases, it can also be applied sequentially or alternately (skipped levels) (Figure 4). However, these cases are more significant in terms of stabilization and complications[10-12].

Bone-disc-bone Osteotomy (BDBO)

This osteotomy involves removal of the disc level together with bony portions immediately adjacent to both the superior and inferior endplates. In general, this technique provides 35-60 degrees of deformity correction. It is used when the apex of the deformity is typically at a disc level and when greater correction than PSO is required. It can be performed in three configurations (Figure 5)[17].

Technically, the disc is removed along with its proximity to the lower endplate, and an oblique osteotomy is performed on the bone above it. Conversely, an oblique osteotomy can be performed on both the disc and the bone below it. Alternatively, a convergent oblique osteotomy can be performed on both the upper and lower bones, and the disc is removed along with it. In this latter type, the maximum sagittal angle correction can be achieved. Fixation should be achieved by applying pedicle screws to at least two (often three) upper and two lower segments of the osteotomy line. The osteotomy line is closed by compression, ensuring complete bone-to-bone contact. If an open area remains in the osteotomy region, or if the anterior column needs to be lengthened to prevent dural buckling, the anterior section should be supported with a metal cage, strut allograft, or autogenous bone graft. Because the disc is completely removed and bony surfaces are brought into contact, a major advantage of this osteotomy is a lower risk of pseudarthrosis[18,19]. Compared with posterior VCR (PVCR), it can be used more safely, particularly in the lumbar region and in cases where the apex is at the disc level, because nerve root

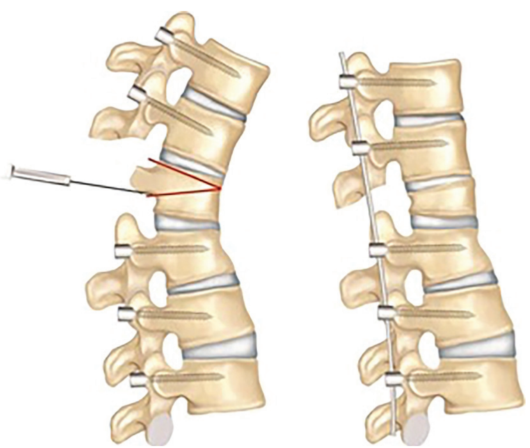

Figure 3. Pedicle subtraction osteotomy

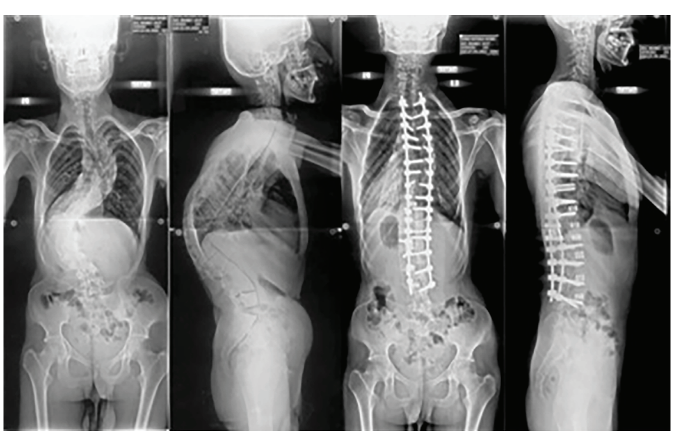

Figure 4. Nineteen-year-old male patient with kyphoscoliosis deformity. PSO at T12 level. Second stage: interbody fusions [via anterior thoracolumbar approach (from Prof. Dr. Azmi Hamzaoğlu archive)]. PSO: Pedicle subtraction osteotomies

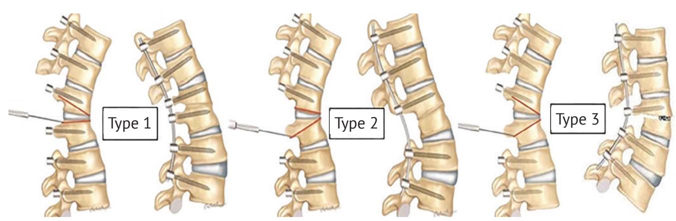

Figure 5. Three types of bone-disc-bone osteotomies

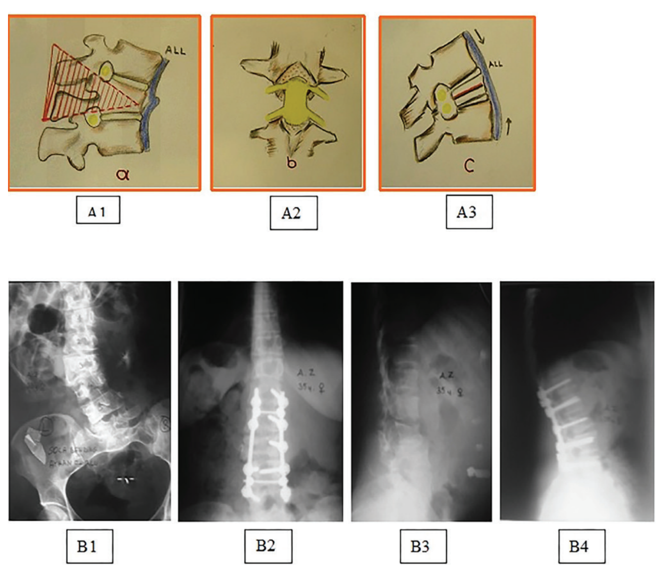

Figure 6. A1-A2-A3) An osteotomy drawing by Prof. Dr. Ünsal Domaniç, named after him (with the permission of Prof. Dr. Ünsal Domaniç). **B1-B2-B3-B4)** A case example of coronal and sagittal plane correction achieved with Domaniç osteotomy (from Prof. Dr. Ünsal Domaniç archive)

sacrifice is not required. Domanic osteotomy is similar to type 3 BDBO but includes nuanced differences[7,17,19].

Domanic Osteotomy (Posterior Total Wedge Resection Osteotomy)[19]

Although the first case was operated on in 1989, the technique was first presented internationally as an oral presentation at the complex deformity spine meeting held in Arcachon in 1991 as a series of eight cases. The expanded series was published as an international manuscript in Acta Orthopaedica Scandinavica in 2004 (Figure 6).

Total wedge osteotomy, in essence, involves resection of the posterior and middle columns that terminates at the anterior cortex of the spine, while preserving the anterior longitudinal ligament. The osteotomy is typically performed at the apex of a kyphotic deformity spanning two vertebrae. The upper and lower boundaries of the osteotomy are just below the transverse processes of the upper and lower vertebrae, respectively. The apex of the posterior-based triangular osteotomy is planned to be in the anterior vertebral body or the anterior longitudinal ligament. The osteotomy is performed carefully to avoid excessive penetration of the anterior cortex or the anterior longitudinal ligament, to prevent translation, to provide a hinge point, and to avoid injury to major or radicular vessels.

With the domanic osteotomy, up to 65 degrees of correction can be obtained in a single stage. After osteotomy and wedge resection are completed, the remaining portions of the upper and lower vertebrae usually form an intervertebral foramen containing two spinal nerves on either side of the resection site. The operation is completed by placing the rods[15]. Although this osteotomy was primarily designed for rigid kyphotic deformity, with increasing experience it has also been applied successfully to selected rigid frontal and sagittal deformities (Figure 7).

VCR

VCR represents aggressive removal of one or more vertebral bodies (Figure 8). To protect the great vessels, a thin bony rim may be left anteriorly. In the SRS-Schwab classification, this corresponds to a grade 5 osteotomy. An extended version that includes the adjacent disc space should be considered grade 6. PVCR is the most powerful posterior osteotomy technique, allowing correction of rigid and complex deformities. However, it requires longer operative time and greater blood loss compared with less invasive osteotomies, is technically demanding, and carries a high complication risk. Therefore, it should be performed only by a highly experienced surgical team. Spinal cord neuromonitoring is essential to prevent potentially catastrophic neurological injuries. VCR is the most suitable form of osteotomy for the most complex and intricate spinal deformities[7]. VCR was first described by MacLennan[20] in 1922 as a combined anterior and posterior procedure. PVCR was first introduced by Suk et al.[21] and popularized by Lenke et al.[22] for severe spinal deformities. It provides the maximum correction achievable with any spinal osteotomy.

Figure 7. Two great masters, two great friends and companions, two great teachers. Prof. Dr. Emin Alıcı (left), Prof. Dr. Ünsal Domaniç (right)

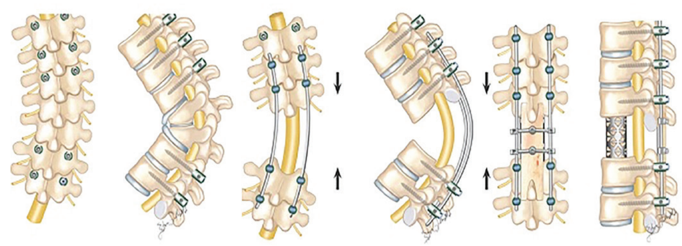

Figure 8. Vertebral column osteotomies

These deformities include rigid multiplanar deformities, fixed coronal imbalances, hemivertebra excisions, and sharp angular deformities. It is a challenging procedure reserved for severe spinal deformities with very limited or no flexibility. It allows for translational and rotational correction of the spine and provides controlled manipulation of both anterior and posterior columns simultaneously in a single approach. With these osteotomies, correction of 35-60 degrees in deformities can be achieved. It involves complete resection of one or more vertebral segments, along with the posterior elements, and the entire vertebral body, including adjacent discs. Since VCR creates a large defect in the spine, spinal fusion is also performed at these levels for reconstruction. Spinal fusion can be achieved using a structural autograft, a structural allograft, or a metal mesh. Initially, VCR was performed with a combined anterior and posterior approach, but it can now also be performed with only a posterior approach[10-12].

PSO and VCR are three-column osteotomies in which bone is removed; the less bone is resected, the easier it is to achieve spinal alignment. In type 2 and type 3 osteotomies, more bone is resected, making it more difficult to achieve spinal alignment, and these osteotomies are more prone to complicated results[5]. Hamzaoglu et al.[23] reported an average correction rate of 62% in the coronal plane and 72% in the sagittal plane in their series of 102 adult patients with severe deformities. Lenke et al.[22] reported significant improvements in curvature in 51% of scoliosis cases, 55% of general kyphosis cases, 58% of angular kyphosis cases, 54% of kyphoscoliosis cases, and 60% of congenital scoliosis cases after PVCR. In other PVCR studies involving adults and children with severe deformities, correction rates were reported as 69% for scoliosis, 54% for general kyphosis, 63% for angular kyphosis, and 56% for kyphoscoliosis[21-23].

Neurological complications can occur as a result of neurological injuries and also spinal subluxation, dural buckling, and compression of the spinal cord by remaining bone or soft tissues in the canal after correction. These complications are alarming for this surgical technique. Suk et al.[21] reported an overall complication rate of 34.3% and a neurological complication rate of 17.1%. Lenke et al.[22] reported a similar overall complication rate of 40% and a neurological complication rate of 11.4%[19]. Hamzaoglu et al.[23] also reported an overall complication rate of 7.84%, including transient nerve palsy in 1.96% of patients.

When these risky surgeries are performed in the operating room with neuromonitoring, under good imaging and/or navigation, by experienced teams, and when postoperative intensive care and clinical monitoring are adequately carried out, excellent results can be achieved in resolving difficult cases.

It has also been reported that the use of PSO and VCR has decreased recently due to technical difficulties, susceptibility to complications, and high probability of morbidity[3,24-26]. However, three-dimensional preoperative planning using CT-based methods and O-arm has increased confidence in its application. Advances in intraoperative navigation have increased the safety of these three-column osteotomies, especially in complicated cases where advanced correction is required[26-29]. It is clear that the use of navigation in osteotomy procedures is an important step towards increasing safety.

Halo-gravity Traction

Preoperative halo-gravity traction may be used to reduce surgical risks[30,31]. Adult indications are theoretically similar to pediatric indications, for example, in the presence of osteoporosis, comorbidities, and respiratory insufficiency[32]. Among other medical benefits, halo-gravity traction has been shown to significantly reduce VCR rates. A recent study in a cohort of adolescents and young adults demonstrated that preoperative halo-gravity traction resulted in a lower rate of surgical complications[31]. Complications such as neck pain, screw infections, screw penetration, and cranial nerve injuries can occur[33].

Restoration of Anterior Column Alignment

Theoretically, PSO alone may not fully restore lordosis. Anterior and anterolateral approaches can compensate for lordosis loss. In addition, anterior lumbar interbody fusion (ALIF) allows more extensive disc removal and better visualization of the endplates; however, ALIF is associated with risks of injury to peritoneal visceral contents, ureter, and the hypogastric plexus[33]. More recently, the minimally invasive anterior column realignment (ACR) approach has become popular. In this approach, anterior annulus fibrosus and anterior longitudinal ligament release should be performed to allow for the placement of “hyperlordotic” cages. The exact definition of the method is the lateral lumbar interbody fusion approach, also known as transpsoas interbody fusion[30-34].

In a recent literature review, Cheung et al.[11] suggested that ACR could be effectively used in patients who had previously undergone posterior instrumentation fusion in addition to primary cases but acknowledged that the limited number of studies in the literature have not yet clearly defined the role and indications of ACR in adult deformity surgery. Godzik et al.[35] worked to optimize the structural design during the same period. Adapting and utilizing such efforts could form the basis of a literature similar to that written on more traditional techniques[35].

One of the debated issues regarding spinal osteotomy surgeries is whether it is appropriate for one or two specialist spinal surgeons to perform these operations. The generally accepted view is that two spinal surgeons should participate in the surgery. However, it is necessary for the senior surgeon to be more experienced, better trained, and experienced in the management of complex spinal deformities. Another important issue is the need for the anesthesia team to be sufficiently experienced. Neuromonitoring is a technique that must be used in these cases, and it is recommended that a technician be present in the operating room, as well as a neurologist who monitors the surgery online. After a successful operation, another important issue is having an intensive care team ready to monitor and follow up with the patient in the intensive care unit. In complex pediatric cases, a multidisciplinary approach is also very important. Therefore, it is extremely important that many specialists, including dieticians, pediatricians, cardiologists, pulmonologists, gastroenterologists, and other child-related social workers, participate in these surgeries along with experienced spinal surgeons[12].

Complications

Complication rates in adult spinal deformity surgery range from 10.5% to 96%. The prospective, multicenter scoli-risk-1 study showed an acute decrease in lower-extremity motor strength in 22.18% of patients undergoing complex deformity surgery for adult scoliosis. At 6 months, this largely improved; 20.52% of patients demonstrated improvement in motor strength compared with preoperative status, while 10.82% did not improve. Revision spine surgery increases these risks[36-39].

Three-column osteotomies have increased complication rates due to the nature of spinal deformity and the invasiveness of the procedure. In a series by the International Spine Study Group, complications were observed in 78.0% of patients following three-column osteotomy for adult deformities. Significant complications were observed in 61% of patients. Another study showed that 11.1% of 108 adults treated with PSO for kyphotic deformity experienced neurological deficits. In children, Lenke et al.[22] found a 40% overall complication rate and an 11.4% neurological complication rate.

Complications may include iatrogenic injury to the spinal cord and nerves, dural injury, infection, or pseudomeningocele. Additionally, injury to adjacent structures such as pneumothorax, pleural effusion, large vessel injury, abdominal injury, or medical sequelae such as deep vein thrombosis, myocardial infarction, or pneumonia may occur.

After surgery, the patient should be monitored for instrumentation failure and the development of proximal junction kyphosis or proximal junctional insufficiency.

CONCLUSION

Balance is the ultimate goal of deformity correction[16]. Osteotomies offer powerful and effective correction options for advanced spinal deformities. Selection should be based on deformity type, rigidity, and patient needs. While PCO provides a safer and more reproducible approach, PSO and VCR have greater correction capacity. Navigation, three-dimensional planning, and modern instrumentation techniques continue to improve the safety and effectiveness of these operations. The patient's overall medical condition and the surgeon's level of experience are other factors in determining the ideal treatment. The high complication rate associated with osteotomies has also created a recent trend towards less invasive methods[10,29-34]. It should be emphasized that using osteotomies for deformity requires skill not only in the operating room but also in preparing a detailed, patient-specific preoperative plan. Looking ahead, multicenter studies and inter-team collaboration, together with effective technologies and digitized segmental, regional, and global preoperative planning, will provide more evidence-based guidance for complex clinical scenarios.

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The authors wish to honor the memory of Prof. Dr. Emin Alıcı, whose invaluable contributions to the establishment and development of the Turkish Spine Society and the Journal of Turkish Spinal Surgery laid the foundation for scientific progress in our field. His leadership, mentorship, and dedication continue to guide future generations. This work is dedicated to his memory with deepest respect.

Footnotes

Authorship Contributions

Surgical and Medical Practises: M.T., Ü.D., Concept: E.A., Design: Ö.A., E.A., Data Collection or Processing: F.D., Analysis or Interpretation: Ö.A., Literature Search: M.T., Ü.D., Writing: M.T., F.D.

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