



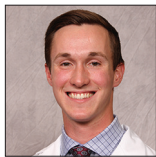
## Review Article

# Spinal deformity correction in ankylosing spondylitis

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## ABSTRACT

**Background:** Ankylosing spondylitis (AS) is a complex, debilitating disease with few available medical therapies in its later stages.

**Methods:** We reviewed current clinical approaches for caring for AS patients with an emphasis on the risks and outcomes associated with surgical intervention.

**Results:** It is critical to understand the natural history and surgical outcomes of patient with AS. Surgery is not without risks, as a vertebral body osteotomy is often required to re-establish spinopelvic equilibrium. However, surgery can lead to clinical improvements in pain, disability, cardiac function, respiration, digestion, and sexual activity.

**Conclusion:** Deformity correction for AS should be carefully considered in symptomatic patients.

**Keywords:** Ankylosing spondylitis, Deformity, Osteotomy, Spondyarthropathy

## INTRODUCTION

Ankylosing spondylitis (AS) is a complex and debilitating disease of the axial skeleton that affects 0.9% of the global population.<sup>[2]</sup> Evidence suggests a strong genetic influence with up to 90% of AS patients testing positive for HLA-B27.<sup>[2]</sup> Although there is a correlation with the HLA-B27 allele, the exact etiology and pathogenesis of disease are not fully known, making early-stage diagnosis, and treatment difficult. Advances in pharmacological treatments have improved outcomes early in the course of AS, but these treatments fail to halt the progressive anatomical changes associated with later stages of disease. As such, surgery is often required to improve quality of life.

## CLINICAL MANIFESTATIONS OF AS

Clinical manifestations of spondyloarthropathies (SpAs) are generally split into articular and extra-articular involvement. Articular symptoms include chronic inflammatory axial back pain, oligoarthritis, and enthesitis. Extra-axial involvement classically includes inflammatory bowel disease, psoriasis, and anterior uveitis.<sup>[2]</sup> Characteristic signs of AS involve spinal tension, kyphotic spinal deformity, and lack of spinal mobility.<sup>[2]</sup> AS enthesitis typically occurs at

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**Table 1:** Findings of reviewed literature.

Authors	Publication Year	Patient/ Population	Research Method/Intervention	Comparison/Outcome/Conclusion
Arun <i>et al.</i>	2011	31 patients with AS	Retrospective review of three cohorts of AS patients (12 CWO, 10 OWO, 9 PWO)	Mean correction of kyphosis and estimated blood loss varied among groups, but surgery significantly improved all patient-reported outcomes among the three cohorts
Braun and Sieper	2007	Not applicable	Literature review	AS is a common cause of inflammatory back pain, which may lead to structural and functional impairments and a decrease in quality of life. New imaging, medical, and surgical therapies have substantially changed the management of this disease compared to the last decade
Caron <i>et al.</i>	2010	112 patients with 122 spinal fractures	Retrospective review of 7-years of AS and DISH patients	Spine fractures among AS patients are high-risk and often lead to complications. Multi-level instrumentation allows effective fracture healing.
Etame <i>et al.</i>	2008	AS patients with chin-on-chest deformity	Literature review identifying six retrospective clinical studies	Following deformity correction surgery complications were minor and all patients had improvement in horizontal gaze and patient satisfaction.
Fox <i>et al.</i>	1993	33 AS patients requiring surgery	Retrospective case series of 41 surgical procedures among AS patients	Neurologic outcomes among AS patients can be favorably improved when managed surgically. Radiological evaluation, extreme caution with endotracheal intubation, and early surgical spinal immobilization are necessary for successful outcomes.
Fu <i>et al.</i>	2014	32 AS patients	Prospective study of pulmonary function following deformity correction for AS	Overall, the clinical improvement rate in was 85.2%. Postoperative pulmonary function (pulmonary volume and ventilatory function) had significantly improved at 2-year follow-up. In addition, the improved pulmonary function had a positive correlation with the kyphosis correction.
Liu <i>et al.</i>	2020	Not Applicable	Systematic literature review	In addition to skeletal changes after spinal osteotomy among AS patients, many other quality of life improvements were reported.

AS: Ankylosing spondylitis

ligamentous attachments of the axial skeleton, and facilitates the development of ectopic bone inside the affected ligaments leading to syndesmophytes. Bony replacement leads to fusion of adjacent vertebrae, and the characteristic “bamboo spine.”<sup>[2]</sup> Immune cells invading the bone marrow promote the loss of trabecular bone, leading to osteoporosis with an increased fracture risk.<sup>[3]</sup>

## NEUROLOGICAL COMPLICATIONS OF AS

Neurologic complications of AS include: spinal cord injury, monophasic myelopathy, cauda equina syndrome, and even transverse myelitis.<sup>[5]</sup> Key findings from the literature are reported in [Table 1]. These occur due to compressive myelopathies and radiculopathies from bony overgrowth and deformity. At the craniovertebral junction, AS can result in atlantoaxial instability and compressive myelopathy due to basilar invagination. Meningeal changes in AS may also contribute to ectasia and/or posterior arachnoid diverticula (with or without adherence of nerve roots). In addition, ossification of the anterior longitudinal ligament may contribute to dysphagia in the cervical spine, while

ossification of the ligamentum flavum may increase the risk of cauda equina compromise.

## SURGERY

Surgical intervention in AS centers around appendicular joint surgery, stabilization of spinal fractures, and spinal deformity correction to regain physiologic alignment.<sup>[4]</sup> Given the predisposition to AAS, evaluation of the cervical spine before surgery is critical to prevent atlantoaxial injury during intubation and patient positioning.

### Spinal fractures

Generalized spinal osteopenia is a hallmark of AS, and fractures most commonly occur at the C7-T1 junction. Surgical treatment for fractures is imperative, especially in patients with evidence of instability, pseudoarthrosis, repeated fractures, and/or evidence of neurologic impairment.<sup>[3]</sup> With modern fixation techniques, surgical intervention has been shown to improve outcomes and decrease pseudoarthrosis.<sup>[5]</sup>

### Corrective osteotomies

Corrective osteotomy of the lumbar spine is frequently necessary to restore sagittal balance, and several distinct forms of osteotomies may be used depending on the overall goals of surgery and amount of correction required. These range from posterior column osteotomies such as Smith-Peterson Osteotomies, to more invasive three column osteotomies such as pedicle subtraction osteotomies and vertebral column resections.<sup>[1,6,7]</sup>

### CONCLUSION

AS is a debilitating disease with few available pharmacological therapies. Surgical intervention for AS is associated with improvements in musculoskeletal, pulmonary, cardiac, digestive, and sexual functioning.<sup>[8]</sup>

### Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Nil.

### Conflicts of interest

There are no conflicts of interest or disclosures relevant to any aspect of this submission and manuscript. Listed below are all disclosures: Andrew Grossbach, MD: Research funding from DePuy, Medtronic, 3M/KCI; consultation fees from 3M/KCI

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### REFERENCES

1. Arun R, Dabke HV, Mehdian H. Comparison of three types of lumbar osteotomy for ankylosing spondylitis: A case series and evolution of a safe technique for instrumented reduction. *Eur Spine J* 2011;20:2252-60.
2. Braun J, Sieper J. Ankylosing spondylitis. *Lancet* 2007;369:1379-90.
3. Caron T, Bransford R, Nguyen Q, Agel J, Chapman J, Bellabarba C. Spine fractures in patients with ankylosing spinal disorders. *Spine* 2010;35:E458-64.
4. Etame AB, Than KD, Wang AC, La Marca F, Park P. Surgical management of symptomatic cervical or cervicothoracic kyphosis due to ankylosing spondylitis. *Spine (Phila Pa 1976)* 2008;33:E559-64.
5. Fox MW, Onofrio BM, Kilgore JE. Neurological complications of ankylosing spondylitis. *J Neurosurg* 1993;78:871-8.
6. Fu J, Song K, Zhang YG, Zheng GQ, Zhang GY, Liu C, *et al.* Changes in cardiac function after pedicle subtraction osteotomy in patients with a kyphosis due to ankylosing spondylitis. *Bone Joint J* 2015;97:1405-10.
7. Fu J, Zhang G, Zhang Y, Liu C, Zheng G, Song K, *et al.* Pulmonary function improvement in patients with ankylosing spondylitis kyphosis after pedicle subtraction osteotomy. *Spine* 2014;39:E1116-22.
8. Liu J, Kang N, Zhang Y, Hai Y. Systemic changes associated with quality of life after surgical treatment of kyphotic deformity in patients with ankylosing spondylitis: A systematic review. *Eur Spine J* 2020;29:794-802.

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