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## Unilateral spinal motion segment rotational deformity causing foraminal stenosis

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### Abstract

The objective of this article is to describe for the first time a case of unilateral spinal motion segment rotational deformity causing foraminal stenosis. In this report we present the case of a 43 year old male with multilevel lumbar degeneration who progressively developed an isolated L3/4 rotational deformity leading to symptomatic neural compression from foraminal stenosis. He first presented to our clinic in 2015 and was followed up over the course of four years. The patient failed non-operative treatment and developed increasing L3 radiculopathy and neurological dysfunction for which he had temporary improvement of symptoms after a foraminal epidural steroid injection. He therefore underwent a decompression with no resolution of symptoms and subsequently a lateral interbody fusion that restored foraminal height but not antero-posterior (AP) compression. Subsequent derotation with pedicle screws resulted in an increase in the antero-posterior size and resolution of his symptoms. Unilateral mono-segmental rotational deformity is a cause of foraminal stenosis that should be considered when patients present with radiculopathy. Surgical management should involve restoration of the antero-posterior dimension, which can be achieved with derotation.

**Keywords:** Spine, Deformity, Pain, Surgery, Nerve.

### INTRODUCTION

Adult spinal deformity (ASD) is a common condition affecting over 30% of patients over the age of 50 years and 68% of patients aged over 70 years [1]. It can be defined as a pathological state in which spinal alignment is outside the accepted limits of normal. ASD is usually progressive in nature and presents because of mechanical or radicular pain or the cosmetic concerns of the increasing curvature [2]. The rate at which these symptoms progress vary and are affected by its underlying cause, of which there are a myriad, most commonly degenerative or osteoporotic.

Non-operative management for ASD utilises physiotherapy and pharmacological management of symptoms. There is evidence to suggest that core strengthening reduces the stress load through the vertebral column [2]. Epidural steroid injections have a role in the transient alleviation of symptoms in some instances, however, this is unlikely to provide long term relief [3, 4]. Due to the progressive nature of ASD, non-operative management has not been shown to change the quality of life (QoL) in the long term as shown in a study by Bridwell and colleagues. In contrast, this study showed that operative management significantly improves QoL [5, 6, 7].

Surgical management is indicated for patients who cannot be managed pharmaceutically and through physical strengthening. The treatments vary depending on the nature and positioning of the pathology, but the principles of surgical treatment are to restore spinal balance and decompress symptomatic neural compression [2, 8, 9]. However, there is a high complication rate when correcting the deformity [6, 10]. Over recent years the focus of alleviating pain and optimising function has focussed on the correction of the deformity in the sagittal plane. This sagittal deformity, has been well studied and proven to be a major determinant on patient outcomes [11, 12, 13]. However, the coronal plane is also an important clinical factor, with recent interest being restored in the coronal plane and its importance in ASD [14]. In contrast, despite ASD often being a multi-planar deformity, the rotational or axial component is rarely discussed, which starkly contrasts paediatric spinal deformities [15].

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This case report reflects on our experience of an adult male with ASD including a mono- segmental rotational deformity, which is to our knowledge the first such case to be described in the literature.

**CASE**

A 43 year old Caucasian male with multilevel lumbar degeneration presented with lumbar back pain in 2009 after working lifting slabs and feeling that his “back went out”. He also reported having noticed an increased curvature of his spine since his adolescence and previous clinical notes report hyperkyphosis with wedging of his vertebrae without any evidence of traumatic injury, in keeping with Scheuermann’s Disease.

His initial magnetic resonance imaging (MRI) scan revealed disc desiccation but no rotational deformity at the L3/4 level [Figure 1].



Figure 1

He was initially treated conservatively however, failing this, ultimately underwent an anterior lumbar interbody fusion (ALIF) as he was no longer able to continue manual work as a paver secondary to the back pain [Figure 2].

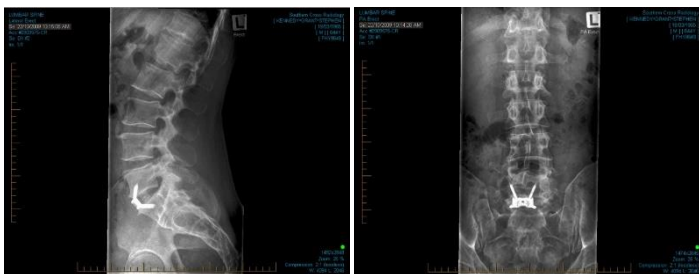


Figure 2

Subsequently, he underwent posterolateral decompression and fusion of L5/S1 as a supplementary procedure due to a failure of fusion from the ALIF. As the patient continued to experience back pain he was treated with a decompression and discectomy of L4/5 and an interspinous spacer insertion of L4/5.

He was then referred to our clinic in 2015 with right sided L3 radiculopathy that was attributed to an L3/4 disc prolapse [Figure 3].



Figure 3

His x-ray and MRI showed unilateral right sided retrolisthesis causing antero-posterior stenosis of the right neuro-foramen and compression of the L3 nerve root [Figure 4].



Figure 4

He was initially treated conservatively but progressively worsened and was ultimately treated with an L3/4 decompression, including an undercutting facetectomy, foraminotomy and discectomy with adjunctive removal of the posterolateral fusion metalware in 2017.

This failed to improve his radicular symptoms and his lumbar back pain progressively worsened and therefore, in addition to a number of other investigations and non-operative treatments, an 18F-sodium fluoride positron emission topography scan was organised which confirmed a unilateral right sided retrolisthesis of L3/4 causing foraminal stenosis [Figure 5].

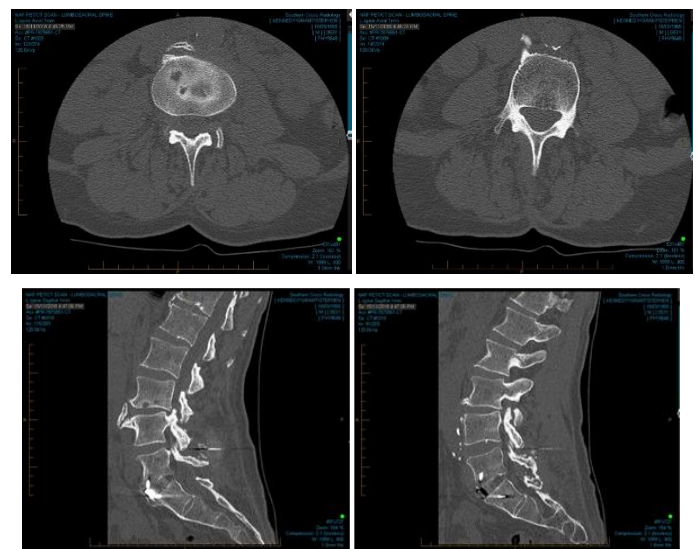


Figure 5

He was then treated with a lateral lumbar interbody (LLIF) fusion with an interbody cage and lateral plate which increased the height of the neuroforamen, but failed to restore its antero- posterior dimension [Figure 6].



Figure 6

This improved his lumbar back pain but offered no benefit for his L3 radiculopathy and therefore percutaneous posterior pedicle screws with rods were inserted to correct the rotation and increase the AP diameter eight weeks later in May 2019. This offered him immediate and complete relief of radicular pain. Subsequent imaging showed reduction of his unilateral retrolisthesis and correction of the rotational deformity [Figure 7].



Figure 7

He has since returned to work as a paver and continues to have resolution of symptoms at all follow up clinics.

## DISCUSSION

Adult spinal deformity (ASD) is common and is typically described as a coronal or sagittal deformity [16]. Recent interest in sagittal imbalance has fuelled the interest in surgical treatment of ASD. In 2005, Glassman and colleagues demonstrated the detrimental effect of sagittal imbalance on one's QoL. Since then numerous studies have confirmed the positive relationship between spinal malalignment and poor QoL [11, 12, 13].

Pathological mono-segmental deformities include spondylolisthesis and coronal deformities, both of which can cause foraminal stenosis, predominantly from a loss of foraminal height, but also from discosteophyte compression, flaval, zygapophyseal and capsular hypertrophy [17,18]. Because of the anatomy of the zygapophyseal joint with the superior articular process rising up in front of the inferior articular process an anterolisthesis typically increases the antero-posterior diameter of the foramen. In contrast, a retrolisthesis reduces the antero- posterior foraminal diameter. This reduction, just as the reduction in foraminal height, can compress the exiting nerve root [17].

Typically, pathological rotation of the spine is seen in idiopathic paediatric deformities that develop as the child grows and therefore permits the nerve root to accommodate to its foramen and rarely causes symptomatic neural compression [18]. In contrast, adult spinal rotation is typically driven by zygapophyseal failure [17]. This case illustrates a potential consequence of unilateral facet joint laxity that results in a pivoting motion of the spine around the contralateral facet joint. This is seen as a rotation with a unilateral retrolisthesis and facet joint gapping with the articular surfaces of the facet joints departing resulting in the inferior articular process moving posteriorly in relation to the superior articular process. This brings the posterior vertebral body of the cranial vertebra and annulus in closer proximity to the superior articular process of the caudal vertebra reducing the AP diameter of the foramen and risking compression of the exiting nerve root [Figure 8].

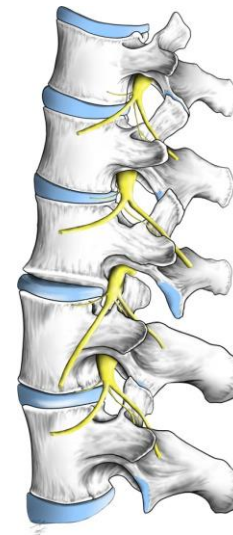


Figure 8

While foraminal epidural steroid injections can temporarily relieve symptoms, the origin of the symptoms is structural by nature and therefore often requires surgical intervention [19]. This case shows that a traditional approach towards spinal deformity through a lumbar interbody fusion is insufficient because re-establishment of the neuroforaminal height does not provide correction through the rotational plane of deformity. Surgical management of symptomatic rotational deformities must involve derotation to increase the antero-posterior dimensions of the foramen to indirectly decompress the exiting nerve.

Direct decompression with a decompression and discectomy in this case also failed to resolve the patients symptoms. This is likely due to the surgical approach further destabilising the facet joint and annulus. Importantly, an undercutting facetectomy resects a portion of the superior articular process, but generally not its entirety and therefore a complete resection of the superior articular process is needed, but this destabilises the spine further incurring the need for fusion. Thus, in this case derotation was indicated and resulted in resolution of symptoms.

In conclusion, unilateral mono-segmental rotational deformity is a cause of foraminal stenosis that should be considered when patients present with radiculopathy. Surgical management should involve restoration of the antero-posterior dimension, which can be achieved with derotation.

## Ethical Statement

1. Funding: Nil
2. Conflict of Interest/Competing Interests: All authors declare no conflicts of interest or competing interests
3. Informed Consent: Given

Ethical Approval: As this was a case report, IRB approval was sought but deemed unnecessary as the single patient consented (and continues to consent) to their involvement, negating the need for review board approval.

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