Asia-Pacific Chiropractic Journal

LUMBOSACRAL TRANSITIONAL VERTEBRA AS A POTENTIAL CONTRIBUTING FACTOR TO SCOLIOSIS:

A REPORT OF TWO CASES

Eric Chun Pu Chu, Kevin Hsu Kai Huang, and John Sing Fai Shum

Abstract: Lumbosacral transitional vertebrae (LSTVs) are the most common congenital anomaly of the lumbosacral spine that presents either as L5 sacralisation or S1 lumbarisation. Although most of the LSTVs are of minor clinical importance, these anomalies may contribute to disruptions in biomechanics and alterations in spinal and paraspinal structures. Here, we present two cases of adolescent idiopathic scoliosis to illustrate some overlooked effects of a unilateral LSTV on spinal deformity. Cure correction was not attained in both cases. While a unilateral LSTV was on a different side of their lumbosacral spine, it is incidentally noticed that the direction of the curve was convex on the contralateral side of the LSTV. Most likely, unilateral LSTVs on certain occasions could cause the growing spine to curve and rotate. The aim of this report is to demonstrate an overlooked association between minor anomalies and the growing spines, which may be important to tailor an appropriate treatment plan.

Indexing Terms: Adolescent idiopathic scoliosis; congenital anomaly; lumbosacral transitional vertebra, Chiropractic adjustment, Vertebral adjustment

Introduction

Lumbosacral transitional vertebra (LSTV) is the most common congenital anomaly of the lumbosacral spine, with a reported prevalence between 16% and 36% in the general population. (1) LSTV may manifest either as a sacral assimilation of the L5 vertebra (sacralisation) or lumbar assimilation of the S1 segment (lumbarisation). Most of these anomalies may either go undetected or be discovered fortuitously. (2) However, an isolated and minor LSTV may disrupt normal spine biomechanics and anatomy. A unilateral LSTV will slow growth on that side of the spine and cause the growing spine to curve and rotate. Recent studies have correlated the presence of LSTV with low back pain. Symptoms can originate from the anomalous articulation itself, the contralateral facet joint, instability and early degeneration of the level cephalad to the transitional vertebrae, and nerve root compression from hypertrophy of the transverse process. (3) Clinical symptoms associated with each of the above processes are treated differently. Our case examples demonstrate the potential association between LSTV and adolescent scoliosis, which was previously overlooked. We present the following two cases in accordance with the CARE Guidelines.

... this cases report describes the finding of a lumbosacral transitional vertebra in two adolescent patients and describes management under which the curves did not progress.'

Quick Tap or Scan

Cases report

Case 1

A 15-year-old boy was found as having spinal deformities in school screenings. The patient was subsequently diagnosed with adolescent idiopathic scoliosis (AIS) by his primary care doctor and referred for chiropractic care. He denied any direct trauma or history of back pain. On examination, left lumbar scoliosis was observed. Lumbar movement restriction and focal tenderness about the lumbosacral area were identified. Spine radiography showed moderate (20-40°) thoracolumbar levoscoliosis (apex at L2). Displacement of the pedicles with respect to segments of the vertebral body was noted throughout the lumbar spine. Lumbar vertebral rotation was graded as 2+ according to the Nash-Moe method.

Incidentally, a unilateral lumbosacral transitional vertebra (LSTV, Castellvi type IIa) (4) with bony fusion between the L5 and the right sacral ala was found (Figure 1A, red arrow).

Chiropractic treatments consisted of diversified manipulation of the thoracic spine, thoracolumbar motorised flexion-distraction and Thompson's technique adjusting the sacroiliac joint. The patient chose to attend treatments at weekends. Treatment sessions were given once a week for 10 months. No intervention was given particularly to the presence of the LSTV. Initial Cobb angle measurement (5) of scoliosis (from T12 to L4) was 24° and the follow-up measurement at 10 months remained 24°. Three were no significant changes of the radiographic parameters for scoliosis. Cure correction was not attained.

Case 2

An otherwise healthy 17-year-old female presented to our clinic for a scoliosis evaluation. She had no previous history of trauma or neuromuscular disease and no back pain. Radiographic examination revealed mild (10-20°) thoracolumbar dextroscoliosis with a 17° curvature as measured from T12 to L4 using the Cobb method. (5) Grade 2+ vertebral rotation was noted in all lumbar vertebrae.

Additionally, there was dysplasia of L5 transverse processes with bony union to the left sacral ala, suggestive of LSTV (Castellvi type IIa) (4) (Figure 1B, red arrow). The subjective findings of this case were consistent with AIS.

Chiropractic treatment comprised of supine spine manipulation, thoracolumbar motorised flexion-distraction, Thompson's technique adjusting the sacroiliac joint and paraspinal muscle strengthening of the concave side. After-school treatment sessions were applied once a week for a year. No procedure was focused particularly on the intervention of LSTV.

A follow-up X-ray at 14 months showed no morphological changes of the scoliosis curve. The final regional Cobb angle remained 17°. Curve correction was not achieved. The curve was considered stable.

Discussion

Minor congenital anomalies can be regarded as anatomical variants

Vertebrae typically develop between the sixth to eighth weeks of intrauterine life. Errors in embryogenesis can lead to failure of vertebral segmentation/formation, defective fusion and developmental variation. (2) Lumbosacral transitional vertebra (LSTV) refers to a total or partial unilateral or bilateral fusion of the transverse process of the L5 vertebra to the sacrum. (4) The morphologic changes represent cranial and caudal shifts of the spine, respectively, resulting in either a greater or lesser number of motion segments. (3)

Minor congenital anomalies that cause no disability or have no significant physical or functional effects can be regarded as anatomical variants. (6) Although LSTVs are very common in

the general population and frequently referred to as anatomical variants, an unintended spinal anomaly can lead to treatment procedures performed at the wrong level. The presence of a LSTV can result in asymmetrical biomechanical alterations as well as anatomical disruption of the spine. In case of a unilateral LSTV, the involved side supports a larger proportion of load, causing a lateral tilting of the top of the transitional (fusing) vertebra and thus a sideways curve to the spine. (7) It seems reasonable to assume that unilateral LSTVs had played a role in causing scoliosis in the growing spine of our cases.

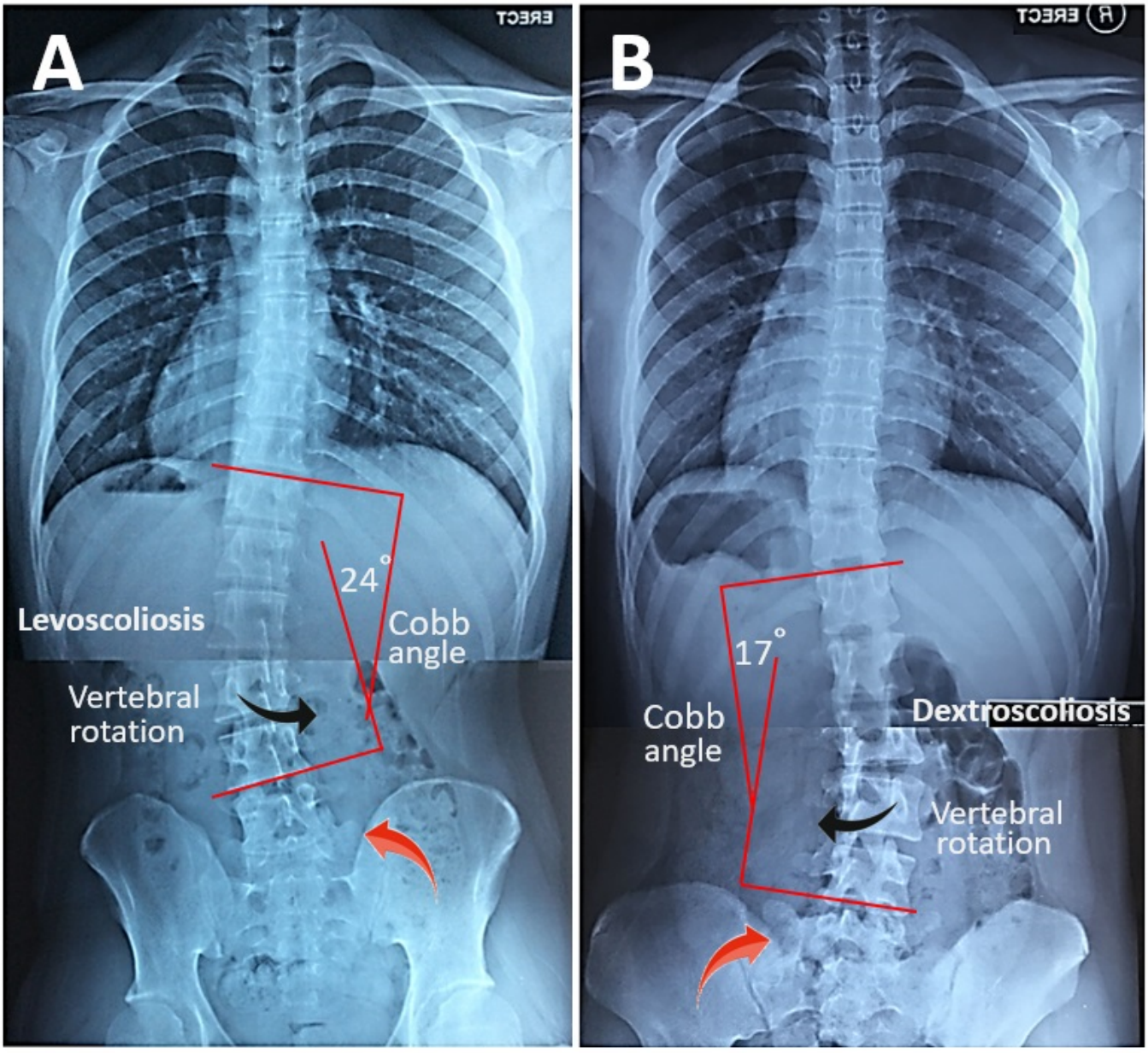

Figure 1: Contrasting findings of spinal deformities in two adolescents. **(A)** Standing plain radiography of a 15-year-old boy showing moderate thoracolumbar levoscoliosis with an uncoupled pelvic shift (C-shaped scoliosis), grade 2 rotation of all the lumbar vertebrae, and lumbarization of the right L5 transverse process with the sacral ala (red arrow). **(B)** A 17-year-old girl had mild thoracolumbar dextroscoliosis with an uncoupled pelvic shift (reverse C-shaped scoliosis), and grade 2 rotation of all the lumbar vertebrae. The left L5 transverse process was dysplastic and fused to the sacral ala (red arrow). In general, lumbar curves are predominantly left convex, which are related to the location of the liver. A right curve direction implies an association with some kind of pathology causing deformity in the growing spine.

Congenital scoliosis is often associated with other major anomalies

The causes of scoliosis can be classified broadly as congenital, neuromuscular and idiopathic. Given that congenital scoliosis develops during a critical stage of organogenesis, it can be associated with cardiac, genitourinary and other spinal anomalies. Neuromuscular scoliosis is caused by medical disorders that impair their ability to control the muscles that support the spine. Idiopathic scoliosis, as its name implies, does not have any identifiable cause. Adolescent idiopathic scoliosis probably results from multifactorial with genetic predisposing factors. (8)

The appropriate approach to a child presenting with scoliosis is to first identify any non-idiopathic issues, which may require intervention. In the absence of other major anomalies, our cases were considered as AIS. Second is to estimate the risk of curve progression and prevent potential complications. Regardless of cause, thoracic curves are predominantly right convex and lumbar curves are left convex, which are related to the location of major organs. (8)

Unusual curve patterns, as noted in Case 2 with thoracolumbar dextroscoliosis, imply an association with some kind of pathology. Proper consideration of the potential effect of anatomical variants on the vertebral rotation and curve deviation would be necessary in our daily practice.

Scoliosis assessment

Scoliosis is a three-dimensional deformity of the spine. For practical purposes, however, standing plain radiography remains the gold standard in the assessment of side curves. The curves are often C-shaped or S-shaped when viewing from the rear. According to the *Society on Scoliosis Orthopaedic and Rehabilitation Treatment* (SOSORT) guidelines, (9) the diagnosis of scoliosis is confirmed when the Cobb angle is ≥10° and axial rotation can be recognised. Periodic observation only is the mainstay of treatment for mild scoliosis (<20°).

Conservative therapies such as physiotherapy, strengthening exercises, spinal bracing, chiropractic and acupuncture are recommended for moderate scoliosis (20– 40°). Surgical intervention may be required for correcting curves of more than 40°. The primary goal of non-operative treatment for AIS is to stop the curve progression or possibly even reduce it. (9)

Between 2 consecutive visits, if the difference of Cobb angle is ±5°, the curve is considered stable. If the angle increases or decreases ≥5° the curve is considered worsened or improved. Our treatment had been continued either until the maximum improvement was reached, or the patient's improvement plateaued. The therapeutic outcomes of our patients with unilateral LSTV were thought equivalent to absence of progression. As mentioned above, a curve progression of ≤5° (stabilisation) is considered treatment success. It appears that chiropractic care could arrest curve progression, but not correct curves in AIS with unilateral LSTV. This trivial anomaly, if left untreated, may be a challenge in clinical practice.

Treatments for LSTVs

Although there is no consensus, a variety of treatments have been advocated for the symptomatic LSTVs. Clinical symptoms can originate from the anomalous articulation itself, the contralateral facet joint, instability and early degeneration of the level cephalad to the transitional vertebrae, and nerve root compression from hypertrophy of the transverse process. (3) In general, therapeutic manipulation can help to strengthen the muscles involved, improve joint mobility and ease pinched nerve caused by adjacent tissues. (10, 11) In patients with symptomatic LSTV, local injection of anesthetic and corticosteroids may relieve pain temporarily and can yield valuable diagnostic information.

Radio-frequency ablation is another treatment option to provide temporary relief of pain. Surgeries including the transverse process resection, laminectomy or lumbar spinal fusion may

be beneficial for those who demonstrate pain truly emanating from a transitional joint. (3, 12) Surgical intervention is the last resort where all other treatments have failed to provide pain relief.

Strengths and limitations

The strength of this case presentation is that it illustrates an overlooked effect of LSTV on a growing spine, which could be essential for an individualised and appropriate rehabilitation planning. Limitations such as the very small sample size and retrospective reporting require more such cases being reported.

Conclusion

Lumbosacral transitional vertebra (LSTV) is the most common congenital anomaly of the lumbosacral spine and frequently referred to as an anatomical variant. There seems to a correlation between LSTV and spine deformity in adolescent idiopathic scoliosis. Knowledge of the biomechanical alterations within the spine caused by LSTVs is essential in our daily practice.

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Cite: Chu ECP, Huang KHK, Shum JSF. Lumbosacral transitional vertebra as a potential contributing factor to scoliosis: a report of two cases. Asia-Pac Chiropr J. 2020;1:007 DOI https://doi.org/10.46323/2021007

Declaration of conflicting interest: The authors declare that there is no conflict of interest.

Funding: The authors received no financial support for the research, authorship, and/or publication of this article.

Informed consent: The patients' guardians provided written consent for publication of the case report.

The Journal appreciates:

New York Chiropractic and Physiotherapy Centre, 41/F Langham Place Office Tower, 8 Argyle Street, Mongkok, Hong Kong, China; and

Hong Kong Advanced Imaging, 12/F Langham Place Office Tower, 8 Argyle Street, Mongkok, Hong Kong, China.

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