

# Circumferential lumbar spinal fusion

Circumferential [lumbar fusion](#) restored [lordosis](#), provided a higher union rate with significantly fewer repeat [operations](#), showed a tendency toward a better [functional outcome](#), and resulted in less peak [back pain](#) and [leg pain](#) than instrumented posterolateral fusion. The clinical perspective of the current study implies a recommendation to favor circumferential fusion as a definitive surgical procedure in complex lumbar pathology involving major instability, flatback, and previous disc surgery in younger patients, as compared with posterolateral fusion with pedicle screws alone <sup>1)</sup>.

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Findings suggest that [anterior lumbar interbody fusion](#) with percutaneous [pedicle screws](#) can achieve better clinical outcomes compared to [TLIF](#) for the treatment of [isthmic spondylolisthesis](#) (IS).

Tye et al. believe the superior radiographic outcomes achieved through ALIFPS, namely a greater restoration of segmental lordosis and disc height, may have contributed to the improved clinical outcomes presented in the current study <sup>2)</sup>.

## Indications

Circumferential fusion provided significantly better long-term clinical, radiographic, and Scoliosis Research Society (SRS) total score than posterolateral or anterior fusion for high-grade isthmic spondylolisthesis <sup>3)</sup>.

Iatrogenic, high-grade L5-S1 spondylolisthesis can be successfully treated with reduction using circumferential fusion of the lumbosacral junction <sup>4)</sup>.

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Pseudoarthrosis in ankylosing spondylitis (Andersson lesion, AL) can cause progressive kyphosis and neurological deficit. Management involves early recognition and surgical stabilisation in patients with instability. However, the need and safety of anterior reconstruction of the vertebral body defect remains unclear.

Twenty consecutive patients with AL whom presented with instability back pain and or neurological deficit were managed by single stage posterior approach with long segment pedicle screw fixation and anterior vertebral reconstruction. Radiological evaluation included- the regional kyphotic angle, measurement of anterior defect in computed tomography (CT) scan and the spinal cord status in magnetic resonance imaging. Radiological outcomes were assessed for fusion and kyphosis correction. Functional outcomes were assessed with visual analogue scale (VAS), ankylosing spondylitis quality of life (ASQoL) and Oswestry disability index (ODI).

The mean age of the patients was 50.1 years (male, 18; female, 2). The levels affected include thoracolumbar (n=12), lower thoracic (n=5) and lumbar (n=3) regions. The mean level of fixation was  $6.2 \pm 2.4$  vertebrae. The mean anterior column defect was  $1.6 \pm 0.6$  cm. The mean surgical duration, blood loss and hospital stay were 112 minutes, 452 mL and 6.2 days, respectively. The mean followup was 2.1 years. At final follow up, VAS for back pain improved from 8.2 to 2.4 while ODI improved from 62.7 to 18.5 ( $p < 0.05$ ) and ASQoL improved from  $14.3 \pm 2.08$  to  $7.90 \pm 1.48$  ( $p < 0.05$ ). All patients had

achieved radiological union at a mean  $7.2 \pm 4.6$  months. The mean regional kyphotic angle was  $27^\circ$  preoperatively,  $16.7^\circ$  postoperatively and  $18.1^\circ$  at the final follow-up.

Posterior stabilisation and anterior reconstruction with cage through an all-posterior approach is safe and can achieve good results in Andersson lesions <sup>5)</sup>.

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Two major [limitations](#) of [lateral lumbar interbody fusion \(LLIF\)](#) have been (a) a perceived need to reposition the patient to the [prone position](#) for posterior [fixation](#), and (b) the lack of a robust solution for [fusion](#) at the L5/S1 level. Recently, two strategies for performing single-position circumferential lumbar spinal fusion have been described. The combination of [anterior lumbar interbody fusion \(ALIF\)](#) in the lateral [decubitus](#) position (LALIF), LLIF, and [percutaneous pedicle screw fixation \(pPSF\)](#) in the lateral decubitus position is known as lateral single-position surgery (LSPS). Prone LLIF (PLLIF) involves transpsoas LLIF done in the prone position that is more familiar for surgeons to then implant [pedicle screw fixation](#). This can be referred to as prone single-position surgery (PSPS). In a review, Thomas et al. described the evolution of and rationale for single-position [spinal surgery](#). Pertinent studies validating LSPS and PSPS are reviewed and future questions regarding the future of these techniques are posed. Lastly, they presented an [algorithm](#) for single-position surgery that describes the utility of LALIF, LLIF, and PLLIF in the treatment of patients requiring AP [lumbar fusions](#).

**Conclusions:** Single position surgery in the circumferential fusion of the [lumbar spine](#) includes posterior fixation in association with any of the following: lateral position [LLIF](#), prone position [LLIF](#), lateral position [ALIF](#), and their combination (lateral position [LLIF](#)+[ALIF](#)). Preliminary studies have validated these methods <sup>6)</sup>.

## Systematic review

A [systematic literature review](#) was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines in PubMed, Web of Science and Scopus database to identify comparative studies reporting the outcomes of SP lumbar interbody fusion versus DP. For risk of bias assessment [ROBINS-I tool](#) (Risk of bias in non-randomized studies of interventions) was used.

**Results:** Four comparative studies were included from an initial search of 3780 papers. All four studies were retrospective cohort studies comparing outcomes of single-position versus dual-position LLIF. A total of 349 patients were operated using a SP versus 254 DP. All the studies involved reported: operating time, estimated blood loss, length of stay, change in segmental lordosis and complications. From a general perspective, baseline variables were similar in both groups in all the studies and all reported a significant decrease in operative time and length of stays with SP.

Literature comparing single-position versus lateral then prone lumbar fusion shows a tendency towards shorter operating time and hospital stays in single position lumbar fusion, while maintaining similar perioperative outcomes <sup>7)</sup>.

1)

Christensen FB, Hansen ES, Eiskjaer SP, Høy K, Helmig P, Neumann P, Niedermann B, Bünger CE. Circumferential lumbar spinal fusion with Brantigan cage versus posterolateral fusion with titanium Cotrel-Dubousset instrumentation: a prospective, randomized clinical study of 146 patients. *Spine*

(Phila Pa 1976). 2002 Dec 1;27(23):2674-83. doi: 10.1097/00007632-200212010-00006. PMID: 12461393.

2)

Tye EY, Tanenbaum JE, Alonso AS, Xiao R, Steinmetz MP, Mroz TE, Savage JW. Circumferential Fusion: A Comparative Analysis Between Anterior Lumbar Interbody Fusion with Posterior Pedicle Screw Fixation and Transforaminal Lumbar Interbody Fusion for L5-S1 Isthmic Spondylolisthesis. Spine J. 2017 Aug 15. pii: S1529-9430(17)30901-4. doi: 10.1016/j.spinee.2017.08.227. [Epub ahead of print] PubMed PMID: 28821444.

3)

Helenius I, Lamberg T, Osterman K, Schlenszka D, Yrjönen T, Tervahartiala P, Seitsalo S, Poussa M, Remes V. Posterolateral, anterior, or circumferential fusion in situ for high-grade spondylolisthesis in young patients: a long-term evaluation using the Scoliosis Research Society questionnaire. Spine (Phila Pa 1976). 2006 Jan 15;31(2):190-6. PubMed PMID: 16418639.

4)

Theologis AA, Jain D, Ames CP, Pekmezci M. Circumferential fusion for degenerative lumbar spondylolisthesis complicated by distal junctional grade 4 spondylolisthesis in the sub-acute post-operative setting. Eur Spine J. 2017 Feb 15. doi: 10.1007/s00586-017-4976-z. [Epub ahead of print] PubMed PMID: 28204925.

5)

Rajoli SR, Kanna RM, Aiyer SN, Shetty AP, Rajasekaran S. Circumferential Fusion through All-Posterior Approach in Andersson Lesion. Asian Spine J. 2017 Jun;11(3):444-453. doi: 10.4184/asj.2017.11.3.444. Epub 2017 Jun 15. PubMed PMID: 28670413; PubMed Central PMCID: PMC5481600.

6)

Thomas JA, Menezes C, Buckland AJ, Khajavi K, Ashayeri K, Braly BA, Kwon B, Cheng I, Berjano P. Single-position circumferential lumbar spinal fusion: an overview of terminology, concepts, rationale and the current evidence base. Eur Spine J. 2022 Aug 1. doi: 10.1007/s00586-022-07229-4. Epub ahead of print. PMID: 35913621.

7)

Guiroy A, Carazzo C, Camino-Willhuber G, Gagliardi M, Fernandes-Joaquim A, Cabrera JP, Menezes C, Asghar J. Single-position surgery versus lateral-then-prone-position circumferential lumbar interbody fusion: a systematic literature review. World Neurosurg. 2021 Apr 17:S1878-8750(21)00579-9. doi: 10.1016/j.wneu.2021.04.039. Epub ahead of print. PMID: 33878467.

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