

# Cause and Effect of Revision Surgery: A Multicenter Study on Outcomes after Recurrent Adult Spinal Deformity Surgery as a Function of Etiology

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## INTRODUCTION:

While treatment of adult spinal deformity (ASD) has increasingly favored surgical correction, incidence of revision surgery remains high. Yet, there has been little exploration on association between etiology of reoperation and its differences in recovery process. This study aimed to assess impact of etiology of revision surgery on postoperative outcomes.

## METHODS:

Operative ASD patients  $\geq 1$  revisions stratified by etiology (mechanical [M] – pseudoarthrosis, thoracic decompensation without junctional failure, x-ray malalignment, implant failure, implant malposition, PJK +/- major malalignment; infection [I]– early vs. late onset, major vs. minor; wound [W]; SI pain [P]). Excluded multiple etiologies, and intraoperative or medical complications. Data from immediate visit prior to final revision used as baseline (rBL). Follow up based on visits best aligned to timepoints after final revision. Radiographic parameters SVA, PI-LL, and PT were used to assess alignment post-revision via ANOVA. Multivariate analysis controlling for relevant covariates assessed differences in outcomes after final revision surgery.

**RESULTS:** A total of 350 met inclusion (Age:  $60.40 \pm 14.17$ , 77% F, BMI:  $27.97 \pm 5.87$  kg/m<sup>2</sup>, CCI:  $1.80 \pm 1.73$ ). Etiology groups were as follows: M: 432; I: 296; W: 65; P: 98. Surgically, I had lower rates of osteotomy, interbody fusion, and decompression ( $p < .05$ ). I and P demonstrated similar correction in radiographic SVA, PI-LL, and PT ( $p > .05$ ), whereas M had significantly less improvement by 2 years ( $p < .003$ ) that improved by 5 years. Compared to without revision, odds of MCID in ODI were 48.6% lower across groups (OR: 0.514 [.280, .945],  $p = .032$ ). Indication of x-ray malalignment were 93.0% less likely to reach MCID (OR: 0.071, [.006, .866],  $p = .038$ ). Similarly, implant failure negatively impacted rates of MCID (40% vs. 15.2%,  $p = .029$ ). Those with PJK had 57% lower odds of MCID (33% vs. 54%, OR: .43, [0.2, 0.9]  $p = 0.023$ ), further negated by major malalignment (OR: 0.05, [.07, .97],  $p = .02$ ). Indications of pseudoarthrosis, thoracic decompensation, implant malposition were not significant. Major sepsis had lower rates of MCID compared to minor (6.4% vs. 21.2%), and early onset infection improved compared to late (OR: 1.43, [1.17, 2.98],  $p < .001$ ). In early follow-up period, M group has significantly worse SRS Pain and Mental Health scores compared to other groups (1-year: M 1.56 vs. I 0.83 vs P 0.72,  $p < 0.001$ ; 2-year: 1.88 vs. 0.71 vs 0.76,  $p = 0.034$ ). Complication rates increased with number of revisions and with mechanical indication (all  $p < .05$ ). At 5 years, patient satisfaction was significantly more likely to improve compared to early follow up (OR: 1.22,  $p = .011$ ), along with improved pain score, in M group (0.89 vs. 0.49 vs. 0.56,  $p = .081$ ).

## DISCUSSION AND CONCLUSION:

This study focused on impact of revision as it varies with etiology and time of occurrence postoperatively. Compared to other etiologies, patients revisiting surgery due to mechanical complications had less radiographic improvement and worsening patient-reported scores in early postoperative period, despite stabilization at 5 years. The depth of impact of mechanical complication, particularly with addition of malalignment, merit greater focus during surgical planning.