

Risk Factors of Screw Malposition in Robot-Assisted Cortical Bone Trajectory: Analysis of 1,344 Consecutive Screws in 256 Patients

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INTRODUCTION: Robot-assisted cortical bone trajectory (RA-CBT) screw malposition occurs through two distinct modes, skive or shift. Skive occurs when a downward force applied to the cannula, drill, tap, or screw, causes the instrument to deflect relative to its bony landmark. Shift is a change in position of the robot-assisted system relative to the patient after registration. The objective of this study is to describe the incidence of and identify risk factors for intraoperative screw malposition secondary to skive or shift during RA-CBT insertion.

METHODS: We prospectively enrolled a consecutive series of patients older than 18 years who underwent RA-CBT screw placement for posterior lumbar instrumented fusion between January 2019 and July 2022. Mode of failure was noted intraoperatively. Baseline demographic and index surgical data were collected. Bone quality was evaluated by Hounsfield unit (HU) on L1 mid-vertebral axial CT. Vertebral shape related to screw planning was compared between identified skive and no-skive by adjusting patient's demographic data and lumbar level.

RESULTS: Of 1,344 CBT screws in 256 patients, malposition was recognized intraoperatively in 33 screws (2.4%) in 27 patients (10.5%); of these 19 occurred via skive in 17 patients and 14 via shift in 10 patients. These 27 patients had higher BMI than control (33.0 kg/m² vs. 30.5 kg/m², P=0.037). The 17 patients that occurred via skive had higher HU (178.2 vs. 145.2, P=0.035), but not the 10 patients with malposition via shift (139.2 vs. 145.2, P=0.935) compared with 229 patients without screw malposition. More than half of screw malposition was observed at the UIV. At the UIV, if the screw's overlap to the bone surface at the insertion point was decreased, skive was more likely (57% vs. 87%, P< 0.001).

DISCUSSION AND CONCLUSION: Intraoperative screw malposition occurred in 2.4% of RA-CBT, and more than half were at the UIV level. High BMI was associated with screw malposition, regardless of etiology. Skive was associated with high HU and decreased screw overlap to bone surface at the insertion point.

