



# Accuracy Comparison for Intraoperative Biplanar and Volumetric Image Guidance: A Systematic Review

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## Introduction

Recent literature suggests lower rates of pedicle screw misplacement using three-dimensional (3D) navigation when compared to two-dimensional (2D) fluoroscopic image guidance techniques. The present study was undertaken to examine the accuracy of pedicle screw placement by comparing 2D and 3D volumetric intraoperative image guidance techniques.

## Methods

A PubMed literature search was conducted that focused on the accuracy of pedicle screw placement using intraoperative real-time fluoroscopic image guidance. We included papers that were published in English and reported accuracy based results from surgeries, during which virtual, Iso-C, O-arm fluoroscopy or preoperative CT scans fused with intraoperative fluoroscopy navigation techniques for pedicle screw placement were used. The accuracy was assessed for 2D and 3D intraoperative navigation-assisted surgeries comparing it between different spine levels.

## Results

The search yielded 30 studies published from 2003 to 2010 that analyzed the accuracy of pedicle screw placement in 963 patients. There were a total of 4,903 pedicle screws with 4,474 screws placed accurately (91.2% accuracy rate). When comparing accuracy of the two systems, there was a significantly higher rate of misplaced screws when 2D navigation was employed ( $p < 0.0001$ ). Utilizing 2D fluoroscopic navigation, 12% of the total screws were misplaced versus a misplacement rate of 7.1% using 3D navigation. The same statistically significant tendency ( $p < 0.0001$ ) and improved accuracy was observed when pedicle screw misplacement rates were compared between the spinal levels: 19.8% vs. 8.9% for thoracic and 9.9% vs. 5.3% for lumbar pedicle screws using 2D and 3D navigation systems, respectively.

## Conclusions

The results of this analysis suggest a significantly greater rate of pedicle screw placement accuracy in lumbar or thoracic spine when 3D intraoperative navigation is used as compared with 2D navigation.

## Learning Objectives

1. Demonstrate improved pedicle screw placement accuracy using 3D navigation
2. Discuss pedicle screw placement accuracy at different levels of the spine.

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