Learning Curves for Robot-Assisted Pedicle Screw Placement

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Introduction

Robot-assisted pedicle screw placement is associated with greater accuracy, reduced radiation, shorter hospital stays, and fewer complications. However, there is concern for longer operative times and the training period required to achieve these benefits. Long-term learning curves have not been reported in the literature.

Objectives

We report the learning curves of a surgeon using a robot system.

Materials and Methods

The first 108 spondylolisthesis patients at a tertiary care institution undergoing robot-assisted pedicle screw placement by a surgeon (NT) using the ExcelsiusGPS® system were retrospectively reviewed. Cases occurred between October 2017-May 2022. Operative time and estimated blood loss were evaluated by linear regression.

Experience level analysis: Cases were divided into a learning period consisting of the first 20 operations (Cases 1-20), an intermediate experienced period (Cases 21-87), and an expert period consisting of the last 20 operations (Cases 88-108). One-way ANOVA and post-hoc Tukey tests were performed to evaluate pairwise comparisons.

Cumulative sum analysis (CUSUM): Cases were ordered chronologically, and the mean operative time of the entire cohort was subtracted from each case’s operative time. Cases longer than the mean were assigned a positive value, and cases shorter than the mean were assigned a negative value. Each case’s distance from the mean was then added to the value from the prior case. The inflection point represents skill mastery.

Results

Operative time and blood loss significantly decreased with more experience. A 20-case learning curve is sufficient to reach experienced proficiency, but 61 cases are required to reach expert proficiency. Even after completion of initial training, surgeons can continue to reduce operative time. Disadvantages of robot-assisted surgery are reduced with advanced experience.