



Youth and Experience: The Effect of Surgeon Experience on Outcomes in Cerebral Palsy Scoliosis Surgery

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Abstract

Background: Series on the learning curve in spinal deformity surgery have been published, but none has addressed neuromuscular spinal deformity, comprised of arguably the most complex cases. We present the first multi-center analysis of the impact of surgeon experience on neuromuscular spinal deformity surgery.

Methods: A multi-center prospective study of spinal deformity surgery for cerebral palsy (CP) with at least 2 years of follow-up provided the dataset for assessment. Surgeons were categorized into one of two groups based on their self-reported first year of practice: an experienced surgeons (ES) group included those with at least 10 years of experience at the time of surgery and a young surgeons (YS) group included those with fewer than 10 years of experience at time of surgery. Groups were compared in multiple pre-operative, operative, and post-operative outcomes.

Results: The YS group had 8 surgeons who performed 59 surgeries; the ES group had 13 surgeons who performed 103 cases, with one surgeon's cases distributed in both groups. The YS group had a greater proportion of patients with severe mental retardation (89.7% vs. 68.6%, $p = .01$). Duration of surgery was greater in the YS group (456 vs. 344 minutes, $p < .001$). The mean number of levels fused was greater in the ES group (15.9 vs. 15.6, $p = .024$), caused by increased variation in the upper level of fusion among the ES group. No significant differences were found between groups for estimated blood loss, length of hospitalization, or in percentage of Cobb correction. Years of experience of the operating surgeon was inversely correlated with duration of surgery ($\rho = -0.476$, $p < .001$).

Conclusions: In performing scoliosis surgery on CP patients, surgeons with fewer than ten years of practice experience demonstrate significantly greater average operative time and decreased mean number of levels fused, yet produce similar clinical outcomes to more experienced surgeons.

Level of Evidence: Level III, therapeutic.

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Keywords: Neuromuscular scoliosis; Surgeon experience; Cerebral palsy

Introduction

Understanding the impact of surgeon experience on patient outcomes is an essential tool for improving both patient safety and surgical training. However, formal inquiry into the relationship between provider experience and clinical outcomes is rife with challenges, particularly when evaluating complex surgical procedures. Surgical management of neuromuscular scoliosis includes some of the most technically demanding cases within spinal deformity

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surgery. Although extensive formal training is completed prior to performing such procedures independently, the effect of surgeons' experience in practice on outcomes for patients undergoing surgery for neuromuscular scoliosis is heretofore unknown.

Significant efforts have been made to characterize the learning curve for providers in all aspects of health-care delivery, including orthopedic surgery [1-6]. Noel de Steiger et al. [7], for example, demonstrated that the anterior approach for total hip arthroplasty must be performed at least 50 times before one reaches surgical proficiency. However, most work addressing the role of experience in surgical performance is constrained by one of two inherent limitations. First, as in the study on total hip arthroplasty, experience is often determined by the number of prior identical surgical cases completed by the surgeon. This metric fails to capture the experiences gained by a surgeon who performs other procedures with overlapping skills. Applied to neuromuscular scoliosis surgery, this approach would fail to account for the experiential learning associated with treating other forms of scoliosis such as adolescent idiopathic scoliosis (AIS). Other study designs compare a single surgeon at different stages of his or her career. Lonner et al. [8] reported on a single-surgeon learning curve over a five-year interval, showing that later cases were associated with reduced blood loss, decreased length of hospitalization, and improved curve correction. As the authors acknowledged, focus on one surgeon at a single institution may limit the generalizability of research findings.

As an alternative, a multicenter, multisurgeon, cross-sectional study comparing the surgical outcomes for multiple surgeons at different stages in their careers over a relatively short time interval may best evaluate the effect of surgeon experience. This study design emphasizes a surgeon's time in practice as the most meaningful assessment of surgical experience. We have previously implemented this approach to evaluate the role of surgeon experience in AIS [9]. Analysis of 165 AIS patients operated on by nine surgeons demonstrated that patients treated by surgeons with more than five years of experience had significantly less intraoperative blood loss, shorter average duration of surgery, and improved SRS-22 scores.

In comparison to patients with AIS, patients with cerebral palsy (CP) present distinct challenges to the physician performing spinal deformity surgery. Patients with CP often have lower functional status and higher perioperative morbidity, with complication rates ranging from 22% to 68% [10-13]. Moreover, surgical techniques are more varied and outcomes are less uniform than those in AIS [14]. We present the first cross-sectional, multicenter analysis of the impact of surgeon experience on neuromuscular spinal deformity surgery.

Materials and Methods

Institutional review board approval was obtained locally at each contributing institution. The study is registered at [ClinicalTrials.gov](https://clinicaltrials.gov): Setting Scoliosis Straight Foundation

Protocol, ID NCT00680264. All posterior-only surgical procedures for scoliosis in children with CP performed since 2008 with at least two years of follow-up were included. Informed consent was obtained for each patient prior to data collection.

Surgeons were categorized into two groups based on their self-reported first year of practice: an experienced surgeons (ES) group included surgeons with at least 10 years of experience at the time of surgery and a young surgeons (YS) group included those with less than 10 years of experience at the time of surgery. One surgeon reached 10 years of experience during the study interval and his cases were divided accordingly.

Preoperative characteristics were evaluated for all patients and included age, gender, Lonstein classification, major Cobb angle, and health-related quality of life (HRQoL) as measured by the Caregiver Priorities and Child Health Index of Life with Disabilities (CPCHILD) score. To also compare the severity of patients' cerebral palsy between surgeon groups, Gross Motor Function Classification Scale level, degree of mental retardation, verbal communication, feeding status, sitting status, and seizure status were recorded. Operative variables analyzed included estimated blood loss (EBL), EBL per blood volume, number of levels fused, EBL per level fused, and duration of surgery. Postoperative variables analyzed included Cobb angle, percentage of Cobb-angle correction, medical and surgical complications, and length of hospitalization. To assess patients' health-related quality of life, the Caregiver Priorities and Child Health Index of Life with Disabilities score and its domains (activities of daily living; positioning, transferring, and mobility; comfort and emotion; health) were also assessed pre- and postoperatively [15]. A secondary analysis was performed to evaluate outcomes as a function of the operating surgeons' years of experience as a continuous variable. This analysis was performed both for the entire surgeon cohort and for the cohort of surgeons with fewer than 5 years of experience.

Data were analyzed using Microsoft Excel (Version 2013; Redmond, WA) and SPSS (Version 20.0, IBM Corp., Armonk, NY) software. Descriptive elements of the data are presented as means (and ranges) and categorical variables presented as counts and percentages. Differences in outcomes between surgeon groups were assessed using independent sample *t* test. A chi-square test and analysis of variance were used to determine significance of categorical variables. Data that were not normally distributed was analyzed using a nonparametric Mann-Whitney *U* test. To evaluate change in variables pre- and postsurgery, repeated measures analysis of variance was used with surgeon experience as the between-subjects factor. Level of significance was established at a two-sided alpha level of $p < .05$.

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