

## Building Consensus: Development of Best Practice Guidelines on Wrong Level Surgery in Spinal Deformity

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Received 3 August 2017; accepted 10 August 2017

### Abstract

**Study Design:** Consensus-building using the Delphi and nominal group technique.

**Objective:** To establish best practice guidelines using formal techniques of consensus building among a group of experienced spinal deformity surgeons to avert wrong-level spinal deformity surgery.

**Summary of Background Data:** Numerous previous studies have demonstrated that wrong-level spinal deformity occurs at a substantial rate, with more than half of all spine surgeons reporting direct or indirect experience operating on the wrong levels. Nevertheless, currently, guidelines to avert wrong-level spinal deformity surgery have not been developed.

**Methods:** The Delphi process and nominal group technique were used to formally derive consensus among 16 fellowship-trained spine surgeons. Surgeons were surveyed for current practices, presented with the results of a systematic review, and asked to vote anonymously for or against item inclusion during three iterative rounds. Agreement of 80% or higher was considered consensus. Items near consensus (70% to 80% agreement) were probed in detail using the nominal group technique in a facilitated group meeting.

**Results:** Participants had a mean of 13.4 years of practice (range: 2–32 years) and 103.1 (range: 50–250) annual spinal deformity surgeries, with a combined total of 24,200 procedures. Consensus was reached for the creation of best practice guidelines (BPGs) consisting of 17 interventions to avert wrong-level surgery. A final checklist consisting of preoperative and intraoperative methods, including standardized vertebral-level counting and optimal imaging criteria, was supported by 100% of participants.

**Conclusion:** We developed consensus-based best practice guidelines for the prevention of wrong-vertebral-level surgery. This can serve as a tool to reduce the variability in preoperative and intraoperative practices and guide research regarding the effectiveness of such interventions on the incidence of wrong-level surgery.

**Level of Evidence:** Level V.

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**Keywords:** Best practice guidelines; Wrong level surgery; Spinal deformity; Delphi process

Author disclosures: MV (other from Pediatric Orthopaedic Society of North America; personal fees from Biomet, Stryker, and Medtronic; other from Wellinks, outside the submitted work); AM (none); HM (none); TA (reports personal fees from Biomet, other from Biometrix, Breakaway Imaging, Crosstree, FacetLink, Gentis, In Vivo, JBJS-American, Paradigm Spine, PMIG, Scoliosis Research Society, Spine, *Spine Deformity* journal,

and Spinicity; personal fees from DePuy, A Johnson & Johnson Company; personal fees and other from Jay Pee, Saunders/Mosby-Elsevier, Thieme; other from United Healthcare, Vertech, ASIP, and Invuity, outside the submitted work); RA (personal fees and other from Stryker and Synthes, outside the submitted work); PA (none); AB (none); SC (other from AAOS, AOSpine North America, and Cervical Spine Research Society; personal

fees from Globus Medical and Medtronic, other from North American Spine Society, Scoliosis Research Society, and Zimmer, outside the submitted work); MC (other from DePuy, A Johnson & Johnson Company, outside the submitted work); TE (personal fees from Fastenetic and K2M; other from Harms Study Group, International Spine Study Group Foundation [ISSG], Medtronic, Paradigm Spine, and Pfizer, outside the submitted work); CF (personal fees from Expert Connect, Invuity Photonics, and K2M, outside the submitted work); HJK (other from AOSpine, other from *HSS Journal: The Musculoskeletal Journal of Hospital for Special Surgery*, *Asian Spine Journal*, ISSGF, K2M, Scoliosis Research Society, and ZimmerBiomet, outside the submitted work); RLJ (other from AOSpine, associate editor—*Spine Deformity*, Cervical Spine Research Society, and deputy editor for *Deformity—The Spine Journal*; personal fees from DePuy, A Johnson & Johnson Company, personal fees from Medtronic and Stryker; other from North American Spine Society and Scoliosis Research Society; personal fees and other from Wolters Kluwer Health—Lippincott Williams & Wilkins, outside the submitted work); BL (reports other from AO Spine, other from DePuy Spine, personal fees and other from DePuy, A Johnson & Johnson Company, personal fees from K2M; other from OREF, Paradigm Spine, Scoliosis Research Society, and Spine Search [board or committee member], SpineUniverse.com, and SRS Spine

Deformity Journal; outside the submitted work); PP (other from Cervical Scoliosis Research Society, other from Medicea, personal fees from Zimmer, outside the submitted work); TP (other from Cervical Spine Research Society; personal fees from Globus Medical, Innovasis, Medicea International, and Nuvasive; other from Zimmer, outside the submitted work); FS (other from DePuy Spine; personal fees and other from DePuy, A Johnson & Johnson Company; personal fees from K2M, Medicea, Medtronic, Nuvasive, and Medtronic Sofamor Danek; other from Nemaris, Scoliosis Research Society, Spine Deformity, and ISSG [vice president]; and personal fees from Zimmer, outside the submitted work); LL (other from Global Spine Outreach and *Journal of Neurosurgery: Spine*; personal fees from K2M, Medtronic, Quality Medical Pub; personal fees and other from Quality Medical Publishing; other from Orthopaedic Research and Education Foundation, Scoliosis Research Society, Setting Scoliosis Straight Foundation, *Spine Deformity Journal*, *Spine*, *Journal of Spinal Disorders & Techniques*, [www.iscoliosis.com](http://www.iscoliosis.com), and [www.spineuniverse.com](http://www.spineuniverse.com), outside the submitted work).

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## Introduction

Wrong-level surgery is an acknowledged, unfortunate reality in spinal surgery which can lead to devastating consequences for patients. Although wrong-site surgery has been extensively studied, there remains a paucity of literature in the specific area of wrong-level surgery in spinal deformity. Despite the National Quality Forum's efforts to address and eliminate wrong-level surgery, wrong-level surgery continues to occur with alarming frequency [1].

In a survey of 415 surgeons from the American Association of Neurological Surgeons, a staggering 50% reported one or more wrong-level surgeries, including 10% who performed four or more during their career [2]. The current literature estimates a procedural incidence of wrong-level surgery ranging from 0.003% to 2.12% [1-10]. However, this is likely under-reported given the lack of prospective studies [4,11].

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO), American Academy of Orthopaedic Surgeons (AAOS), and North American Spine Society (NASS) have issued guidelines in an attempt to reduce the risk of incorrect procedures (wrong site, procedure, or person) [12-15]. Although preoperative verification, site marking, and time-out protocols in the operating room assist with the reduction of such errors [12-16], they may not have had the intended goal of making wrong-level spinal surgery a “never event.”

Prior studies have identified numerous risk factors for wrong-level surgery, including failure to recognize aberrant anatomy, vertebral miscounting, failure to relocalize after exposure, suboptimal intraoperative radiographs, and lack of communication [1,17]. Despite these identified risk factors, many of which are preventable [1], there remains considerable variation in preoperative and intraoperative methods to correctly identify vertebral levels.

The purpose of this initiative was to develop formal consensus-based best practice guidelines (BPGs) to help minimize wrong-level surgery in spine deformity using a systematic literature review and experience of fellowship-trained spine surgeons using the Delphi and Nominal Group Technique.

## Materials and Methods

### Consensus participants

Eighteen spine surgeons with various levels of experience from four academic institutions in the Spinal Deformity Club of New York were asked to join in this effort, and 16 agreed to participate. Surgeons were selected based on clinical experience, relevant research, and leadership positions in various spine organizations and study groups. The study was approved by the Columbia University Institutional Review Board (Protocol AAAR1745).

### Overview of the Delphi and nominal group technique

This initiative closely followed the methodology utilized for the published BPGs on the prevention of surgical site infections in high-risk pediatric spine surgery [18] and intraoperative neuromonitoring in spinal deformity surgery [19]. Consensus building was established using the Delphi technique and nominal group technique.

Briefly, the Delphi method is a validated methodology of developing formal consensus via iterative rounds consisting of consensus statements or recommendations [20-24]. Throughout the process, statements are revised based on participant feedback and collaborative discussions [20,23]. Furthermore, the nominal group technique is a form of small group discussion that consists of three main

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