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# Defining Best Practices for Patient Safety in Positioning and Transferring Patients With the Surgical Spine Table

Sarah J. Kraft ▼ Bethany R. Lowndes ▼ M. Susan Hallbeck

This quality improvement project's purpose was to define and provide best practices in surgical patient positioning and transfer processes with the surgical spine table to increase patient safety. Using the Define, Measure, Analyze, Improve, and Control quality improvement framework, a multidisciplinary team analyzed surveys, qualitative interviews, ergonomics, near-miss sentinel events and skin integrity data to standardize this process. Results reinforced the need to develop and standardize the process of patient positioning and transfer from cart to table. Findings resulted in practice changes, including a standardized best practice for transfer of patients, educational tools, and checklists for continued monitoring of patient safety issues. Metrics for intervention effectiveness include reduced patient skin integrity, increased staff satisfaction, and improved comfort level with use of spine table accessories and equipment. This practice improvement has a patient safety focus in the perioperative nursing practice.

The number of spinal fusion operations is increasing in the United States, with 457,500 cases in 2011 (Andersson & Watkins-Castillo, 2014) versus 174,223 cases just 13 years earlier, in 1998 (Rajaee, Bae, Kanim, & Delamarter, 2012). Spinal fusion surgery can range in duration (average, 5–7 hours) given the approach (anterior, posterior, or both and one-stage or two-stage procedure) and the number of levels involved (Viviani, Raducan, Bednar, & Grandwilewski, 1993). Because spinal fusion surgical patients are immobile during surgery, they are at risk for skin integrity injury. With the increase in both number and duration of spine operations performed yearly, healthcare workers have been challenged with preventing skin integrity issues through correct positioning while still optimizing the number of patients treated (Andersson & Watkins-Castillo, 2014). Skin integrity maintenance has become an important perioperative care quality indicator. Skin integrity issues after spinal fusion operations are a result of many variables, including patient positioning, surgical duration, type of positioning device used, and comorbidity characteristics such as sex, age, body mass index (BMI), and patient systemic functions (i.e., cardiac perfusion history and diabetes mellitus) (Scarlatti, Michel, Gamba, & de Gutierrez, 2011).

Spinal fusion surgical patients are at risk for development of pressure injuries (PIs) because the patient is kept in one position for an extended period. The anesthetized patient lacks muscle tone, and iatrogenic injury in prone patients has been widely reported (Bowers, 2012). Rates of PIs as an intraoperative complication have been reported to be between 5% and 66% (Shoemake & Stoessel, 2015). Operating room (OR) practitioners need to anticipate the risk of harm and introduce strategies to protect the health and safety of the surgical patient.

A PI is a "localized injury to the skin and/or underlying tissue, usually over a bony prominence" (Scarlatti et al., 2011, p. 2). There are many contributing factors to PI development, including intrinsic factors such as age, body weight, and chronic disease and extrinsic factors such as insuffcient support and padding of the patient when positioned for surgery and the duration of the surgical procedure (Kwee, Ho, & Rozen, 2015). The risk of intraoperative ulcerations increases as surgical time increases (Aronovitch, 1999). The Association of periOperative Registered Nurses (AORN) (2013) has reported

Sarah J. Kraft, DNP, MSN, RN, NEA-BC, Department of Nursing, Mayo Clinic, Rochester, MN.

Bethany R. Lowndes, PhD, MPH, Department of Neurological Sciences, University of Nebraska Medical Center, Omaha, NE.

M. Susan Hallbeck, PhD, Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery, and Division of Health Care Policy and Research, Mayo Clinic, Rochester, MN

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Correspondence: Sarah J. Kraft, DNP, MSN, RN, NEA-BC, Department of Nursing, Mayo Clinic, 200 First St SW, Rochester, MN 55905 (kraft.sarah@mayo.edu).

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that patients having procedures that last more than 3 hours qualify as at high risk for PI development in the OR. The PIs, specifically Stages I and II, have become one of the most common complications of surgical procedures (Scarlatti et al., 2011). These ulcers, which can be seen right after surgery, can advance rapidly to Stages III and IV because the skin and deeper tissues undergo tissue hypoxia and hypoxemia due to compression during surgery (Scarlatti et al., 2011). Table 1 provides a summary of the staging of PIs (Shoemake & Stoessel, 2015).

Stage III and Stage IV PIs are classified as "never events" by the Centers for Medicare & Medicaid. Never events are adverse events that are identifiable, measurable, result in serious injury, and usually preventable. The additional costs incurred for never events, such as a hospital-acquired PI, are not reimbursed (Cooper, 2013). Consequently, there has been growing attention to best practices for preventing PIs. In the surgical environment, positioning and padding are one area of focus that could potentially influence the risk of PIs (Shoemake & Stoessel, 2015). The AORN (2013) explains, "The primary safety feature consideration for positioning equipment is that it redistributes pressure, especially at bony prominences on the patient's body" (p. 425). Historically, the traditional OR table mattress has consisted of 1–2 inches of foam covered with vinyl or nylon fabric. This amount of padding has been shown to be ineffective in reducing PIs (AORN, 2013). In contrast, gel mattresses are more effective in preventing PIs (AORN, 2013).

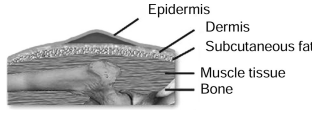
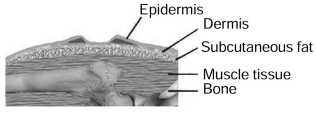
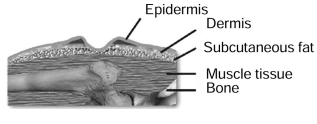
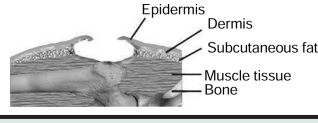
Positioning patients undergoing spinal fusion presents challenges for staff, especially when attempting to position to minimize or prevent the risk of PIs. Padding must be placed under the patient, without wrinkles, and patients must be positioned to prevent excess pressure. With spinal fusion prone procedures in particular, there is an approach for positioning called the *flip process* (also called the *sandwich mechanism*) that can create an additional risk of skin integrity issues. This process may introduce additional movement or friction of the patient on the table top and against the positioning straps because securing the patient does not prevent normal gravity and flow when turning 180°.

Although medical technology has advanced, a specific process, or best practice, has not been defined for optimal patient positioning in turning from the supine to the prone position. Two key safety factors are the number of individuals who should be involved in the turning for both the safety of the patient and the staff and the systemic approach to the use of the Jackson spine table.

Safe transfer includes having the required number of staff, which varies according to the technique used (i.e., "log roll" or "flip and catch," sliding sheets, or use of a spine table), and an assessment of the individual situation. However, there is no clear guideline on what the number should be. General guidelines call for a minimum of two team members for the conscious patient and a minimum of four team members for a nonmobile, conscious, or unconscious patient (Association of Surgical Technologists Education and Professional Standards Committee, 2006). AORN's Perioperative Standards and Recommended Practice (2013) recommends three or four caregivers (including anesthesia personnel for airway maintenance) for the supine-to-prone transfer, depending on the patient's weight. Bowers (2012), in addressing supine-to-prone transfer, indicated a need for three to six staff depending on the technique and stressed that this must be planned in the workflow. Attention to ensuring the adequacy of people to assist in the transfer is critical to preventing hazardous weight-bearing and subsequent musculoskeletal injury for staff. Ogg (2011) noted that "in 2001, nurses working in private healthcare facilities experienced a reported 11,800 [musculoskeletal disorders], the majority of which (i.e., nearly 9,000) were back injuries" (pp. 331–332).

Special precautions are needed to prevent injury in the surgical patient, especially in the patient who is

**Table 1. Ulcer Staging Criteria Summary[a]**

| Ulcer Stage | Criteria |
|---|---|
| Stage I   | Nonblanchable erythema of intact skin; the heralding lesion of skin ulceration. May also include changes in skin color, skin temperature, skin stiffness, and/or sensation (pain). |
| Stage II   | Partial-thickness skin loss involving epidermis and/or dermis. The ulcer is superfiscial and presents clinically as an abrasion, blister, or shallow crater. |
| Stage III   | Full-thickness skin loss involving damage or necrosis of subcutaneous tissue; may extend down to but not through underlying fascia. Present clinically as a deep crater with or without undermining of adjacent tissue. |
| Stage IV   | Full-thickness skin loss with extensive destruction, tissue necrosis, or damage to muscle, bone, and/or supporting structures (e.g., tendon and joint capsule). |

[a]From Shoemake and Stoessel (2015); used with permission.

transitioned between the supine and prone positions, as with spinal fusion operations. The spine table poses both benefits and concerns for patient safety, given its design and table specifications (Asiedu, Lowndes, Huddleston, & Hallbeck, 2018). This table was designed specific to spine surgeries in the prone position and allows for radiolucent imaging, so the patient can be repositioned, if needed, from supine to prone ("Modular table system [MTS]: spinal surgery top," 2019). Many features of the table ensure patient safety, of which staff must be aware. These include safety straps that are placed around a patient to secure the patient to the table; T-pins or the locking pins to secure the table top to the Jackson spine table frame, and a table brake. Without the proper steps to ensure patient safety—specifically, proper securing of the patient on the spine table with straps and T-pins—there is a risk of the table collapsing, resulting in potential injury to the patient or the staff. A Jackson spine table checklist is needed to address these risks and to define best practice for the use of the table, specifically the flip process. Historically, the surgical practice in our institution has not defined a clear direction for the spine table patient transfer process or the positioning of the prone patient.

DiPaola et al. (2009) noted two safety concerns with the Jackson spine table, and both concerns involved incorrect removal of a T-pin that can cause the table to collapse on one end. They also noted that proper use of the Jackson table depends on the OR staff following a specific series of steps during the positioning process and that no fail-safe safety mechanism is established to prevent such events. The authors suggested a step-by-step process with staff validation and cross-checking.

Dauber and Roth (2009) reported another surgical spine case in which an axial rotation adjustment was attempted to rotate the Jackson table. The table became loose and the patient, secured with pinion fixation, dropped to the floor ending up with a large subgaleal hematoma. A root cause analysis found that the locking mechanism had failed. The Jackson table was originally locked by staff, but the weight of the obese patient disengaged the lock.

In 2008, a study evaluated the Jackson table instruction manual and turning methods (DiPaola et al., 2008). The investigators noted that the Jackson table involves a multistep cooperative process that needs to be done with precision. Further, they noted that "surgical teams must practice and perform patient care techniques often in order to be proficient in high-pressure circumstances" and noted "the role of training modules for operating room staff learning to perform complex tasks that necessitate coordinated effort among team members" (p. 1,703). In other words, education through role-play or simulation promotes proficiency.

DiPaola et al. (2009) highlighted that patients who have sustained a spinal cord injury could incur secondary injury in patient transfer until their spine is adequately stabilized. They examined the cervical spine motion associated with different patient transfer methods from the supine to prone position, specifically the log-roll technique compared with the flip process for use on the Jackson spine table. They noted that the log-roll technique requires four staff: one person to secure the patient's head, two to move the midsection, and one for the feet. In addition, the leader at the head validates with other team members the number of safety straps in place and confirms that four T-pins are engaged at each end of the table setup. The study noted that the log-roll technique may not be the best method for securing cervical spine patients because there is no way to determine the amount of spinal motion that is generated through the process. Earlier, DiPaola et al. (2008) had noted, "the Jackson table turn technique generated significantly less motion ($P < .05$) in the unstable cervical spine during transfers … regardless of whether a cervical collar was used" (p. 1,699).

## Study Design and Methods

The present quality improvement (QI) project was implemented in the surgical suite of a Midwest quaternary care hospital. The target population was surgical spine patients whose cases involved surgical practice from two specialties: orthopaedic spine surgery and neurologic spine surgery. The interprofessional OR team that participated in the project included registered nurses, surgical technologists, surgical assistants, nurse anesthetists, surgical residents, and surgeons. In addition, ergonomic engineers were added to the team. The institutional review board approved the project.

Implementation of this project was guided by the Define, Measure, Analyze, Improve, and Control (DMAIC) QI framework (Levine, Gitlow, & Melnyck, 2015).

### Phase I: Define

The Define phase defines the problem and project goals. Examining problems related to the Jackson table, we assessed the current use of the Jackson table in regard to the patient flip process (the process where the patient is either manually or through spine table technology rotated from supine to prone). Partnership with the institution's ergonomics team occurred to help better understand opportunities to improve the flip process. There was also a review of the spine table events that had occurred. Two specific near-miss events were identified when the table was not assembled properly. Causes of these two events included improper T-pin engagement and not following the step-by-step process of the Jackson table setup. A regular review of equipment safety and deterioration before use of the table was found not to consistently occur. Overall, it was believed that personnel had concerns and lacked confidence in use of the Jackson table and the patient flip process. Skin integrity issues were defined as a concern, occurring from both patient positioning and the positioning aides used on the table. Additionally, no process was in place for the replacement of the table pads, which could impact PI formation.

Staff noted that they do not monitor the patient through the continuum of care and so are unaware of what happens with the patient in the postsurgical period. Consequently, they are not aware of skin integrity issues that occurred after the patient left the OR.

In an attempt to standardize the flip process, we defined the terminology for the procedure and included

*sender*, *receiver*, *patient flip*, *sandwiched patient*, and *repositioning of patient*. The definitions of these terms were clarified. Figure 1 shows staff positions during the process.

- Sender: Person with the role of flipping the patient from current position (prone or supine) to opposite position (patient rolls away from the sender) (see Figure 1, staff positions A and B)
- Receiver: Person with the role of catching the patient during the flip (patient rolls toward the receiver) (see Figure 1, staff positions D and E)
- Head support and airway control: Assigned to anesthesia (see Figure 1, staff position C)
- Foot position: Staff member supporting the legs rotation and position (see Figure 1, staff position F)
- Patient flip: Roll of the adult spinal patient from gurney or bed in start position, or supine position, to the final prone position on the Jackson table, or the reverse
- Sandwiched patient: Placing the patient between the top and bottom pieces of the Jackson table for a turn in place
- Repositioning of the patient: After the patient is prone, adjusting and lifting any part of the patient's body. Includes moving and adjusting pads or medical equipment (e.g., ventilation tubes, intravenous lines, and compression devices) to prevent accidental disconnection and removal

The AORN (Nelson, Waters, Spratt, Petersen, & Hughes, 2007) provides an algorithm to support use of lifting and transfer devices toward the safe patient handling decision-making pathway (see Figure 2).

## Phase II: Measure

Data collection occurred through various venues, including survey, focus group, benchmarking process with other like institutions, a literature review to assess current research and information on the flip practice, and direct observations of current practice.

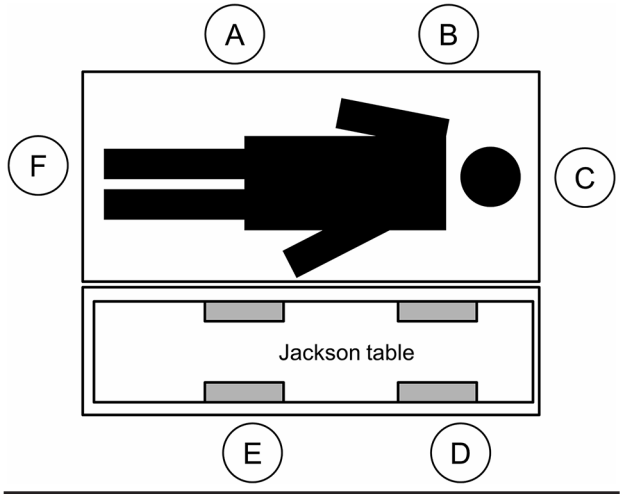



**Figure 1.** Various staff positions during the patient flip process. Lettered circle indicates a staff position.

### *Survey: Confidence for the Safe Completion of Prone Positioning*

A REDCap (Research Electronic Data Capture) survey of the surgical staff regarding their confidence for the safe completion of prone positioning was e-mailed to all staff by the research team and was open for 30 days (Appendix A). Each link was specific to that staff person, and the survey could be completed only once. Staff were allowed to open the e-mail and participate in the survey during five specified work times to facilitate completion. Snacks were provided during these set times in the computer classroom. Alternatively, participants could complete the survey on their own time at any computer.

### *Focus Group*

Data were also collected through a focus group conducted with 11 OR staff members to outline the project's direction. Staff members were asked by the nurse managers to voluntarily participate in the focus group as part of their workday. To better understand the challenges and opportunities of this process, we focused questions on profession, role in the flip process, how often you perform the flip process in regard to daily/weekly, average number of staff that participate in the flip process, and incidence of individual musculoskeletal injury during flip process.

Persons from the focus groups were then asked whether they were willing to participate in a task group to assist in developing a standardized workflow for spine table use and a checklist to enhance the safety of the process for patient and staff. Five members of the OR staff participated: one nurse, one surgical assistant, one nurse anesthetist, and two surgical technologists. Additionally, two nurse managers, two nursing education specialists, and a surgeon lead participated to guide the task group process. This group collaborated with an ergonomic engineering team from within the healthcare institution to define the spine table process with the aim of standardization and safe patient handling.

### *Benchmarking*

Benchmarking is a process of measuring performance in one organization and comparing it with those of other, similar organizations or organizations thought to be the best in class. This process allows for identification of internal opportunities for improvement and commonalities to standardize practice. Eleven similar U.S. hospitals that perform spine surgery were contacted regarding their processes for use of the Jackson table and the flipping protocol or guideline with the table. Additionally, internal benchmarking occurred specifically looking at equipment use, replacement and repair process (including whether there were a designated number of uses before replacement), and comparison between the orthopaedic and neurosurgical spine practices.

### *Literature Review*

A literature review was conducted to explore evidence regarding suggested guidelines for the flip process in

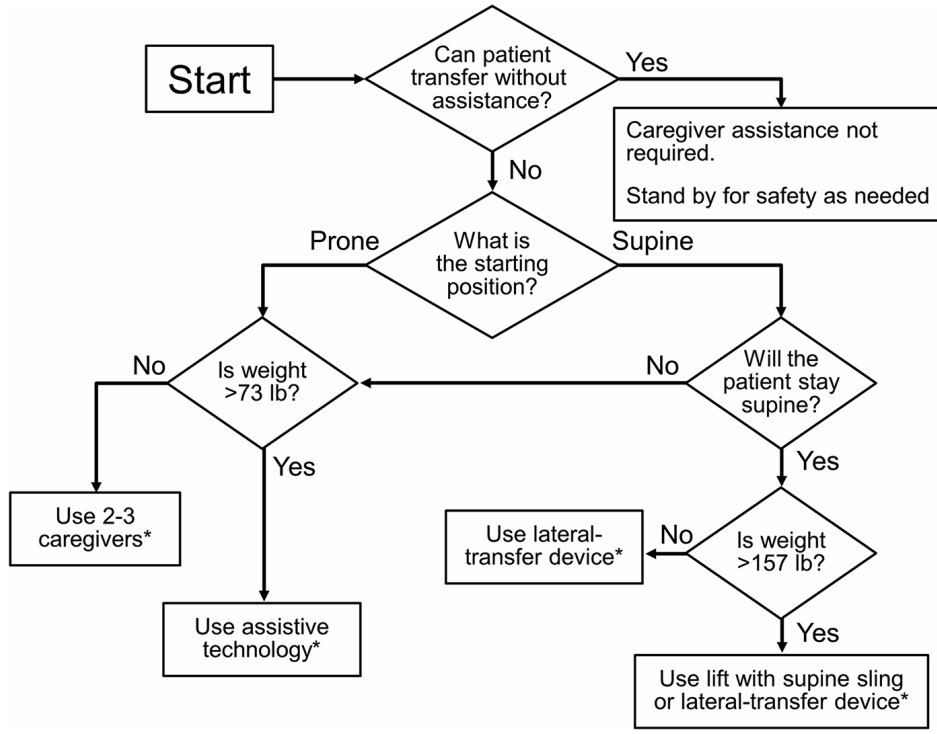



**Figure 2.** Association of periOperative Registered Nurses algorithm for decision process. Asterisk indicates that one of the caregivers may be the anesthesia provider. (Modified with permission from Guidelines for Perioperative Practice. Copyright © 2018, AORN, Inc, 2170 S. Parker Road, Suite 400, Denver, CO 80231. All rights reserved.)

spine surgeries, the number of staff suggested for patient safety in the flip process, and skin integrity issues related to spine surgeries with use of the Jackson table in conjuction with use of Tempur-Pedic pads (Tempur-Pedic North America, LLC). The searched databases were PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Google Scholar, Cochrane Library, National Guideline Clearinghouse, Joanna Briggs Institute, and Best Evidence. All retrieved articles were limited to English-language publications.

### *Direct Observation and Chart Review*

Direct observations were performed by the two nurse managers, a surgeon lead, and the organization's ergonomics engineering research. Three areas were targeted for observation.

1. The flip process: was there a current systemic approach or standardized way of transferring the patient
2. The systematic process of spine table use: what was the safety check to table stabilization and security for the patient
3. The type and location of the padding: was there consistency with padding options and placement

The healthcare facility's skin integrity data (entered as an event at the time of discovery) were typically not shared with the practice staff for regular review unless a skin integrity event was sentinel at the PI level or was entered into the health record by the OR nurse. Skin integrity data were pulled from nursing documentation that was reported from observations in the OR and hospital units for skin integrity events related to spine surgery. Collected over a year (April 2012 through April 2013), the data were filtered for the appropriate care location, the equipment, and the comments related to the use of the Jackson table during spine surgery. Events for the hospital and the OR were separated in the system to provide the different time frames of skin integrity discovery. This review process was used to identify common themes in regard to event type and PI locations.

## Phase III: Analyze

### *Survey: Confidence for the Safe Completion of Prone Positioning*

The REDCap survey had a response rate of 41% ($n$ = 75). The average age of the participants was 42.4 years, 75% were women, and the average number of years of experience was 12.5. According to the respondents, the most physically demanding role in the patient flip was that of the receiver (57%), followed by the sender's role (29%). The riskiest phase of the patient flip was the head holding and stabilization (27%); management of the head frame system was next riskiest (20%) (Appendix B). Frequency of use of the Jackson table for prone patients was once every 2–4 four days for 33% of respondents, once per week for 16%, and once daily for 13%. Among the respondents, 36% noted using the Jackson table with the flip within the past week, and 32% noted within the past day. They reported that their most recent

encounter with the manual flip was within the past week, with the next most common encounter within the past 2 weeks, followed by once per week. The number of staff involved during the patient flip averaged between three and six members but had no standard or consistency. Additionally, staff noted that the variability in both the actual process used and the ability to engage in this process caused a lack of confidence in patient safety. Of note, questions that focused on body dynamics and injury are being addressed by the ergonomic team partnership manuscript and will not be addressed in this article.

## Focus Group

Focus group participants identified the following three key themes.

1. Potential barriers, which included not having enough staff to safely transfer the patient during the spine table process. Staff noted they would have taken additional help to perform the flip process, but oftentimes, no one was available.
2. Missing information or items needed for the spine table process and safe patient handling, such as the padding or safety pins. Because of the size of the surgical suite and the volume of spine cases, equipment was not centralized, making it difficult to find. Additionally, the lack of tracking equipment that was out for repair and broken equipment waiting for replacement did not help in better understanding of what was needed to support spine cases.
3. Staff perception of *culture of safety*, which varied greatly on the basis of the level of concern or urgency to ensure the safety of the process. Seasoned staff reported their ability to adapt and make the process work without the additional help. Newer staff or staff not as familiar with this practice reported safety concerns for both staff safety (back injury) and patient safety (skin injury).

## Benchmarking

Benchmarking was done to help determine current practice and the commonalities toward a best practice process. Information was collected through phone interviews. Box 1 presents areas for standardization identified from the 11 hospitals participating in the benchmarking process.

Internal benchmarking (see Figures 3 and 4) also served as a baseline to determine the padding and equipment standardizations through discussions with the institutions' equipment coordinators ($n$ = 2).

## Observation and Chart Review

Initial observations witnessed inconsistencies in the number of staff involved to perform the flip process, the systematic process of spine table use with the safety and mechanisms to secure both the patient and the table, and the type and location of the padding ($n$ = 15).

**Box 1. Current Practice Identified From the 11 Hospitals Participating in the Interview Portion of the Quality Improvement Project**

| |
|---|
| Average number of staff to perform the transfer process |
| Use of Jackson table for orthopaedic or spine surgery (or both) |
| Transfer method from supine to prone |
| Type of surgical spine table |
| Frequency of surgical spine table use per week |
| Standard number of staff to transfer patient |
| Minimum number of staff to transfer patient |
| Type of spine table padding |
| Rationale for padding choice |
| Use of pinions, tongs, or head pillows |
| Profession of the individual who applies/secures the head frame |
| Patient safety issues that have occurred |
| Problems with the manual method |
| Safety issues that have occurred |
| Education used for training staff |

Common barriers to the Jackson table patient positioning process included inconsistency in practice among various surgeons and staff, transfer of patients with higher BMIs in regard to staff positioning, agreement on the best positioning of staff, use of the positioning aides to minimize PI risk, and a general dislike for the current surgical spine table's functionality and the location of table attachments and positioning aides.

Data were summarized graphically to facilitate interpretation (see Figures 5 and 6). In both orthopaedic and neurologic surgery, an average of 2.8 operations per day (1,022 per year) used the Jackson table.

The number of audited spine cases that involved the flip process was recorded from June 5, 2014, through June 30, 2017. During this period, 153 spine cases were identified that involved the manual flip process. Skin integrity issues of patients who were positioned on the Jackson table during the reporting time ranged from 12.5% to 47.1% of the total reported OR skin integrity issues each month. These included location of skin integrity issue and a description (see Table 1).

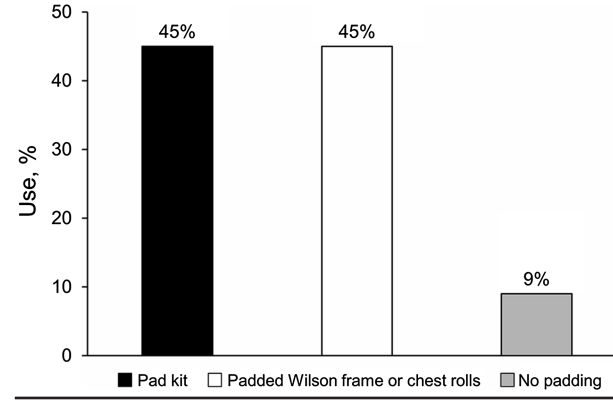



**Figure 3.** Use of padding and type of padding according to benchmark survey responses.

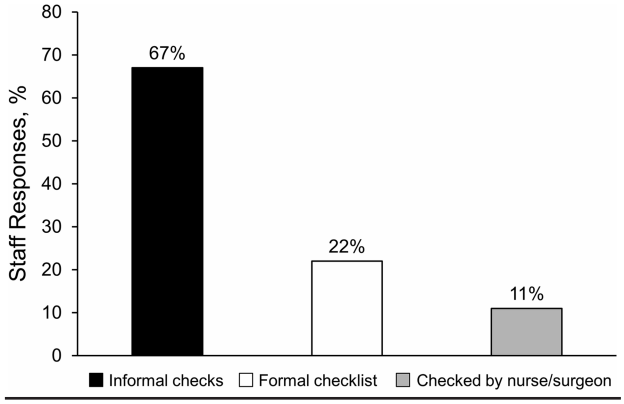



FIGURE 4. Safety checks during patient flip process according to benchmark survey responses.

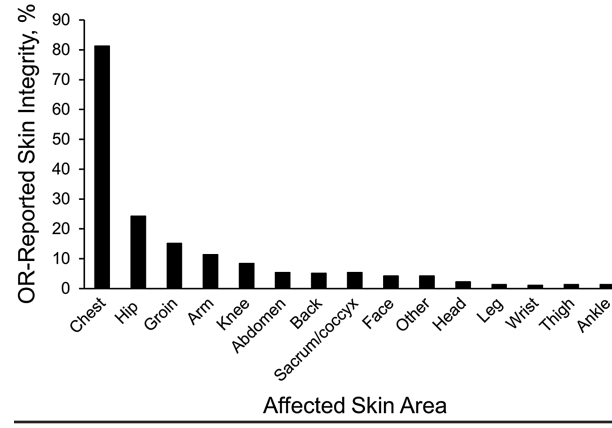



FIGURE 6. Affected body part of pressure injuries, OR, reported for April 2012 through April 2013. OR indicates operating room.

## PHASE IV: IMPROVE

The improve phase serves to help identify a solution to a problem. As a result of our findings, the following best practice approach was developed for use with the Jackson table.

### *Audible and Visual Pause*

The practice identified a team leader (nurse) who conducts an audible and visual pause with all members of the surgical team before patient transfer. The team leader is responsible for the checklist process and documentation.

### *Checklist Development*

A checklist was developed to ensure patient safety through a thorough equipment check that is used at each Jackson table use (Appendix C). Use of the safety checklist initially was done manually. A mnemonic of *444* was developed to aid checklist use: 4 transfixion pins on the top; 4 transfixion pins on the bottom; and 4 safety belts for both the mechanical flip and the manual flip (Appendix B). Transfixion pins and the level of the bed were colored red to alert staff to the correct locking for the spine table. These interventions were not identified in the literature previously or through benchmarking. Further to the findings of this QI project, the healthcare facility added the checklist from its paper form to be done electronically through the nursing documentation to ensure that a hard stop was made to complete this step before progressing with the surgical case.

### *Education*

Before the QI project intervention in 2013, our practice had two near-miss events regarding the spine table setup process. Training was developed to support staff to adapt and adhere to the new equipment use standards. The training included a video, which all staff members are required to view on their hire and annually thereafter, and mandatory staff education that used live simulation and the checklist (Appendix D). With the implementation of both the checklist and training, no additional events related to table misuse have been reported.

The surgical practice trialed other beds and padding including gel padding, a viscoelastic foam mattress (Tempur-Pedic), and positioning attachments. Because of the decrease in skin integrity event reports (see Figure 7) with the implementation of gel padding, the

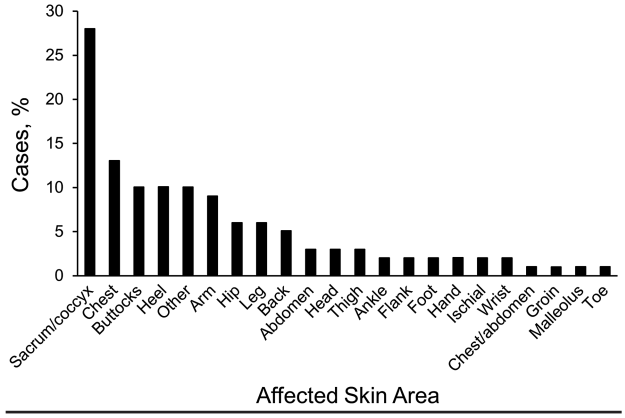



FIGURE 5. Affected body part of pressure injuries, from skin integrity data.

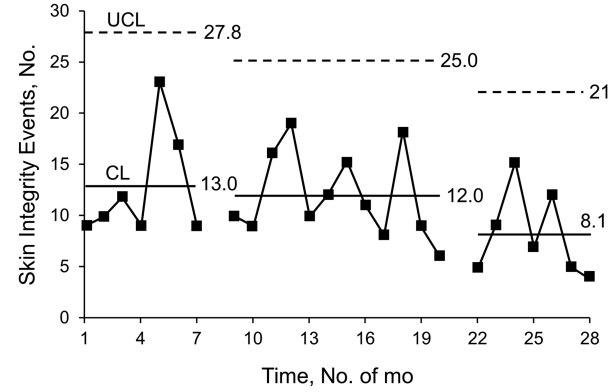



FIGURE 7. Skin integrity event data related to prone patient positioning from June 2012 through June 2014. CL indicates checklist used; UCL, checklist not used.

practice decided to purchase new table mattresses and positioning attachments with this material. With the introduction of the new gel padding, a trend of continued decrease in skin integrity issues, including PIs, has been observed.

## Phase V: Control

The control phase occurs to ensure those improvements made continue to occur once the project is closed. Although implementation of annual refresher training has been recent, these interventions are expected to improve patient safety and ensure that staff are more comfortable using the spine table for the mechanical flip and the manual flip methods. This process is monitored by analyzing patient events as tracked in the electronic patient record in the nurse charting application. Figure 8 shows the use of the readiness checklist and the transition from paper audit to electronic entry within a nurse's charting document. A pop-up screen was developed to remind staff to chart the checklist in the electronic nurse documentation. As the paper method was phased out and the electronic entry started, compliance improved. Since the electronic submission, compliance is at 100%. This use is validated through the nurse auditing process within the charting system.

A surgeon lead for neurosurgery and orthopaedic surgery had been assigned to address any noncompliance in following the checklist. A quality analyst now tracks these process outcomes. Skin integrity continues to be monitored through the patient event records and will be reviewed in monthly nurse manager meetings and quarterly unit scorecards. A decrease in skin integrity rates will trigger a review of the process in regard to positioning and foam pad replacement.

Skin integrity events continue to show a downward frequency trend (see Figure 7). Data for 2014 noted a 37% decrease in chest integrity events with a 28% decrease in hip skin integrity events since inception of the QI project.

A process has been initiated for regular maintenance of foam padding for both the mattress and the positioning aides. This involves placing the date of receipt on the mattress, the attachments, and the metal bracket on each attachment. The step was undertaken to allow regular review of solidity and usability of these equipment items, looking for overall wear or defects. If a pad had a tear or was more than 1 year old, an automatic replacement was ordered. Because attachments are metal, a new one was ordered when there was a crack or break, because no fix was available for these parts. Regular review of the metal portion for cracks and breaks is done by staff at the time of setup and every 6 months.

Maintenance is done with daily review, and issues are handled in the moment. Staff training encourages a review of equipment before patient placement on the table. Currently, no replacement process is in place for the Tempur-Pedic pads. Staff will set equipment aside to be repaired or replaced in the event of any concerns. The company notes that pads are good for 1 year, although the company does not define a specific number of uses that could change the 1-year expiration.

After this QI process, the surgeon and staff confidence in the flip process has improved markedly. To date, no patient events have occurred that are related to the Jackson table setup process. OR team members have noted that the education provided and the resource tools created have been most beneficial in the off-shift (evening and overnight) and weekends. This is due to the decrease in the staff that standardly practices in this area to respond to any questions that arise.

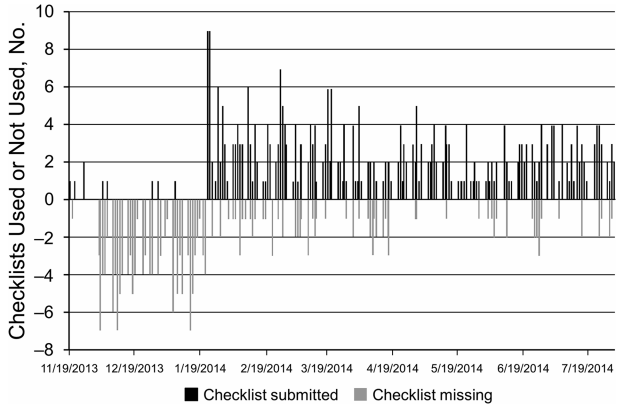



**Figure 8.** The 180° flip spine surgery checklist use.

## Implications for Practice

The DMAIC QI process was a valuable tool for this project because it helped to identify success early through analysis and identification of gaps and solutions to improve a process. By using an interdisciplinary change team, we were able to gather various perspectives on the impact of change while enhancing communication and teamwork. Attention to the details and adherence to the spine table checklist by all OR staff in regard to patient positioning and the monitoring of skin during surgical procedures can help reduce the risk of serious complications. Strategies to identify continued gaps and opportunities for improvement should be continually explored, as spine table technology continues to evolve.

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# Appendix A

## Questionnaire (Courtesy of Mayo Foundation for Medical Education and Research)

### Definitions

*Sender:* Person with the role of flipping the patient from current position (prone or supine) to opposite position (patient rolls away from the sender).

*Receiver:* Person with the role of catching the patient during the flip (patient rolls toward the receiver).

*Patient flip:* Roll of the adult spinal patient from gurney or bed in start position, or supine position, to the final prone position on the Jackson table, or the reverse.

*Sandwiched patient:* Placing the patient between the top and bottom pieces of the Jackson table for a turn in place.

*Repositioning of the patient:* After the patient is prone, adjusting and lifting any part of the patient's body. Includes moving and adjusting pads or medical equipment (e.g., ventilation tubes, intravenous lines, and compression devices) to prevent accidental disconnection and removal.

Section A: Demographics

1. Please fill in your age: _____
2. Gender:
   - ☐ Male
   - ☐ Female
3. What is your weight?
   Pounds: _____
4. What is your height?
   Feet: _____ Inches: _____
5. What is your dominant hand?
   - ☐ Right
   - ☐ Left
   - ☐ Ambidextrous
6. Position/Job:
   - ☐ Surgeon
   - ☐ Anesthesiologist
   - ☐ Fellow
   - ☐ Resident
   - ☐ RN
   - ☐ CSA
   - ☐ CRNA
   - ☐ CST
   - ☐ Other
7. Are you usually participating in the patient flip as a:
   - ☐ Member of the surgical team who turns patients as part of my job
   - ☐ Just pulled in for the patient turn over
   - ☐ I don't participate in patient turning (Please skip to #11)
8. How long have you been in your current job? _____ years
9. Role (what do you do during patient flip from *supine to prone*):

*Note: Will add in graphic and letters for different positions*

   - ☐ Receiver (A)
   - ☐ Holding head (B)
   - ☐ Sender (C)
   - ☐ Feet (D)
   - ☐ Sender (E)
   - ☐ Other _____
10. Role (what do you do during patient flip from *prone to supine*):

*Note: Will add in graphic and letters for different positions*

   - ☐ Receiver (A)
   - ☐ Holding head (B)
   - ☐ Sender (C)
   - ☐ Feet
   - ☐ Sender (E)
   - ☐ Other_____
11. What is the most physically demanding role (receiver/sender) during the patient flip?
12. What is the riskiest phase of the flip for the patient?
13. Do you assist in lifting the patient for repositioning after the flip?
   - ☐ Yes
   - ☐ No
14. Are you currently taking medication for pain?
   - ☐ Yes
   - ☐ No
15. Have you had any previous diagnosis of injury or repetitive illness in the following areas?

(Check all that apply)

   - ☐ Neck
   - ☐ Shoulder
   - ☐ Upper back
   - ☐ Lower back
   - ☐ Elbow
   - ☐ Wrist
   - ☐ Hand
   - ☐ Hip
   - ☐ Knee
   - ☐ Ankle
   - ☐ Feet

Section B: Physical Discomfort

1. Do you experience physical discomfort or related symptoms while:

| | Yes | No |
|---|---|---|
| I do not experience any physical discomfort | ☐ | ☐ Skip to #3 |
| Rotating the patient to roll onto/off of the Jackson table (Sending) | ☐ | ☐ |
| Flipping the patient onto/off of the Jackson table (Receiving) | ☐ | ☐ |
| Lifting the patient up the chest pad area to adjust patient position | ☐ | ☐ |
| Lifting up the hip pad area to adjust patient position | ☐ | ☐ |
| Aligning the spine/full body shift | ☐ | ☐ |
| Positioning the patient's head/neck | ☐ | ☐ |

2. Which of the following physical discomfort or symptoms apply following using Jackson bed?

| | *Frequency*: During the last work week, how often did you experience ache, pain, and discomfort? | | | | *Severity*: If you experienced ache, pain, and discomfort, how uncomfortable was this? | | | *Productivity*: If you experienced ache, pain, and discomfort, how much did this interfere with your ability to do your work? | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Body discomfort | 1–2/ week | 3–4/ week | Once every day | Several times every day | Slightly uncomfortable | Moderately uncomfortable | Very uncomfortable | Did not interfere | Slightly interfered | Substantially interfered |
| Neck | | | | | | | | | | |
| Shoulder (right) | | | | | | | | | | |
| Shoulder (left) | | | | | | | | | | |
| Upper back | | | | | | | | | | |
| Lower back | | | | | | | | | | |
| Upper arm (right) | | | | | | | | | | |
| Upper arm (left) | | | | | | | | | | |
| Forearm (right) | | | | | | | | | | |
| Forearm (left) | | | | | | | | | | |
| Wrist (right) | | | | | | | | | | |
| Wrist (left) | | | | | | | | | | |
| Hips/buttocks | | | | | | | | | | |
| Thigh (right) | | | | | | | | | | |
| Thigh (left) | | | | | | | | | | |
| Knee (right) | | | | | | | | | | |
| Knee (left) | | | | | | | | | | |
| Lower leg (right) | | | | | | | | | | |
| Lower leg (left) | | | | | | | | | | |
| Ankle (right) | | | | | | | | | | |
| Ankle (left) | | | | | | | | | | |
| Foot (right) | | | | | | | | | | |
| Foot (left) | | | | | | | | | | |

1. How have you attempted to minimize issues with patient turning and positioning?
(Check all that apply)
   - ☐ Not applicable
   - ☐ Ignore it
   - ☐ Take a break
   - ☐ Take pain relief medication
   - ☐ Ask more coworkers to assist
   - ☐ Refuse to turn patient
   - ☐ Go to the feet
   - ☐ Other (please specify)

2. How many times in the last 6 months have you missed work due to injury or pain related to the physical portion of your workload?
   - ☐ Not applicable
   - ☐ 0 or never
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 5
   - ☐ 6 or more

Section C: Nature of Work

1. How often do you use Jackson table for prone patients?
   - ☐ Multiple times a day
   - ☐ Every day
   - ☐ Once every 2–4 days
   - ☐ Once a week
   - ☐ Once every 2 weeks
   - ☐ Once every month
   - ☐ Less than once every month

2. When did you last position a prone patient on a Jackson table?
   - ☐ Yesterday
   - ☐ A week ago
   - ☐ Two weeks ago
   - ☐ A month ago
   - ☐ Six months ago
   - ☐ A year ago

3. How long have you been using Jackson table to position prone patients?
   _____ (weeks/month/years)

4. Typically how many coworkers fill each role to flip the patient using Jackson bed?
   - ☐ Sender
   - ☐ Receiver
   - ☐ Head
   - ☐ Feet
   - ☐ Other
5. How do you perform an equipment setup check before using the Jackson bed?
   - ☐ What should be done or included during such a check?
6. Is the current process of spinal positioning/repositioning safe for the patient?
   Comment:
7. Is the current process of spinal positioning/repositioning safe for the staff flipping the patient?
   Comment:

# Appendix B

### Prone Patient Positioning Interview Highlights and Comments (Courtesy of Mayo Foundation for Medical Education and Research)

*Focus group statistics:* Eleven interviews have been conducted: six with circulating nurses, four certified surgical assistants, and one certified surgical technologist out of which seven interviews have been transcribed and imported to Nvivo. E-mails have been sent to six residents requesting their participation; one declined, and follow-up e-mails will be sent to the five.

### Preliminary Results

*Overview*

On the whole, participants felt the current process of spinal positioning is safe for the patient and the staff if attention is paid and all processes are followed correctly.

There were mixed responses on sender and receiver roles. Some felt the senders' role is harder than receivers' and the reverse was true for other participants. Arguably, the sender needs a lot of energy to "push" or "roll" a patient over. The same is true for the receiver.

With the exception of the patient's head, anyone can receive or push, and the roles are not necessarily assigned. However, more experienced staff are usually in the receiving positions than less experienced staff because of the required level of skill and attention.

*Difficulties with positioning*

- Preoperative planning takes lots of time
- Making sure pads (e.g., chest and hip) are in the right place
- Minimizing movements of the patient so the movements do not cause wrinkling of the pads, which can cause bruises
- Lifting patients
- Pads are too small, especially for bigger patients

*Use of Jackson table and sandwich mechanism*

- Use of Jackson table and sandwich depends on surgeon preference, and it is mostly used for patients with unstable fractures, patients with posterior infusions, heavy patients
- What influences a surgeon's decision to use? Surgeon's safety issues, pathologic reasons, clinically unstable patients, neurologic changes—for example, if a patient has neurologic deficits, surgeons would not want to change the patient's position and so they use the sandwich flip

*Problems with the table and the flip*

- Jackson table is too narrow because most patients are "large"
- Metals are too heavy and the table is difficult to set up
- Sometimes, all of the equipment parts for the table are not set in one room
- Lying underneath the table to adjust the head can be difficult
- It is a lot of work making sure all straps are secured

*Mistakes with the table and the flip*

- Sometimes, pins are not secured properly
- Most participants recounted that they have encountered "close calls" for patient fall but were immediately rectified, mostly because one or two of the pins that hold the prone portion were not in place
- Most of them learned from the mistake and double-checked all pins thereafter. One person made a rule named *rule of fours* or *444*, which means checking that there are 4 pins in correct position at the head, 4 pins at the foot, and at least 4 belts going around the patient

*Recommendations and suggestions*

- One person should be in charge of the flipping process and others just assisting. Currently, everyone is charged and all of them do one assessment. There is a problem when one person thinks another person checked that all pins are secured, when in fact, it was not done. Thus, there should be one person driving the movement—most likely,

the person who has the hold of the head because that person is in a vantage position to see all team members. This could be as simple as letting that one person come up with a phrase to check that all pins are in correct positions. For example, "We do a pause before we make incisions on our patients doing a pause before flipping a patient isn't unreasonable"
- There should be more communication in the room as some people do not know much about the Jackson table
- Employ someone to work solely on the Jackson table to make sure all the parts work properly and all the tools are assembled correctly. Currently, parts of the tools for the Jackson table are in different rooms, and running around to get them may be time-consuming. And also, to make sure it is working. This person will have to look at the surgery list and set up the table and have all parts in one room
- The rule of fours or 444 could be helpful for others who use the Jackson table. Do not turn patients without the 444 pins that hold the turning mechanism

**Appendix C.** Spine Table Safety Checklist (Courtesy of Mayo Foundation for Medical Education and Research)

*Ensure that the number of staff to transfer patient is adequate for patient needs*

| Patient Transfer From Cart to Spine Table | Rotation Flip Part I | After Rotation Flip Part II |
|---|---|---|
| RN circulator conducts an audible count of the following:<br>• Brakes engaged: 1 on cart and 1, 2, 3, 4 on spine table<br>• 1, 2 (T-pins at the head end). All drop locks are visible and pivot freely<br>• 3, 4 (T-pins at the foot end). All drop locks are visible and pivot freely<br>• 1, 2, 3 blue lights illuminated<br>• 180° rotation lock is tight | RN circulator conducts an audible count of the following:<br>• Brakes engaged: 1, 2, 3, 4 on spine table<br>• 1, 2, 3, 4 (T-pins at the head end). All drop locks are visible and pivot freely<br>• 5, 6, 7, 8 (T-pins at the foot end). All drop locks are visible and pivot freely<br>• 1, 2, 3, 4 safety straps are tight and in place<br>• Airway/lines/urinary catheter are free | RN circulator conducts an audible count of the following:<br>• 1, 2, 3 blue lights illuminated<br>• 180° rotation lock is tight<br>• Before removing flat frame identify correct T-pins for removal |

Abbreviation: RN, registered nurse.

# Appendix D

## Spine Table Competency Checkoff (Courtesy of Mayo Foundation for Medical Education and Research)

## Spine Table Safety Checklist

*Role*: RN, CST, CSA

*Location*: Surgical services

[Mayo Clinic] Nursing Professional Practice Model Role(s): Vigilant guardian, pivotal communicator

*Safe behaviors:* Pay attention to detail, communicate clearly, hand off effectively, support each other

*The rationale for completing this competency:* To allow staff to discuss and illustrate safety measures associated with the use of the spine table

- *New* procedure, policy, equipment, or initiative
- *Changes* in current procedures, policies, equipment, or initiatives
- *High-risk* aspect of the job
- *Problematic* aspect of the job

## Appendix D Figure

| Criteria Statements | Met | Not Met |
|---|---|---|
| 1. Locate the resources available for using the spine table. | ☐ | ☐ |
| 2. When using the spine table, identify at what 2 critical points you would use the spine table checklist. | ☐ | ☐ |
| 3. Discuss four safety steps addressed when using the spine table checklist. | ☐ | ☐ |
| 4. Using the pictures below indicate which transfixion pins should be removed after the 180 degree rotation.<br><br>Head of Spine Table<br><br>  <br> | Verbalize or circle the letter/s associated with the correct pin/s. | |

| Foot of Spine Table | Verbalize or circle the letter/s associated with the correct pin/s. |
|---|---|
|  <br> | |

*Resources*: The resources listed will assist you to successfully complete this competency. They are not intended to give you the exact answers. There may be other available resources that are not listed here.

- Surgical services/specialties/ortho resource page
- Surgical services/specialties/neuro resource page
- Surgical services/weekend 12-hour team resource page
- Surgical services/education/orientation manual/self-learning module

Criteria Statement: All objective statements must be met according to polices and the guide for this topic. Criteria met_____Yes _____No
RN evaluator signature and credentials: _____ Date: _____

If the criteria were not met for this competency topic, an action plan must be developed that includes methods to meet the objectives and criteria for this competency and how the competency will be reassessed.

Action plan: _____
_____

Competency reassessment plan: _____
_____

Abbreviations: CSA, certified surgical assistant; CST, certified surgical technologist; neuro, neurology; ortho, orthopaedic; RN, registered nurse.