

**Guideline for Positioning the Patient
Evidence Table**

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
1	Dybec Robert B. Keeping up-to-date on patient positioning. <i>OR NURSE</i> . 2013;7(2): 16-17.	Expert opinion	N/A	N/A	N/A	N/A	Safe positioning of surgical patients requires a combination of current and basic knowledge.	VC
2	Lopes CM, Galvao CM. Surgical positioning: evidence for nursing care. <i>Rev Lat Am</i> . 2010;18(2): 287-294.	Literature review	N/A	N/A	N/A	N/A	Included studies focused on risk factors for complications due to surgical positioning, and nursing care related to surgical positioning.	VB
3	Bouyer-Ferullo S. Preventing perioperative peripheral nerve injuries. <i>AORN J</i> . 2013;97(1): 110-124.e9.	Literature review	N/A	N/A	N/A	N/A	No standard exists to identify, document, or monitor peripheral nerve injuries; however, increasing awareness of the potential for injury and implementing safe positioning practices has the potential to decrease the incidence of peripheral nerve injury.	VA
4	Fleisch MC, Bremerich D, Schulte-Mattler W. Prevention of Positioning Injuries during Gynecologic Operations Guideline of DGGG (S1-Level, AWMF Registry No.015/077, February 2015). 2015;75(8): 792-807.	Clinical practice guideline	N/A	N/A	N/A	N/A	The recommendations address information provided to the patient, documentation, injury prevention, monitoring and diagnosis of positioning injuries.	IVB
5	MacDonald JJ, Washington SJ. Positioning the surgical patient. <i>Anaesthesia and Intensive Care Medicine</i> . 2012;13(11): 528-532.	Expert opinion	N/A	N/A	N/A	N/A	Recommendations are provided for patient positioning and the physiological changes associated with different positions.	VB
6	Rowen Lisa, Rowen Lisa, Hunt David, Johnson Karen L. Managing obese patients in the OR. <i>OR NURSE</i> . 2012;6(2): 26-36.	Expert opinion	N/A	N/A	N/A	N/A	Perioperative patients who are obese require an evidence-based, integrated approach to their care.	VB
7	Washington SJ, Smurthwaite GJ. Positioning the surgical patient. <i>Anaesthesia and Intensive Care Medicine</i> . 2009;10(10): 476-479.	Expert opinion	N/A	N/A	N/A	N/A	It is imperative that the anesthesia professional, surgeon, and perioperative team work together to prevent injuries related to surgical positioning.	VB
8	Sørensen Erik Elgaard, Kusk Kathrine Hoffmann, GrønkJaer Mette. Operating room nurses' positioning of anesthetized surgical patients. <i>J Clin Nurs</i> . 2015.	Nonexperimental-Survey	481/Operating room nurses employed at four public university hospitals in Denmark	N/A	N/A	Problems associated with positioning surgical patients	Lack of appropriate positioning equipment combined with poor availability of positioning equipment in operating rooms were found to cause problems for team members positioning patients.	IIIB

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9	Chitlik A. Safe positioning for robotic-assisted laparoscopic prostatectomy. <i>AORN J</i> . 2011;94(1): 37-45.	Expert opinion	N/A	N/A	N/A	N/A	The lithotomy with Trendelenburg position used for robotic procedures creates unique challenges. Using a beanbag positioning device designed for use with this position helps prevent complications.	VA
10	AORN standards - association of periOperative registered nurses http://www.aorn.org/guidelines/clinical-resources/aorn-standards . Accessed 8/4/2016.	Clinical practice guideline	N/A	N/A	N/A	N/A	The perioperative nurse has an obligation to provide safe, professional, and ethical patient care.	IVC
11	Sawyer RJ, Richmond MN, Hickey JD, Jarratt JA. Peripheral nerve injuries associated with anaesthesia. <i>Anaesthesia</i> . 2000;55(10): 980-991.	Expert opinion	N/A	N/A	N/A	N/A	Prevention of peripheral nerve injuries involves awareness of potential problems associated with operative positions and careful positioning of the patient with optimal padding.	VB
12	Kuponiyi O, Alleemudder DI, Latunde-Dada A, Eedarapalli P. Nerve injuries associated with gynaecological surgery. <i>OBSTETRICIAN GYNAECOLOGIST</i> . 2014;16:29-36.	Expert opinion	N/A	N/A	N/A	N/A	Poor patient positioning is a major contributor to intraoperative nerve injuries.	VA
13	Johnson RL, Warner ME, Staff NP, Warner MA. Neuropathies after surgery: Anatomical considerations of pathologic mechanisms. <i>Clinical Anatomy</i> . 2015;28(5): 678-682.	Expert opinion	N/A	N/A	N/A	N/A	Avoiding direct compression and stretch to soft tissues and nerves reduces the frequency of positioning-related problems.	VA
14	Ducic I, Zakaria HM, Felder JM 3rd, Arnsperger S. Abdominoplasty-related nerve injuries: systematic review and treatment options. <i>Aesthetic Surgery Journal</i> . 2014;34(2): 284-297.	Systematic review	23/Studies related to abdominoplasty-related nerve injuries	N/A	N/A	Postoperative nerve injury	Results showed a low incidence of nerve injury after abdominoplasty, some injuries were caused by incorrect positioning techniques.	IA
15	Nilsson UG. Intraoperative positioning of patients under general anesthesia and the risk of postoperative pain and pressure ulcers. <i>Journal of PeriAnesthesia Nursing</i> . 2013;28(3): 137-143.	Nonexperimental	86/Patients undergoing elective surgery in the supine position who had normal BMI and were ASA class I or II	N/A	N/A	Risk factors associated with intraoperative positioning/ Development of postoperative pain or pressure injury	The risk for positioning pain seems to be greater in patients suffering from preoperative pain.	IIIB

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16	Waters T, Short M, Lloyd J, et al. AORN ergonomic tool 2: positioning and repositioning the supine patient on the OR bed. <i>AORN J</i> . 2011;93(4): 445-449.	Expert opinion	N/A	N/A	N/A	N/A	It is important to determine which tasks may be safe to perform manually and which tasks should be performed with using assistive technology.	VA
17	Lindgren M, Onosson M, Krantz AM, Ek AC. Pressure ulcer risk factors in patients undergoing surgery. <i>J Adv Nurs</i> . 2005;50(6): 605-612.	Nonexperimental	286/Adult patients undergoing surgical treatment	N/A	N/A	Pressure injury development	Special attention to the risk of pressure injury development is warranted for patients undergoing surgery who are women, have low ASA classification, or low food intake.	IIIB
18	Practice advisory for perioperative visual loss associated with spine surgery: An updated report by the american society of anesthesiologists task force on perioperative visual loss. <i>Anesthesiology</i> . 2012;116(2): 274-285.	Clinical practice guideline	N/A	N/A	N/A	N/A	The task force does not believe there are identifiable preoperative patient characteristics that predispose patients to perioperative ischemic optic neuropathy.	IVA
19	The National Pressure Ulcer Advisory Panel. 2014 Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline. Accessed on 11/17/2015.	Clinical practice guideline	N/A	N/A	N/A	N/A	Pressure injury is a frequently occurring health problem throughout the world that is painful, costly, and an often preventable complication for which many individuals are at risk.	IVA
20	Mangham M. Positioning of the anaesthetised patient during robotically assisted laparoscopic surgery: Perioperative staff experiences. <i>J Perioper Pract</i> . 2016;26(3):50-52.	Expert opinion	N/A	N/A	N/A	N/A	Perioperative team members should never stop questioning and evaluating current practices and continue to look for improved methods of caring for patients undergoing robotic procedures.	VC
21	Fletcher Hester Cline. Preventing skin injury in the OR. <i>OR NURSE</i> . 2014;8(3): 29-34.	Expert opinion	N/A	N/A	N/A	N/A	Preoperative assessment can prevent skin injury and reduce hospital length of stay. Prolonged surgery is a risk factor for pressure injury development in surgical patients.	VC
22	Jacobs Amanda, Rose Sarah. Assessment is more than skin deep in older adults. <i>OR NURSE</i> . 2011;5(4): 29-29.	Expert opinion	N/A	N/A	N/A	N/A	Older adults are more susceptible to pressure injury due to decreased skin elasticity, reduced subcutaneous tissue, dry skin, chronic illness, malnutrition, incontinence, and decreased vascular sufficiency.	VC

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23	Penprase Barbara, Johnson Chellie. Optimizing the perioperative nursing role for the older adult surgical patient. <i>OR NURSE</i> . 2014;8(4): 26-34.	Expert opinion	N/A	N/A	N/A	N/A	Early identification and interventions for older adult surgical patients through preoperative assessments, careful positioning, maintaining normothermia, managing pain, and providing education is essential.	VB
24	Dybec RB. Intraoperative positioning and care of the obese patient. <i>Plastic Surgical Nursing</i> . 2004;24(3): 118-122.	Expert opinion	N/A	N/A	N/A	N/A	Positioning obese patients presents significant challenges.	VB
25	Schultz A. Predicting and preventing pressure ulcers in surgical patients. <i>AORN J</i> . 2005;81(5): 986-1006.	Systematic review	31/Published studies	N/A	N/A	Development of a new pressure ulcer within 72 hours after surgery	Contradictory findings with limited sample sizes and questionable internal validity provide only weak support for recommendations to predict and prevent pressure injury in surgical patients.	IIIB
26	Shaw LF, Chang PC, Lee JF, Kung HY, Tung TH. Incidence and predicted risk factors of pressure ulcers in surgical patients: Experience at a medical center in taipei, taiwan. <i>Biomed Res Int</i> . 2014.	Nonexperimental-Survey	297/Patients admitted to a teaching hospital for a surgical procedure	N/A	N/A	Pressure injury development	Older age, type of anesthesia, surgical position, and type of surgery are associated with pressure injury development.	IIIB
27	Tschannen D, Bates O, Talsma A, Guo Y. Patient-specific and surgical characteristics in the development of pressure ulcers. <i>Am J Crit Care</i> . 2012;21(2):116-125.	Nonexperimental	3225/Patients undergoing surgical procedures	N/A	N/A	Pressure injury development	Braden Scale scores at admission can be used to identify patients at risk of pressure injury development	IIIB
28	ECRI. Patient Positioning. <i>Operating Room Risk Management</i> . August;2011;2.	Expert opinion	N/A	N/A	N/A	N/A	Incorrect positioning can lead to stretching or prolonged pressure on peripheral nerves that can result in transient or permanent nerve injury.	VC
29	Lumbley JL, Ali SA, Tchokouani LS. Retrospective review of predisposing factors for intraoperative pressure ulcer development. <i>J Clin Anesth</i> . 2014;26(5):368-374.	Nonexperimental	222/Patients who underwent an operation of at least two hours duration	N/A	N/A	Pressure injury development	Risk factors for pressure injury development included surgical times of four hours or longer, comorbidities affecting tissue perfusion, supine position, and abdominal, noncardiac thoracic, and orthopedic positions. Regions of the body most at risk of injury included the sacral region, buttocks, genitalia, and heels.	IIIB
30	Armstrong D, Bortz P. An integrative review of pressure relief in surgical patients. <i>AORN J</i> . 2001;73(3): 645, 647-8, 650-3.	Literature review	N/A	N/A	N/A	N/A	All surgical patients should be considered at risk for pressure injury development. Effective perioperative nursing interventions should be implemented to prevent pressure injury.	VB

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31	Walton-Geer PS. Prevention of pressure ulcers in the surgical patient. <i>AORN J</i> . 2009;89(3): 538-552.	Expert opinion	N/A	N/A	N/A	N/A	All surgical patients should be considered at risk of pressure injury; therefore, perioperative team members should develop and implement strategic plans to prevent pressure injury.	VB
32	Sukhu T, Krupski TL. Patient positioning and prevention of injuries in patients undergoing laparoscopic and robot-assisted urologic procedures. <i>Current Urology Reports</i> . 2014;15(4): 398.	Expert opinion	N/A	N/A	N/A	N/A	Remaining cognizant of the operative time while in steep Trendelenburg, avoiding excessive intravenous fluid loading while maintaining perfusion, and careful positioning of extremities with avoidance of shoulder braces may help to reduce complications associated with surgical positioning.	VA
33	Hayes RM, Spear ME, Lee SI, et al. Relationship between time in the operating room and incident pressure ulcers: A matched case-control study. <i>Am J Med Qual</i> . 2015;30(6):591-597.	Nonexperimental	931/Patients who developed pressure injury after surgery	N/A	N/A	Pressure injury development	Patients who developed pressure injuries had longer lengths of stay, were older, had lower Braden Scale scores, and were more likely to die or be discharged to a long-term care hospital.	IIIB
34	Aronovitch SA. Intraoperatively acquired pressure ulcers: Are there common risk factors? <i>Ostomy Wound Manage</i> . 2007;53(2):57-69.	Nonexperimental	281/Members of the Wound, Ostomy, and Continence Nurses Society	N/A	N/A	Pressure injury development	The results of the study showed that 3.5% of patients developed a pressure injury within seven days of their operation. Factors that may increase patient risk for developing intraoperative pressure ulcers include positioning, use of positioning and thermoregulatory devices, length of surgery, type of anesthesia, and comorbidities. Current risk assessment tools to predict intraoperatively-acquired pressure injury are not adequate.	IIIB
35	American Society of Anesthesiologists Task Force on Prevention of Perioperative Peripheral Neuropathies. Practice advisory for the prevention of perioperative peripheral neuropathies: an updated report by the American Society of Anesthesiologists Task Force	Clinical practice guideline	N/A	N/A	N/A	N/A	It is helpful to ascertain that patients can comfortably tolerate the anticipated operative position. Arm abduction in supine patients should be limited to 90°. When the arms are tucked the forearm should be in a neutral position. Prolonged pressure on the peroneal nerve at the fibular head should be avoided. Using padding may decrease the risk of neuropathy.	IVA
36	O'Connell MP. Positioning impact on the surgical patient. <i>Nurs Clin North Am</i> . 2006;41(2): 173-192.	Expert opinion	N/A	N/A	N/A	N/A	There are many challenges and physiologic risks associated with surgical positioning.	VB

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37	Clayton JL. Special needs of older adults undergoing surgery. <i>AORN J</i> . 2008;87(3): 557-574.	Expert opinion	N/A	N/A	N/A	N/A	Successful surgical management of an older adult depends on the perioperative RN's understanding of age-related factors that may affect the outcome of the procedure.	VB
38	Fritzen T, Kremer M, Biddle C. The AANA Foundation Closed Malpractice Claims Study on nerve injuries during anesthesia care. <i>AANA J</i> . 2003;71(5): 347-352.	Nonexperimental	44/Cases of nerve injury contained within the total AANA Closed Malpractice Claims Database (N = 223)	N/A	N/A	Mechanisms of neurologic injury	The most common injury was to the brachial plexus. Documentation was lacking or inadequate in a majority of the claims. Abnormal body habitus, comorbidities, anesthesia technique, lack of adequate padding, and tourniquet use were implicated as risk factors for positioning injuries.	IIIB
39	Mills JT, Burris MB, Warburton DJ, Conaway MR, Schenkman NS, Krupski TL. Positioning injuries associated with robotic assisted urological surgery. <i>J Urol</i> . 2013;190(2): 580-584.	Nonexperimental	334/Patients undergoing robotic-assisted urological surgery	N/A	N/A	Positioning injury	Operative time, in-room time, and ASA classification were significantly associated with positioning injury	IIIB
40	Enchev Y. Checklists in neurosurgery to decrease preventable medical errors: A review. <i>Balkan Medical Journal</i> . 2015;32(4): 337-346.	Expert opinion	N/A	N/A	N/A	N/A	Neurosurgical positioning checklists represent an efficient, reliable, cost-effective, and time-saving tool for increasing patient safety.	VA
41	Adedeji R, Oragui E, Khan W, Maruthainar N. The importance of correct patient positioning in theatres and implications of mal-positioning. <i>Journal of Perioperative Practice</i> . 2010;20(4): 143-147.	Expert opinion	N/A	N/A	N/A	N/A	Correct patient positioning in the OR is crucial to avoid the preventable complications of pressure injury, nerve compression, DVT, and compartment syndrome.	VB
42	Price MC, Whitney JD, King CA, Doughty D. Wound care. Development of a risk assessment tool for intraoperative pressure ulcers. <i>J WOCN</i> . 2005;32(1): 19-32.	Literature review	N/A	N/A	N/A	N/A	A risk assessment tool that incorporates specific variables relevant to the perioperative environment is proposed.	VB
43	ECRI. Pressure ulcers. <i>Operating Room Risk Management</i> . November;2011;2.	Expert opinion	N/A	N/A	N/A	N/A	Pressure injury is debilitating and often caused by a combination of factors.	VC

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44	Stansby G, Avital L, Jones K, Marsden G, Guideline Development Group. Prevention and management of pressure ulcers in primary and secondary care: summary of NICE guidance. <i>BMJ</i> . 2014;348: g2592.	Clinical practice guideline	N/A	N/A	N/A	N/A	Guidance includes five detailed algorithms on identifying who is at risk; prevention of pressure injury in adults at risk and high risk; prevention of pressure ulcers in neonates, infants, children, and young people; management of pressure injury in adults; and management of pressure injury in neonates, infants, children, and young people.	IVA
45	Curley MA, Razmus IS, Roberts KE, Wypij D. Predicting pressure ulcer risk in pediatric patients: The Braden Q scale. <i>Nurs Res</i> . 2003;52(1):22-33.	Nonexperimental	322/Pediatric patients on bedrest for at least 24 hours without preexisting pressure ulcers from three pediatric ICUs	N/A	N/A	Consistency of predictive risk factors with Braden Q Scale measurements	The performance of the Braden Q Scale in a pediatric population was similar to that reported for the Braden Scale in adult patients.	IIIB
46	Sewchuk D, Padula C, Osborne E. Prevention and early detection of pressure ulcers in patients undergoing cardiac surgery. <i>AORN J</i> . 2006;84(1): 75-96.	Nonexperimental	150/Patients undergoing cardiac surgery	N/A	N/A	Development of a new pressure injury within 72 hours after surgery	The number of pressure injuries decreased when the fluid, pressure-redistributing mattress was used in conjunction with a comprehensive RN education program.	IIIB
47	Galvin PA, Curley MA. The Braden Q+P: A pediatric perioperative pressure ulcer risk assessment and intervention tool. <i>AORN J</i> . 2012;96(3):261-270.	Organizational experience	N/A	N/A	N/A	Number of pressure injury events	The use of a risk assessment tool may not decrease overall incidence of pressure injury, but an increased focus on skin assessment and pressure injury prevention strategies can improve outcomes.	VB
48	Quigley SM, Curley MA. Skin integrity in the pediatric population: Preventing and managing pressure ulcers. <i>J Soc Pediatr Nurs</i> . 1996;1(1):7-18.	Organizational experience	N/A	N/A	N/A	Number of pressure injury events	The Skin Care Task Force recommended the use of the Braden Q Scale for pediatric risk assessment.	VB
49	Cherry C, Moss J. Best practices for preventing hospital-acquired pressure injuries in surgical patients. <i>Can Oper Room Nurs J</i> . 2011;29(1): 6-8.	Expert opinion	N/A	N/A	N/A	N/A	All surgical patients should be considered at risk for pressure injury development. A comprehensive approach is essential to prevent perioperative pressure injuries.	VB
50	Centers for Medicare and Medicaid Services (CMS), HHS. Medicaid program; payment adjustment for provider-preventable conditions including health care-acquired conditions. final rule. Fed Regist. 2011;76(108):32816-32838.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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51	Stechmiller JK, Cowan L, Whitney JD, et al. Guidelines for the prevention of pressure ulcers. <i>WOUND REPAIR REGENERATION</i> . 2008;16(2): 151-168.	Clinical practice guideline	N/A	N/A	N/A	N/A	These guidelines were developed to provide consensus and evidence-based recommendations for preventing pressure injury.	IVA
52	Bergstrom N, Braden BJ, Laguzza A, Holman V. The braden scale for predicting pressure sore risk. <i>Nurs Res</i> . 1987;36(4):205-210.	Expert opinion	N/A	N/A	N/A	N/A	The Braden Scale was developed to foster early identification of patients at risk of pressure injury.	VA
53	Instructions for the munro pressure ulcer risk assessment scale for perioperative patients for adults. Prevention of Perioperative Pressure Ulcers Toolkit Web site. http://www.aorn.org/guidelines/clinical-resources/toolkits/prevention-of-perioperative-pressure-ulcers-tool-kit . Accessed 12/15, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
54	Munro pressure ulcer risk assessment scale for perioperative patients for adults. Prevention of Perioperative Pressure Ulcers Toolkit Web site. http://www.aorn.org/guidelines/clinical-resources/toolkits/prevention-of-perioperative-pressure-ulcers-tool-kit . Accessed 12/15, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
55	Scott SM. Progress and challenges in perioperative pressure ulcer prevention. <i>J Wound Ostomy Continence Nurs</i> . 2015;42(5):480-485.	Expert opinion	N/A	N/A	N/A	N/A	The Scott Triggers include age, ASA classification, BMI, serum albumin levels, and time on the OR bed.	VB
56	Giachetta-Ryan Denise. Perioperative pressure ulcers: How can they be prevented?. <i>OR NURSE</i> . 2015;9(4): 22-28.	Expert opinion	N/A	N/A	N/A	N/A	Validating a surgery-specific tool to determine risk assessment of the perioperative patient is an important step in the prevention of hospital-acquired pressure injury.	VC

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57	He W, Liu P, Chen HL. The braden scale cannot be used alone for assessing pressure ulcer risk in surgical patients: A meta-analysis. <i>Ostomy Wound Manage</i> . 2012;58(2):34-40.	Systematic review with meta-analysis	3/Studies evaluating the use of the Braden Scale in surgical patients	N/A	N/A	Predictive validity of the Braden Scale in surgical patients	The Braden Scale has a low predictive validity for pressure injury risk in surgical patients.	IIIB
58	Owers CE, Abbas Y, Ackroyd R, Barron N, Khan M. Perioperative Optimization of Patients Undergoing Bariatric Surgery. <i>J OBESITY</i> . 2012;; 1-6.	Expert opinion	N/A	N/A	N/A	N/A	Optimal management of the obese patient undergoing bariatric surgery is complex.	VB
59	Bulfone Giampiera, Marzollil Ilaria, Wuattrin Rosanna, Fabbro Carmen, Palese Alvisa. A longitudinal study of the incidence of pressure sores and the associated risks and strategies adopted in Italian operating theatres...[corrected]	Nonexperimental	102/Consecutive patients undergoing major surgery for more than two hours on the OR bed and who were observable for at least six days after surgery	N/A	N/A	Pressure injury development	On average, 12.7% of patients developed a pressure injury. Health conditions (diabetes, cardiac diseases), hematocrit less than 35%, and intraoperative factors (operative time more than 6.15 hours, intraoperative hypothermia) were associated with the occurrence of pressure injury.	IIIB
60	Doerflinger DMC. Older adult surgical patients: presentation and challenges. <i>AORN J</i> . 2009;90(2): 223-244.	Expert opinion	N/A	N/A	N/A	N/A	The older surgical patient presents a greater challenge for prevention of positioning injury because of risk factors, loss of physiologic reserves, and comorbid diseases.	VA
61	Engels D, Austin M, McNichol L, Fencl J, Gupta S, Kazi H. Pressure ulcers: Factors contributing to their development in the OR. <i>AORN J</i> . 2016;103(3):271-281.	Quality Improvement	60/Patients who had surgery and did not develop a pressure injury (n = 45) and patients who had surgery and developed a pressure injury (n = 15)	N/A	N/A	Risk factors associated with pressure injury development	Early identification of risk factors is the first step toward implementing a preventive care bundle to decrease the incidence of pressure injury.	VA
62	Black J, Fawcett D, Scott S. Ten top tips: Preventing pressure ulcers in the surgical patient. <i>Wounds International</i> . 2014;54(4):14-18.	Expert opinion	N/A	N/A	N/A	N/A	Prevention of pressure injury begins before surgery, continues in the operating room, and is imperative during recovery.	VB
63	Minnesota Hospital Association, ed. Pressure ulcer prevention in the operating room: Recommendations and guidance. Minnesota Hospital Association; 2014.	Clinical practice guideline	N/A	N/A	N/A	N/A	Recommendations are provided for safe patient positioning.	IVC
64	Fred Cynthia, Ford Sharon, Wagner Doreen, Vanbrackle Lewis. Intraoperatively acquired pressure ulcers and perioperative normothermia: a look at relationships. <i>AORN J</i> . 2012;96(3): 251-260.	Nonexperimental	138/Patients who had developed postoperative pressure injury	N/A	N/A	Pressure injury development	Patients at a higher risk for developing an intraoperatively acquired pressure injury included men, those who were critically ill, had a low Braden Scale score, and were thin.	IIIA

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65	Menezes S, Rodrigues R, Tranquada R, MÜLLER S, Gama K, Manso T. Injuries resulting from positioning for surgery: Incidence and risk factors. <i>Acta Med Port</i> . 2013;26(1): 12-16.	Nonexperimental	172/Patients undergoing elective surgery	N/A	N/A	Positioning injury	Postoperative evaluation of surgical patients allows early detection, documentation, and treatment of injury	IIC
66	Strasser Leslie A. Improving Skin Integrity in the Perioperative Environment Using an Evidence-Based Protocol. <i>J DERMATOL NURSES ASSOC</i> . 2012;4(6): 351-362.	Organizational experience	N/A	N/A	N/A	Number of skin events	Data indicated that skin events decreased after implementation of the standardized protocol. Most of the skin tears were associated with removal of the drapes and the high volume of patients with fragile skin.	VA
67	Winfree CJ, Kline DG. Intraoperative positioning nerve injuries. <i>Surg Neurol</i> . 2005;63(1):5-18.	Expert opinion	N/A	N/A	N/A	N/A	Intraoperative positioning nerve injuries are largely preventable, yet they continue to occur.	VB
68	Agostini J, Goasguen N, Mosnier H. Patient positioning in laparoscopic surgery: tricks and tips. <i>Journal of visceral surgery</i> . 2010;147(4): e227-32.	Expert opinion	N/A	N/A	N/A	N/A	Strategies to prevent injuries associated with patient positioning including nerve injury due to stretching or compression, rhabdomyolysis, and compartment syndrome are provided.	VB
69	Cullen A, Ferguson A. Perioperative management of the severely obese patient: A selective pathophysiological review. <i>Canadian Journal of Anesthesia</i> . 2012;59(10): 974-996.	Expert opinion	N/A	N/A	N/A	N/A	The literature clearly highlights the complexity of severe obesity as a multisystem disease. There are important considerations for positioning of obese patients.	VA
70	Sezer SD, Küçük M, Yüksel H, Odabaşı AR, Şen S, Ogurlu M. Drop foot, an unexpected complication of vaginal hysterectomy. <i>Türk Jinekoloji ve Obstetrik Dernegi Dergisi</i> . 2012;9(1): 73-76.	Case report	1/49-year-old woman undergoing vaginal surgery in the lithotomy position	N/A	N/A	N/A	The unregulated state of type 2 diabetes and the prolonged surgery increased the risk of common peroneal nerve injury and caused the patient's injury.	VC
71	Connor T, Sledge JA, Bryant-Wiersema L, Stamm L, Potter P. Identification of pre-operative and intra-operative variables predictive of pressure ulcer development in patients undergoing urologic surgical procedures. <i>Urol Nurs</i> . 2010;30(5): 289-305.	Quasi-experimental	498/Patients undergoing urologic surgery under general anesthesia	Preoperative, intraoperative, and postoperative assessments of patients for pressure injury by perioperative RNs who completed an educational program	Standard care	Pressure injury development	The ability to monitor patient's blood pressure and correspondingly adjust the dynamic pressure of a support surface could be a link to preventing intraoperative pressure injury.	IIB

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
72	Thomas DR. Does Pressure Cause Pressure Ulcers? An Inquiry Into the Etiology of Pressure Ulcers. <i>J AM MED DIR ASSOC</i> . 2010;11(6): 397-405.	Expert opinion	N/A	N/A	N/A	N/A	The notion that sustained pressure is the only factor in the development of pressure injury disregards additional factors in the pathogenesis of pressure injury intrinsic to the patient.	VA
73	Anusionwu IM, Wright EJ. Compartment syndrome after positioning in lithotomy: what a urologist needs to know. <i>BJU Int</i> . 2011;108(4): 477-478.	Expert opinion	N/A	N/A	N/A	N/A	There is evidence that modified lithotomy, heel support, avoidance of the Trendelenburg position, ankle dorsiflexion, and use of intermittent compression devices can minimize the risk of compartment syndrome.	VB
74	Bushard S. Trauma in patients who are morbidly obese. <i>AORN J</i> . 2002;76(4):585-589.	Expert opinion	N/A	N/A	N/A	N/A	Perioperative nurses should be prepared to deal with the multiple issues presented by obese patients.	VB
75	Mackey D. Support surfaces: Beds, mattresses, overlays-oh my! <i>Nurs Clin North Am</i> . 2005;40(2):251-265.	Expert opinion	N/A	N/A	N/A	N/A	The selection of a support surface is an important component of a pressure injury prevention program.	VB
76	Pham B, Teague L, Mahoney J, et al. Support surfaces for intraoperative prevention of pressure ulcers. <i>Surgery</i> . 2011;150(1): 122-132.	Nonexperimental	Not specified/Simulated patients undergoing scheduled surgical procedures lasting ≥ 90 minutes	N/A	N/A	Cost and effectiveness of support surface in preventing pressure injury	In patients undergoing scheduled surgical procedures lasting ≥ 90 minutes, implementing effective support surfaces could prevent patient injury and reduce costs.	IIIB
77	Silverstein JW, Matthews E, Mermelstein LE, DeWal H. Causal factors for position-related SSEP changes in spinal surgery. <i>European Spine Journal</i> . 2016:1-6.	Nonexperimental	398/Patients undergoing thoracolumbar and lumbosacral spine surgery	N/A	N/A	Adverse events detected by SSEPs monitoring	Sex, patient positioning, length of procedure, and BMI are determinants for upper extremity neural compromise during thoracolumbar and lumbosacral spine surgery	IIIB
78	Parnham Alison. Pressure ulcer risk assessment and prevention in children. <i>NURS CHILD YOUNG PEOPLE</i> . 2012;24(2): 24-29.	Expert opinion	N/A	N/A	N/A	N/A	Children are vulnerable to pressure injuries. An assessment of risk factors, followed by early preventative interventions is essential.	VA
79	Anthony D, Willock J, Baharestani M. A comparison of braden Q, garvin and glamorgan risk assessment scales in paediatrics. <i>J Tissue Viability</i> . 2010;19(3):98-105.	Nonexperimental	236/Children who developed pressure injury after surgery	N/A	N/A	Consistency of predictive risk factors with risk assessment scale measurements	The Glamorgan risk assessment scale had a higher predictive ability than either the Braden Q or the Garvin, and was the most valid tool.	IIIB
80	Willock J, Anthony D, Richardson J. Inter-rater reliability of glamorgan paediatric pressure ulcer risk assessment scale. <i>Paediatr Nurs</i> . 2008;20(7):14-19.	Nonexperimental	15/Pediatric-specialty RNs	N/A	N/A	Inter-rater reliability on Glamorgan Scale scores	The risk assessment scale is reliable. More research on the reliability and validity of this tool with specific pediatric patient groups is needed.	IIIB

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81	Huffines B, Logsdon MC. The neonatal skin risk assessment scale for predicting skin breakdown in neonates. <i>Issues Compr Pediatr Nurs</i> . 1997;20(2):103-114.	Nonexperimental	32/Neonates	N/A	N/A	Inter-rater reliability on Neonatal Skin Risk Assessment Scale scores	The Neonatal Skin Risk Assessment Scale is useful in predicting days most likely for skin breakdown to occur.	IIIB
82	McNichol L, Lund C, Rosen T, Gray M. Medical adhesives and patient safety: State of the science: Consensus statements for the assessment, prevention, and treatment of adhesive-related skin injuries. <i>J Wound Ostomy Continence Nurs</i> . 2013;40(4):365-80; quiz E1-2.	Clinical practice guideline	N/A	N/A	N/A	N/A	This document details the consensus definitions and statements and identified research priorities for development of new adhesive technologies and protocols for skin protection.	IVB
83	Dyer Andrea. Ten top tips: Preventing device-related pressure ulcers. <i>WOUNDS INT</i> . 2015;6(1): 9-13.	Expert opinion	N/A	N/A	N/A	N/A	Pressure injury may be caused by medical devices.	VB
84	Larkin BG. The ins and outs of body piercing. <i>AORN J</i> . 2004;79(2): 333-342.	Expert opinion	N/A	N/A	N/A	N/A	Jewelry should be removed from surgical patients to prevent pressure injuries.	VA
85	Smith FD. Caring for surgical patients with piercings. <i>AORN J</i> . 2016;103(6):583-596.	Expert opinion	N/A	N/A	N/A	N/A	The presence of piercings and dermal implants places patients at risk for surgical site infection, electrical burns, trauma, and airway obstruction.	VB
86	Ogg MJ. Clinical Issues—April 2012. <i>AORN J</i> . 2012;95(4):541-548.	Expert opinion	N/A	N/A	N/A	N/A	If the proposed surgery could last longer than two hours, the removal of the extensions or hair pins should be discussed with the patient, surgeon, and anesthesia professional.	VB
87	Cho JK, Han JH, Park SW, Kim KS. Deep vein thrombosis after spine operation in prone position with subclavian venous catheterization: A case report. <i>Korean Journal of Anesthesiology</i> . 2014;67(1): 61-65.	Case report	1/73-year-old woman undergoing spinal surgery	N/A	N/A	N/A	The existence of a factor affecting blood flow, such as the prone position may increase the risk of thrombus formation.	VA
88	Denholm B, Spruce L. Clinical Issues—March 2013. <i>AORN J</i> . 2013;97(3):369-377.	Expert opinion	N/A	N/A	N/A	N/A	Perioperative RNs should apply the same principles found in AORN recommendations for preoperative assessment, informed consent, positioning, electrosurgery, and documentation.	VA

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89	Identifying and minimizing risks for surgical patients with dermal implants. <i>AORN J</i> . 2012;96(4):C5-C6.	Expert opinion	N/A	N/A	N/A	N/A	When caring for patients with dermal implants, special attention should be paid to risks posed during positioning, patient transfers, and electrocautery use.	VB
90	Guideline for surgical energy devices. In: Guidelines for perioperative practice. 2017 ed. Denver, CO: AORN, Inc.; 2017:129-156.	Clinical practice guideline	N/A	N/A	N/A	N/A	The energy produced by energy-generating devices is transferred to the patient by various methods, including monopolar, bipolar, advanced bipolar devices (eg, vessel-sealing devices); tripolar devices (eg, plasma knife); class 3 and class 4 laser devices; ultrasound (eg, ultrasonic tissue ablation system, phacoemulsification); and argon-enhanced coagulation modalities.	IVA
91	Haldar R, Kaushal A, Srivastava S, Singh PK. Paediatric intravenous splint: A cause of pressure injury during neurosurgery in prone position. <i>Pediatr Neurosurg</i> . 2016;51(1):55-56.	Case report	1/7-month-old infant undergoing neurosurgery in prone position	N/A	N/A	N/A	Splints used to protect IV lines have the potential for causing pressure injuries.	VB
92	Weng MH. The effect of protective treatment in reducing pressure ulcers for non-invasive ventilation patients. <i>Intensive Crit Care Nurs</i> . 2008;24(5):295-299.	Quasi-experimental	90/Patients undergoing non-invasive ventilation treatments	Application of one of two prophylactic dressings to nasal bridge	No prophylactic dressing	Pressure injury development	Prophylactic dressings can be used to prevent pressure injury on the face of patients undergoing non-invasive ventilation treatments.	IIB
93	Kuo CY, Wootten CT, Tylor DA, Werkhaven JA, Huffman KF, Goudy SL. Prevention of pressure ulcers after pediatric tracheotomy using a mepilex ag dressing. <i>Laryngoscope</i> . 2013;123(12):3201-3205.	Nonexperimental	134/ Pediatric patients with tracheostomies	Use of a silver dressing under tracheostomy tube and ties	N/A	Pressure injury development	The use of a silver dressing reduced the occurrence of postoperative pressure injury.	IIIB
94	Huang TT, Tseng CE, Lee TM, Yeh JY, Lai YY. Preventing pressure sores of the nasal ala after nasotracheal tube intubation: From animal model to clinical application. <i>J Oral Maxillofac Surg</i> . 2009;67(3):543-551.	Quasi-experimental	18/Patients undergoing nasal intubation	Use of a prophylactic dressing and soft liner on nasal ala	No prophylactic dressing	Pressure injury development	The combined use of the prophylactic dressing and the soft liner reduced the size and severity of nasal ala pressure injury.	IIC

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95	Gunlemez A, Isken T, Gokalp AS, Turker G, Arisoy EA. Effect of silicon gel sheeting in nasal injury associated with nasal CPAP in preterm infants. <i>Indian Pediatr</i> . 2010;47(3):265-267.	Randomized controlled trial	179/Preterm infants undergoing nasal continuous positive airway pressure	Use of silicone gel sheeting to protect the nares	No treatment	Pressure injury development	The use of silicone gel sheeting to protect the nares may reduce the incidence and severity of nasal injury in preterm infants undergoing nasal continuous positive airway pressure.	IB
96	Ulm MA, Fleming ND, Rallapali V, et al. Position-related injury is uncommon in robotic gynecologic surgery. <i>Gynecol Oncol</i> . 2014;135(3): 534-538.	Nonexperimental	831/Patients who underwent robotic surgery during the study period	N/A	N/A	Neurologic, musculoskeletal, or vascular injuries related to patient positioning	Modifiable risk factors for position-related injury following robotic surgery could not be identified.	IIIB
97	Makary MA, Holzmueller CG, Thompson D, et al. Operating room briefings: Working on the same page. <i>Jt Comm J Qual Patient Saf</i> . 2006;32(6):351-355.	Organizational experience	N/A	N/A	N/A	Improved communication and reduction of errors	A team of quality and safety researchers at The Johns Hopkins Medical Institutions created the OR Briefing tool to provide a structured approach to promote effective interdisciplinary communication and teamwork in the OR.	VB
98	Makary MA, Holzmueller CG, Sexton JB, et al. Operating room debriefings. <i>Jt Comm J Qual Patient Saf</i> . 2006;32(7):407-10, 357.	Organizational experience	N/A	N/A	N/A	Improved communication and reduction of errors	Debriefing is a proactive approach to learn from problems, a strategy that may prevent the occurrence of sentinel events.	VB
99	AORN position statement: Preventing wrong-patient, wrong-site, wrong-procedure events. 2015.	Position statement	N/A	N/A	N/A	N/A	Wrong-patient, wrong-site-wrong-procedure events can and must be prevented.	IVB
100	WHO WHO surgical safety checklist http://www.who.int/patientsafety/safesurgery/checklist/en/ . Accessed 8/3/2016, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
101	UP.01.03.01: A time-out is performed before the procedure. In: Comprehensive accreditation and certification manual: Critical access hospitals. July 2016 ed. Oakbrook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
102	UP.01.03.01: A time-out is performed before the procedure. In: Comprehensive accreditation and certification manual: Ambulatory. July 2016 ed. Oakbrook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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103	Guideline for product selection. In: Guidelines for perioperative practice. 2017 ed. Denver, CO: AORN, Inc.; 2017:183-190.	Clinical practice guideline	N/A	N/A	N/A	N/A	A mechanism for product selection assists with consistently selecting functional and reliable products that are safe, cost-effective, environmentally friendly, promote quality care, and prevent duplication or rapid obsolescence.	IVB
104	Hoshowsky VM, Schramm CA. Intraoperative pressure sore prevention: An analysis of bedding materials. <i>Res Nurs Health</i> . 1994;17(5):333-339.	Randomized controlled trial	505/Patients undergoing surgery in the supine or prone position	Postoperative inspection using the Hemphill tool after placement on standard vinyl-covered, 2-inch thick mattress; nylon fabric-covered, 2-inch thick foam and gel OR bed mattress; or a viscoelastic dry polymer mattress overlay in both prone and supine positions	Paired comparisons of patients' right and left heels or knees	Pressure injury development	The viscoelastic overlay was more effective than either the foam and gel or standard foam mattress for preventing pressure injury.	IB
105	King CA, Bridges E. Comparison of pressure relief properties of operating room surfaces. <i>Perioperative Nursing Clinics</i> . 2006;1(3):261-265.	Quasi-experimental	11/Perioperative team members	Pressure measurements of occiput, sacrum, heels, and trochanter in supine and lateral positions	Standard OR bed mattress compared with OR bed mattress with foam overlay, and OR bed mattress with gel overlay	Differences in pressure measurements	The peak skin interface pressures exceeded the mean of 32 mm Hg for all participants, suggesting that the peak skin interface may be tolerated without ischemic injury upward of four to six hours by some patients.	IIB
106	Reddy M. Pressure ulcers. <i>Clinical Evidence</i> . 2011.	Systematic review with meta-analysis	64/Systematic reviews, randomized controlled trials, and observational studies	N/A	N/A	Pressure injury development	Pressure-relieving overlays on OR beds may be more effective than no overlays in preventing pressure injury.	IIIA
107	Wu T, Wang ST, Lin PC, Liu CL, Chao YF. Effects of using a high-density foam pad versus a viscoelastic polymer pad on the incidence of pressure ulcer development during spinal surgery. <i>Biol Res Nurs</i> . 2011;13(4): 419-424.	Quasi-experimental	30/Patients who underwent spinal surgery for more than three hours in the prone position	Average and peak pressure measurements when one side of the chest is padded with high density foam pad, and the other side is padded with viscoelastic polymer pad	Paired comparisons of patients' right and left chest	Differences in pressure measurements	The average and peak pressures measured at the points padded with the viscoelastic polymer pads were significantly lower than those padded with high-density foam pads; however, there was no significant differences between the pads with regard to prevention of pressure ulcers.	IIA
108	McInnes E Jammali-Blasi A Bell-Syer SEM Dumville JC Middleton V Cullum N. Support surfaces for pressure ulcer prevention. <i>Cochrane Database of Systematic Reviews</i> . 2015.	Systematic Review	59/Randomized controlled trials and quasi-randomized trials assessing the effects of any support surface for prevention of pressure ulcers, in any patient group or setting	N/A	N/A	Pressure injury development and severity of injury	The review found that people lying on ordinary foam mattresses are more likely to get pressure ulcers than those lying on a higher-specification foam mattress. Pressure-relieving overlays on the OR bed reduced the incidence of postoperative pressure injury.	IIB

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109	McNichol L, Watts C, Mackey D, Beitz JM, Gray M. Identifying the right surface for the right patient at the right time: Generation and content validation of an algorithm for support surface selection. <i>J Wound Ostomy Continence Nurs</i> . 2015;42(1):19-37.	Clinical practice guideline	N/A	N/A	N/A	N/A	An algorithm has been developed to provide guidance for selecting support surfaces that uses the Braden subscales of mobility and moisture to drive surface selection.	IVA
110	Deane LA, Lee HJ, Box GN, et al. Third place: Flank position is associated with higher skin-to-surface interface pressures in men versus women: implications for laparoscopic renal surgery and the risk of rhabdomyolysis. <i>Journal of Endourology</i> . 2008;22(6)	Quasi-experimental	20/ Volunteers with BMI \leq 25 (n = 10 [5 men; 5 women]) and with BMI > 25 (n = 10 [5 men; 5 women])	Measurement of interface pressures when placed in lateral position with the OR bed half-flexed, fully-flexed, half-flexed with elevated kidney rest, and fully-flexed with elevated kidney rest	Measurement of interface pressures when placed in lateral position with the OR bed flat	Differences in interface pressure measurements	Women have significantly lower interface pressures when compared with men. Having a BMI > 25 also increases interface pressures. The use of the kidney rest is associated with markedly increased pressure. Use of a half-flexed position is preferable to a full-flexed position.	IIB
111	Guidelines for environmental infection control in health-care facilities: Recommendations of CDC and the healthcare infection control practices advisory committee (HICPAC) https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm . Published 2003. Accessed 7/18/2016.	Clinical practice guideline	N/A	N/A	N/A	N/A	Strategies for cleaning and disinfecting should consider the potential for direct patient contact, the degree and frequency of hand contact, and the potential for contamination of the surface with body substances or environmental sources of microorganisms.	IVA
112	Ahmad R, Tham J, Naqvi SG, Butt U, Dixon J. Supports used for positioning of patients in hip arthroplasty: is there an infection risk? <i>Ann R Coll Surg Engl</i> . 2011;93(2): 130-132.	Nonexperimental	40/Supports used in 20 hip arthroscopy procedures	N/A	N/A	Colony forming units per device	This study showed contamination of supports used for positioning patients during hip arthroplasty reflecting the potential for contaminated devices to contribute to surgical site infection.	IIIC
113	Guideline for environmental cleaning. In: Guidelines for perioperative practice. Denver, CO: AORN. Inc.; 2017:7-28.	Clinical practice guideline	N/A	N/A	N/A	N/A	Application of rigorous environmental cleaning practices will assist in providing a clean environment for perioperative patients and minimize the exposure risk of health care personnel and patients to potentially infectious microorganisms.	IVA

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114	Neurosurgical head holders (skull clamps) and device slippage: FDA safety communication. http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm487665.htm?source=govdelivery&utm_medium=email&utm_source=govdelivery . Updated February 25, 2016.	Expert opinion	N/A	N/A	N/A	N/A	Based on current information, the FDA believes the overall benefits of these devices continue to outweigh the risks; however, health care providers should be aware of patient-specific characteristics, techniques for safe use, and maintenance of neurosurgical head holder systems to prevent skull clamps from slipping before or during the procedure.	VA
115	Dauber MH, Roth S. Operating table failure: another hazard of spine surgery. <i>Anesthesia & Analgesia</i> . 2009;108(3): 904-905.	Case report	1/Obese patient undergoing spinal fusion with instrumentation in the prone position	N/A	N/A	N/A	Familiarity with intricacies of specialized operating room equipment is necessary. Attention to safety measures may improve patient care.	VB
116	Ahmad FU, Madhavan K, Trombly R, Levi AD. Anterior thigh compartment syndrome and local myonecrosis after posterior spine surgery on a Jackson table. <i>World Neurosurgery</i> . 2012;78(5): 553.e5-553.e8.	Case report	2/Patients, one 55-year-old obese man, and one 49-year-old obese man undergoing spinal surgery in the prone position on a Jackson table	N/A	N/A	N/A	The compartment syndrome that developed in these patients was likely related to reversing the position of the iliac crest and hip pads on a Jackson table.	VB
117	Flieri MA, Stahel PF, Hak DJ, Morgan SJ, Smith WR. Traction table-related complications in orthopaedic surgery. <i>J Am Acad Orthop Surg</i> . 2010;18(11): 668-675.	Expert opinion	N/A	N/A	N/A	N/A	The use of a traction table is not without risks and significant complications can occur, including injury to the perineum and soft tissues, neurologic impairment, and compartment syndrome of the well-leg.	VA
118	Bonnaig N, Dailey S, Archdeacon M. Proper patient positioning and complication prevention in orthopaedic surgery. <i>J Bone Joint Surg Am</i> . 2014;96(13):1135-1140.	Expert opinion	N/A	N/A	N/A	N/A	Negative outcomes such as peripheral neuropraxia, fracture malrotation, and soft tissue injuries can often be avoided with careful positioning.	VB
119	Mallet R, Tricoire JL, Rischmann P, Sarramon JP, Puget J, Malavaud B. High prevalence of erectile dysfunction in young male patients after intramedullary femoral nailing. <i>Urology</i> . 2005;65(3):559-563.	Nonexperimental-Survey	101/Male patients treated for femoral or tibial shaft fractures by intramedullary nailing	N/A	N/A	N/A	Development of erectile dysfunction Reduced pressure on the pudendal nerve by the perineal post was associated with better sexual functioning after surgery.	IIIB

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120	Toolan BC, Koval KJ, Kummer FJ, Goldsmith ME, Zuckerman JD. Effects of supine positioning and fracture post placement on the perineal countertraction force in awake volunteers. <i>J Orthop Trauma</i> . 1995;9(2):164-170.	Nonexperimental	30/Volunteers	N/A	N/A	Development of pudendal nerve injury	Placement of the fracture post influenced the magnitude of counter-traction force.	IIIC
121	MedWatch: The FDA safety information and adverse event reporting program http://www.fda.gov/Safety/MedWatch/default.htm . Accessed 8/3/2016, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
122	Poli JC, Zoia C, Lattanzi D, Balbi S. Epidural haematoma by mayfield head-holder: Case report and review of literature. <i>Journal of Pediatric Sciences</i> ;2013(5):e195.	Case report	1/7-year-old boy undergoing cranial surgery in the prone position	N/A	N/A	N/A	The use of the Mayfield skull clamp produced a skull fracture and epidural hematoma.	VA
123	Berry C, Sandberg DI, Hoh DJ, Krieger MD, McComb JG. Use of cranial fixation pins in pediatric neurosurgery. <i>Neurosurgery</i> . 2008;62(4):913-8.	Nonexperimental-Survey	164 of 605/ Neurosurgeons with membership in at least one of three professional pediatric neurosurgical societies	N/A	N/A	Common techniques for use of neurosurgical head holders in the pediatric population	Cranial fixation pins are widely used among pediatric neurosurgeons in patients younger than 5-years-old. Guidelines for safe use are not well defined despite common use and significant complications associated with these devices.	IIIB
124	Chappy S. Perioperative patient safety: A multisite qualitative analysis. <i>AORN J</i> . 2006;83(4):871-4, 877-88, 891-7.	Nonexperimental	863/Perioperative incident reports	N/A	N/A	Events that affected patient safety	The most common types of events reported were incorrect counts, equipment malfunction, and medication errors.	IIIB
125	Waters Thomas, Baptiste Andrea, Short Manon, Plante-Mallon Lori, Nelson Audrey. AORN ergonomic tool 1: Lateral transfer of a patient from a stretcher to an OR bed...first in a series of seven articles. <i>AORN J</i> . 2011;93(3): 334-339.	Expert opinion	N/A	N/A	N/A	N/A	It is important to determine which tasks may be safe to perform manually and which tasks should be performed using assistive technology.	VA
126	Waters T, Lloyd JD, Hernandez E, Nelson A. AORN ergonomic tool 7: Pushing, pulling, and moving equipment on wheels. <i>AORN J</i> . 2011;94(3):254-260.	Expert opinion	N/A	N/A	N/A	N/A	It is important to determine which tasks may be safe to perform manually and which tasks should be performed using assistive technology.	VA

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127	Asiedu GB, Lowndes BR, Huddleston PM, Hallbeck S. "The Jackson table is a pain in the...": A qualitative study of providers' perception toward a spinal surgery table. <i>J Patient Saf</i> . 2016.	Qualitative	11/Members of a spinal positioning team	Interviews, coding, and thematic analysis	N/A	Themes related to prone positioning	Best results for prone positioning can be achieved through standardized practices, educational tools, and equipment checklists.	IIIB
128	Beyea SC. Preventing patient falls in perioperative settings. <i>AORN J</i> . 2005;81(2):393-395.	Expert opinion	N/A	N/A	N/A	N/A	To prevent falls, perioperative RNs should collaborate to develop an evidence-based approach specific to the perioperative setting. This approach would help determine which patients are at greatest risk of falling.	VB
129	Redman JF, McNatt SJ. Portable cushioned operating table siderails: an adjunct to pediatric surgery. <i>South Med J</i> . 2000;93(11): 1081-1082.	Case report	1/8-month-old infant	N/A	N/A	N/A	Cushioned siderails may provide a barrier to falling off the OR bed, but are not a substitute for vigilant observation of the patient and safe positioning practices.	VC
130	Chen HL, Chen XY, Wu J. The incidence of pressure ulcers in surgical patients of the last 5 years: A systematic review. <i>Wounds</i> . 2012;24(9):234-241.	Systematic review with meta-analysis	17/Studies	N/A	N/A	Pressure injury development	The pooled incidence of pressure injury in surgical patients was 0.15. This pooled incidence data may provide a benchmark to evaluate surgery-related pressure	IIIB
131	Shon YJ, Bae SK, Park JW, Kim IN, Huh J. Partial displacement of epidural catheter after patient position change: A case report. <i>J Clin Anesth</i> . 2017;37:17-20.	Case report	1/36-year-old woman undergoing ankle surgery under epidural anesthesia	N/A	N/A	N/A	The change in patient position was the reason for the displacement of the epidural catheter.	VB
132	Campbell K. Pressure point measures in the operating room. <i>J Enterostomal Ther</i> . 1989;16(3):119-124.	Organizational experience	N/A	N/A	N/A	Pressure measurements	Factors associated with development of sacral ulcers included multiple layers of materials under the patient, increased metabolism, pressure, shear, time, and type of anesthesia.	VB
133	Lupe L, Zambrana D, Cooper L. Prevention of hospital-acquired pressure ulcers in the operating room and beyond: A successful monitoring and intervention strategy program. <i>Int Anesthesiol Clin</i> . 2013;51(1):128-146.	Organizational experience	N/A	N/A	N/A	Pressure injury development	Multidisciplinary programs designed to monitor, educate, and evaluate the incidence of pressure ulcers are effective in reducing pressure injury.	VB
134	Grous CA, Reilly NJ, Gift AG. Skin integrity in patients undergoing prolonged operations. <i>J Wound Ostomy Continence Nurs</i> . 1997;24(2):86-91.	Nonexperimental	33/Patients undergoing surgical procedures lasting longer than 10 hours	N/A	N/A	Pressure injury development	The use of warming blankets under the patient is not recommended.	IIIB

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
135	Whitney J, Phillips L, Aslam R, et al. Guidelines for the treatment of pressure ulcers. <i>Wound Repair Regen</i> . 2006;14(6):663-679.	Clinical practice guideline	N/A	N/A	N/A	N/A	Static pressure-reducing devices are superior to standard hospital mattresses. However, if the patient "bottoms out," the device may be ineffective.	IVB
136	Landis E. Micro-injection of capillary blood pressure in human skin. <i>1930;15:209-228.</i>	Nonexperimental	Not specified/Human subjects	N/A	N/A	Pressure measurements	The average blood pressure in the arteriolar limb is 32 mm Hg	IIIA
137	Malkoun M, Huber J, Huber D. A comparative assessment. <i>Int Wound J</i> . 2012;9(3):259-263.	Nonexperimental	116/Patient volunteers from an outpatient vascular laboratory	N/A	N/A	Interface pressure measurements	The device protects the heel without causing hyperextension of the knee and popliteal vein compression.	IIIB
138	Kosiak M. Etiology and pathology of ischemic ulcers. <i>Arch Phys Med Rehabil</i> . 1959;40(2):62-69.	Nonexperimental	16/Dogs	N/A	N/A	Pressure injury development	Pressure injuries occurred with both high pressures applied for short durations and low pressures applied for long durations.	IIIB
139	Sutton S, Link T, Makic MB. A quality improvement project for safe and effective patient positioning during robot-assisted surgery. <i>AORN J</i> . 2013;97(4): 448-456.	Organizational experience	N/A	N/A	N/A	Physician satisfaction	The surgeons preferred the high-density foam padding.	VB
140	Fletcher, J., Harris, C., & Mahoney, K. (2014). A small-scale evaluation of the dolphin fluid immersion simulation® mattress. <i>10(1)</i> , 97-100.	Organizational experience	N/A	N/A	N/A	Interface pressure measurements	The fluid immersion simulation system seems to be an effective pressure-redistributing surface. Further research is warranted.	VC
141	Worsley PR, Parsons B, Bader DL. An evaluation of fluid immersion therapy for the prevention of pressure ulcers. <i>Clin Biomech (Bristol, Avon)</i> . 2016;40:27-32.	Nonexperimental	17/Volunteers	N/A	N/A	Interface pressure measurements	Fluid immersion simulation provides an intelligent approach to increasing surface area. Further research is warranted to provide evidence-based guidance on the use of these support surfaces.	IIIB
142	Kirkland-Walsh H, Teleten O, Wilson M, Raingruber B. Pressure mapping comparison of four OR surfaces. <i>AORN J</i> . 2015;102(1):61.e1-61.e9.	Nonexperimental	51/Hospital personnel	N/A	N/A	Interface pressure measurements	All surfaces had similar average interface pressures; however, the air-inflated static seat cushion had the best pressure redistribution properties in the sacral area.	IIIB
143	Akhavan A, Gainsburg DM, Stock JA. Complications associated with patient positioning in urologic surgery. <i>Urology</i> . 2010;76(6): 1309-1316.	Expert opinion	N/A	N/A	N/A	N/A	Perioperative team members should be familiar with the potential injuries that can result from incorrect positioning.	VB
144	Martin, John T., Warner, Mark A. Positioning in anesthesia and surgery. Philadelphia: Saunders; 1997.	N/A	N/A	N/A	N/A	N/A	Meticulous adherence to safe positioning practices will minimize patient injury.	N/A

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145	Stephenson LL, Webb NA, Smithers CJ, Sager SL, Seefelder C. Lateral femoral cutaneous neuropathy following lateral positioning on a bean bag. <i>J Clin Anesth</i> . 2009;21(5): 383-384.	Case report	1/14-year-old boy undergoing thoracoscopic surgery in the lateral position	N/A	N/A	N/A	Three hours of positioning on a hard surface, possibly with an abnormal course of the nerve, is sufficient to explain the development of a neurological deficit. No padding was provided to the area where the nerve damage occurred.	VB
146	Pressure ulcer prevention: The prevention and management of pressure ulcers in primary and secondary care. clinical guideline 179. methods, evidence, and recommendations. London, UK: National Clinical Guideline Centre; 2014. NICE (National Institute for Health and Care Excellence), ed.	Clinical practice guideline	N/A	N/A	N/A	N/A	Pressure injuries are caused when an area of skin and the tissues below are damaged as a result of being placed under pressure sufficient to impair blood supply. The effects are related to both the magnitude and the duration of the pressure; however, in some circumstance they can occur very rapidly (eg, heels, sacrum).	IVA
147	Optimal perioperative care of the geriatric patient American College of Surgeons National Surgical Quality Improvement Program Web site. https://www.facs.org/quality-programs/acs-nsqip/geriatric-periop-guideline . Accessed 6/10/2016.	Clinical practice guideline	N/A	N/A	N/A	N/A	Older adult surgical patients often require a higher level of care than other patients during the perioperative period.	IVB
148	Santamaria N, Gerdtz M, Sage S, et al. A randomised controlled trial of the effectiveness of soft silicone multi-layered foam dressings in the prevention of sacral and heel pressure ulcers in trauma and critically ill patients: The border trial. <i>Int Wound J</i> . 2015;12(3):302-308.	Randomized controlled trial	440/Trauma and critically ill patients	Application of silicone multilayered foam dressings to the heels and sacrum	Standard care	Pressure injury development	Multilayered soft silicone foam dressings are effective in preventing pressure injury in critically ill patients when applied in the ED before transfer to the ICU.	IB
149	Brindle CT, Wegelin JA. Prophylactic dressing application to reduce pressure ulcer formation in cardiac surgery patients. <i>J Wound Ostomy Continence Nurs</i> . 2012;39(2):133-142.	Quasi-experimental	85/Patients in the cardiac surgery ICU	Application of silicone multilayered foam dressings to the sacrum	Standard care	Pressure injury development	Pressure injury incidence was lower than anticipated over the study period for both groups. No statistically significant difference in pressure injury incidence was found between the intervention and control group.	IIB

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150	Moore ZE, Webster J. Dressings and topical agents for preventing pressure ulcers. <i>Cochrane Database Syst Rev</i> . 2013;(8):CD009362. doi(8):CD009362.	Systematic review with meta-analysis	4/Trials of dressings applied over bony prominences	N/A	N/A	Pressure injury development	Evidence is inconclusive due to low quality of clinical trials.	IB
151	Call E, Pedersen J, Bill B, et al. Enhancing pressure ulcer prevention using wound dressings: What are the modes of action? <i>Int Wound J</i> . 2015;12(4):408-413.	Nonexperimental	9/Commercially available dressings	N/A	N/A	Pressure measurements	The use of the dressings can reduce the amplitude of shear stress and friction in patients at risk of pressure injury.	IIIB
152	Walsh NS, Blanck AW, Smith L, Cross M, Andersson L, Polito C. Use of a sacral silicone border foam dressing as one component of a pressure ulcer prevention program in an intensive care unit setting. <i>J Wound Ostomy Continence Nurs</i> . 2012;39(2):146-149.	Organizational experience	N/A	N/A	N/A	Pressure injury development	The use of the dressing diminished the incidence of sacral pressure injury in ICU patients.	VB
153	Chaiken N. Reduction of sacral pressure ulcers in the intensive care unit using a silicone border foam dressing. <i>J Wound Ostomy Continence Nurs</i> . 2012;39(2):143-145.	Organizational experience	N/A	N/A	N/A	Pressure injury development	The use of the dressing diminished the incidence of sacral pressure injury in ICU patients.	VB
154	Forni C, Loro L, Tremosini M, et al. Use of polyurethane foam inside plaster casts to prevent the onset of heel sores in the population at risk. A controlled clinical study. <i>J Clin Nurs</i> . 2011;20(5-6):675-680.	Quasi-experimental	156/Patients undergoing lower limb casting	Polyurethane foam dressing applied to the heel	No dressing	Pressure injury development	The use of the dressing diminished the incidence of heel pressure injury in patients with leg casts.	IIB
155	Call E, Pedersen J, Bill B, Oberg C, Ferguson-Pell M. Microclimate impact of prophylactic dressings using in vitro body analog method. <i>Wounds</i> . 2013;25(4):94-103.	Nonexperimental	8/Commercially available dressings	N/A	N/A	Temperature and humidity measurements	Dressings should be evaluated for suitable characteristics before use. Temperature and humidity can negatively affect dressing effectiveness.	IIIB
156	Zhang J, Moore AE, Stringer MD. Iatrogenic upper limb nerve injuries: a systematic review. <i>ANZ J Surg</i> . 2011;81(4): 227-236.	Literature review	N/A	N/A	N/A	N/A	Most cases of upper limb nerve injuries are preventable by an adequate knowledge of surgical anatomy and an awareness of the procedures in which peripheral nerves are particularly vulnerable.	VB

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157	Bale E, Berrecloth R. The obese patient. Anaesthetic issues: airway and positioning. <i>Journal of Perioperative Practice</i> . 2010;20(8): 294-299.	Expert opinion	N/A	N/A	N/A	N/A	The author reviewed the challenges, assessment and solutions available to the clinician faced with a high BMI patient with particular reference to the technique of ramping.	VB
158	Kam AW, Lam PH, Murrell GAC. Brachial plexus injuries during shoulder arthroplasty: What causes them and how to prevent them. <i>Techniques in Shoulder and Elbow Surgery</i> . 2015;15(4): 109-114.	Expert opinion	N/A	N/A	N/A	N/A	Abduction greater than 90° can stretch the brachial plexus. Rotation and lateral flexion of the neck to the contralateral side also augments brachial plexus strains.	VA
159	Colsa Gutierrez P, Viadero Cervera R, Morales-Garcia D, Ingelmo Setien A. Intraoperative peripheral nerve injury in colorectal surgery. an update. <i>Cirugia Espanola</i> . 2016;94(3):125-136.	Literature review	N/A	N/A	N/A	N/A	The Trendelenburg position, use of inappropriately padded arm boards and excessive shoulder abduction may increase the development of brachial plexopathy during laparoscopic procedures.	VA
160	Shimizu S, Sato K, Mabuchi I, et al. Brachial plexopathy due to massive swelling of the neck associated with craniotomy in the park bench position. <i>Surg Neurol</i> . 2009;71(4): 504-508.	Case report	1/56-year-old woman undergoing craniotomy in the lateral position	N/A	N/A	N/A	Possible pathologic mechanisms for the patient's injury included kinking of the jugular vein due to extremely flexed neck position during surgery and subsequent swelling of the neck and brachial plexus.	VB
161	Uribe JS, Kolla J, Omar H, et al. Brachial plexus injury following spinal surgery. <i>Journal of Neurosurgery Spine</i> . 2010;13(4): 552-558.	Literature review	N/A	N/A	N/A	N/A	Brachial plexus injuries are a recognized complication following spinal surgery. Attention to patient positioning with the use of electrophysiological monitoring techniques could minimize injury.	VB
162	Lin SP, Sung CS, Chan KH. Compartment syndrome and rhabdomyolysis as a positioning complication following retrosigmoid craniotomy. <i>Acta Anaesthesiologica Taiwanica: Official Journal of the Taiwan Society of Anesthesiologists</i> . 2013;51(4): 184-186.	Case report	1/30-year-old man undergoing retrosigmoid craniotomy in the supine position	N/A	N/A	N/A	The patient's postoperative compartment syndrome of the head and neck was likely the result of extreme rotation of the neck during a prolonged surgical procedure.	VB
163	Ortega R, Suzuki S, Sekhar P, Stram JR, Rengasamy SK. Paraplegia after mastoidectomy under general anesthesia. <i>American Journal of Otolaryngology - Head and Neck Medicine and Surgery</i> . 2009;30(5): 340-342.	Case report	1/34-year-old woman undergoing mastoidectomy and tympanoplasty of the right ear	N/A	N/A	N/A	This case raises the possibility that the combination of neck rotation and relative hypotension may precipitate paraplegia in patients with preexisting spinal cord pathology.	VB

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164	Singha SK, Chatterjee N. Postoperative sialadenitis following retromastoid suboccipital craniectomy for posterior fossa tumor. <i>Journal of Anesthesia</i> . 2009;23(4): 591-593.	Case report	1/23-year-old woman undergoing cranial surgery in the lateral position	N/A	N/A	N/A	The mechanism of acute sialadenitis in this patient was obstruction of the salivary duct caused by surgical positioning.	VB
165	Postaci A, Aytac I, Dikmen B, Oztekin CV. Acute unilateral parotid gland swelling after lateral decubitus position under general anesthesia. <i>Saudi Journal of Anaesthesia</i> . 2012;6(3): 295-297.	Case report	1/35-year-old woman undergoing right laparoscopic simple nephrectomy in the lateral position under general anesthesia	N/A	N/A	N/A	To prevent parotid swelling during prolonged procedures, the authors recommended the use of padding, changing the head and neck position, and avoiding mechanical compression of the parotid gland and ducts.	VB
166	Hsieh CT, Liu MY, Chen YH, Chang CF. Postoperative acute sialadenitis following posterior fossa surgery. <i>Neurosciences</i> . 2011;16(4): 378-380.	Case report	2/One 49-year-old woman undergoing removal of a mass from the right tentorial membrane, and one 54-year-old woman undergoing microvascular decompression	N/A	N/A	N/A	Avoiding extreme head rotation and flexion and compression of the tongue reduces the risk of salivary gland obstruction.	VB
167	Kim LJ, Klopfenstein JD, Feiz-Erfan I, Zubay GP, Spetzler RF. Postoperative acute sialadenitis after skull base surgery. <i>Skull Base</i> . 2008;18(2): 129-133.	Case report	5/Patients developing sialadenitis after skull base surgery	N/A	N/A	N/A	The mechanism of acute sialadenitis in these patients was obstruction of the salivary duct caused by surgical positioning.	VB
168	Asghar A, Karam K, Rashid S. A case of anesthesia mumps after sacral laminectomy under general anesthesia. <i>Saudi Journal of Anaesthesia</i> . 2015;9(3): 332-333.	Case report	1/52-year-old man undergoing lumbar spine surgery in the prone position	N/A	N/A	N/A	The patient's face should be sufficiently padded to prevent compression of the parotid gland and ducts. Turning the neck should be minimized to maintain normal venous blood circulation.	VC
169	Morrison CM, Dobryansky M, Warren RJ, Zins JE. The table tilt: preventing traction on the brachial plexus during facelift surgery. <i>Aesthetic Surgery Journal</i> . 2012;32(4): 524.	Expert opinion	N/A	N/A	N/A	N/A	Tilting the OR bed improves visibility and reduces the potential for brachial plexus injury during rhytidectomy procedures.	VC
170	Khokhar RS, Baaj J, Alhazmi HH, Dammas FA, Aldalati AM. Pressure-induced alopecia in pediatric patients following prolonged urological surgeries: The case reports and a review of literature. <i>Anesth Essays Res</i> . 2015;9(3):430-432.	Case report	2/Pediatric patients undergoing prolonged surgical procedures	N/A	N/A	N/A	Regular repositioning of the patient's head during surgical procedures may help to prevent postoperative alopecia.	VB

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
171	Davies KE, Yesudian P. Pressure alopecia. <i>Int J Trichology</i> . 2012;4(2):64-68.	Literature review	N/A	N/A	N/A	N/A	Regular repositioning of the patient's head during surgical procedures may help to prevent postoperative alopecia.	VB
172	Gollapalli L, Papapetrou P, Gupta D, Fuleihan SF. Post-operative alopecia after robotic surgery in steep Trendelenburg position: a restated observation of pressure alopecia. <i>Middle East J Anesthesiol</i> . 2013;22(3): 343-345.	Case report	1/53-year-old woman undergoing robotic-assisted gynecological surgery	N/A	N/A	N/A	Repositioning the head, avoiding mechanical compression, and maintaining intraoperative hemodynamics may help to prevent postoperative alopecia.	VC
173	Keidan I, Ben-Menchem E. Postoperative occipital nerve injury in a child. <i>Anaesth Intensive Care</i> . 2012;40(2): 355-356.	Case report	1/7-year-old boy undergoing a free-flap graft of the latissimus dorsi muscle to the right forearm	N/A	N/A	N/A	This case reinforces the need for meticulous care when positioning children and the risk of nerve compression at unusual sites.	VB
174	Lee C, Choi PD, Scott G, Arkader A. Postoperative alopecia in children after orthopaedic surgery. <i>Journal of Pediatric Orthopaedics</i> . 2012;32(7): e53-e55.	Case report	3/Adolescent patients (two females [16 years; 13 years], and one male [12 years]) undergoing orthopedic surgery in the supine position	N/A	N/A	N/A	Postoperative alopecia can occur in children and may be prevented by padding of the head during surgery.	VA
175	Goodenough J, Highgate J, Shaaban H. Under pressure? Alopecia related to surgical duration. <i>Br J Anaesth</i> . 2014;113(2): 306-307.	Expert opinion	N/A	N/A	N/A	N/A	Regular pressure relieving maneuvers, such as head repositioning and scalp massage may guard against postoperative alopecia.	VC
176	Matsushita K, Inoue N, Ooi K, Totsuka Y. Postoperative pressure-induced alopecia after segmental osteotomy at the upper and lower frontal edentulous areas for distraction osteogenesis. <i>Oral & Maxillofacial Surgery</i> . 2011;15(3): 161-163.	Case report	1/29-year-old man undergoing osteotomy in the supine position	N/A	N/A	N/A	Scalp massages and head repositioning during the procedure may help prevent postoperative alopecia.	VB
177	Bagaria M, Luck AM. Postoperative (pressure) alopecia following sacrocolpopexy. <i>Journal of Robotic Surgery</i> . 2015;9(2): 149-151.	Case report	1/57-year-old woman undergoing robotic-assisted sacrocolpopexy in the lithotomy position	N/A	N/A	N/A	The patient's postoperative alopecia resulted from pressure-induced ischemia caused by the static position of the head for a prolonged period of time.	VB

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178	Dumiel-Peeters I, Halfens R, Berger M, Snoeckx L. The effects of massage as a method to prevent pressure ulcers. A review of the literature. 2005;51(4):70-80.	Literature review	N/A	N/A	N/A	N/A	The evidence regarding the use of massage for preventing pressure injury is inconclusive.	VB
179	Ghomi A. Robotics in practice: New angles on safer positioning. <i>Contemporary OB/GYN</i> . 2012:May 11, 2016.	Expert opinion	N/A	N/A	N/A	N/A	Positioning injury can occur during robotic gynecological surgery. Robotic surgery without steep Trendelenburg appears to be feasible without compromising surgical outcomes.	VB
180	Kan KM, Brown SE, Gainsburg DM. Ocular complications in robotic-assisted prostatectomy: A review of pathophysiology and prevention. <i>Minerva Anesthesiol</i> . 2015;81(5): 557-566.	Expert opinion	N/A	N/A	N/A	N/A	Ocular complications may be more likely to occur after procedures using steep Trendelenburg position.	VA
181	Grixti A, Sadri M, Watts MT. Corneal protection during general anesthesia for nonocular surgery. <i>Ocul Surf</i> . 2013;11(2):109-118.	Literature review	N/A	N/A	N/A	N/A	None of the available methods of corneal protection for patients undergoing anesthesia are completely effective, and they all have unwanted side effects. Lid taping is the single, best protective measure.	VB
182	Freshcoln Michelle, Diehl MR. Repositioning during robotic procedures to prevent postoperative visual loss. <i>OR NURSE</i> . 2014;8(4): 36-41.	Expert opinion	N/A	N/A	N/A	N/A	A review of the evidence supports performing a position change from Trendelenburg to supine for 5 to 7 minutes during lengthy procedures.	VC
183	Kocatürk O, Kocatürk T, Kaan N, Dayanir V. The comparison of four different methods of perioperative eye protection under general anesthesia in prone position. <i>Journal of Clinical and Analytical Medicine</i> . 2012;3(2).	Quasi-experimental	368/Eyes undergoing general anesthesia for < 90 minutes for spinal surgery in the prone position	Application of hypoallergenic adhesive tape, antibiotic ointment, artificial liquid tear gel, or ocular lubricant	No protection	Basal tear production/Corneal and conjunctival staining	All of the methods tested are suitable to reduce the incidence of corneal injuries.	IIB
184	Roth S. Perioperative visual loss: what do we know, what can we do? <i>Br J Anaesth</i> . 2009;103(Suppl 1): 31-40.	Literature review	N/A	N/A	N/A	N/A	There is no evidence to support any interventions for preventing ischemic optic neuropathy, in most instances it is preventable by correct head positioning and avoiding external compression on the eyes.	VA

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185	Olsen GH, Krishna SG, Jatana KR, et al. Changes in intracuff pressure of cuffed endotracheal tubes while positioning for adenotonsillectomy in children. <i>Paediatr Anaesth</i> . 2016;26(5):500-503.	Nonexperimental	84/Pediatric patients undergoing adenotonsillectomy	N/A	N/A	Intracuff pressure measurements	Both increases and decreases in the intracuff pressure may occur following positioning of the pediatric patient for adenotonsillectomy.	IIIB
186	Anghelescu DL, Burgoyne LL, Khan RB. Multiple mechanisms of perioperative brachial plexus injury. <i>Anaesth Intensive Care</i> . 2008;36(2): 276-278.	Case report	1/19-year-old male undergoing limb-sparing surgery for osteosarcoma	N/A	N/A	N/A	Some risk factors for perioperative brachial plexus injury can be modified. All efforts should be made to modify the factors that are amenable to change, especially in high-risk situations.	VB
187	Truong AT, Sturgis EM, Rozner MA, Truong DT. Recurrent episodes of asystole from carotid sinus hypersensitivity triggered by positioning for head and neck surgery. <i>Head Neck</i> . 2013;35(1): E28-30.	Case report	1/39-year-old man undergoing thyroid surgery in the supine position	N/A	N/A	N/A	The fact that asystole occurred twice on separate occasions under the same circumstances suggests that the asystolic episodes were triggered by compression or mechanical manipulation of the carotid sinus during positioning of the neck in hyperextension.	VB
188	Li CC, Yie JC, Lai CH, Hung MH. Quadriplegia after off-pump coronary artery bypass surgery: look before you place the neck in an extended position. <i>Journal of Cardiothoracic & Vascular Anesthesia</i> . 2013;27(2): e16-7.	Case report	1/77-year-old man undergoing coronary artery bypass surgery in the supine position	N/A	N/A	N/A	Neck extension to facilitate surgical exposure appeared to be the main factor involved in the genesis of the spinal cord injury.	VB
189	Reddy MKR, Arivazhagan A, Chandramouli BA. Intractable hypotension and bradycardia during surgical positioning in atlantoaxial dislocation. <i>J Neurosurg Anesthesio I</i> . 2008;20(1): 71.	Case report	1/25-year-old man undergoing posterior fusion	N/A	N/A	N/A	This report emphasizes the need for meticulous positioning of unstable cervical spines.	VC
190	Addas BM. An uncommon cause of brachial plexus injury. <i>Neurosciences</i> . 2012;17(1): 64-65.	Case report	1/35-year-old woman undergoing lumbar spine surgery in the prone position	N/A	N/A	N/A	The cause of the injury was believed to be a very tight endotracheal tube tie in combination with the patient's head being turned to one side.	VB
191	St-Arnaud D, Paquin MJ. Safe positioning for neurosurgical patients. <i>AORN J</i> . 2008;87(6): 1156-1168.	Expert opinion	N/A	N/A	N/A	N/A	The neurosurgical perioperative team faces additional challenges related to patient positioning because of the potential for complications during prolonged and complex procedures.	VA

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192	Ahmed K, Khan N, Khan MS, Dasgupta P. Development and content validation of a surgical safety checklist for operating theatres that use robotic technology. <i>BJU Int</i> . 2013;111(7): 1161-1174.	Organizational experience	N/A	N/A	N/A	Elimination and control of identified hazards	It is anticipated that the use of the checklist will encourage a culture of safety and awareness within the operating theater, but it is unlikely that a simple checklist can be the sole driver of significant culture change without support and cooperation from all members of the team.	VA
193	Teeple TJ, Rallis DJ, Rieck KL, Viozzi CF. Lower extremity compartment syndrome associated with hypotensive general anesthesia for orthognathic surgery: a case report and review of the disease. <i>Journal of Oral & Maxillofacial Surgery</i> . 2010;68(5): 1166-11	Case report	1/53-year-old obese man undergoing orthognathic surgery in the supine position	N/A	N/A	N/A	Preoperative identification of risk factors, taking careful intraoperative preventive measures, and rapid response to postoperative lower leg pain will minimize the risk of a complication with long-term morbidity or potential mortality.	VB
194	Judge A, Fecho K. Lateral antebrachial cutaneous neuropathy as a result of positioning while under general anesthesia.. <i>Anesthesia & Analgesia</i> . 2010;110(1): 122-124.	Case report	1/25-year-old man undergoing medial meniscal transplant	N/A	N/A	N/A	Correct positioning should include minimal shoulder abduction, extension, and external rotation, the head should remain midline, elbows should be slightly flexed with forearm supination, and the wrists should remain neutral. It may be beneficial to assess the patient's comfort preoperatively.	VB
195	Moore Chad. Intraoperative Median Nerve Injury. <i>INT STUDENT J NURSE ANESTH</i> . 2011;10(2): 11-14.	Case report	1/24-year-old male undergoing elective surgery	N/A	N/A	N/A	The blood pressure cuff cycling every three minutes for four hours could have caused the injury.	VB
196	Song JB, Vemana G, Mobley JM, Bhayani SB. The second "time-out": a surgical safety checklist for lengthy robotic surgeries. <i>Patient Safety in Surgery</i> . 2013;7(1): 19.	Organizational experience	N/A	N/A	N/A	Reduced perioperative complications after robotic surgery	A standardized surgical checklist conducted three to four hours after the start of surgery, may enhance perioperative patient safety and quality of care.	VC
197	Drummond JC, Ciacci JD, Lee RR. Direct pressure on a pseudomeningocele resulting in intraoperative cerebral ischemia. <i>Canadian Journal of Anaesthesia</i> . 2014;61(7): 656-659.	Case report	1/32-year-old man with spina bifida and a pseudomeningocele undergoing urologic surgery in the lithotomy position	N/A	N/A	N/A	Intraoperative pressure on lesions containing cerebrospinal fluid can result in increases in cerebrospinal fluid pressure and a reduction in cerebral perfusion sufficient to result in cerebral ischemia.	VB

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
198	Anastasian ZH, Ramnath B, Komotar RJ, et al. Evoked potential monitoring identifies possible neurological injury during positioning for craniotomy. <i>Anesthesia & Analgesia</i> . 2009;109(3): 817-821.	Case report	2/One 73-year-old woman, and one 62-year-old man undergoing craniotomy procedures in the supine position with head turned to the right	N/A	N/A	N/A	These cases illustrate the usefulness of SSEP monitoring and the ability to reposition the patient to prevent injury	VB
199	Jahangiri FR, Holmberg A, Vega-Bermudez F, Arlet V. Preventing position-related brachial plexus injury with intraoperative somatosensory evoked potentials and transcranial electrical motor evoked potentials during anterior cervical spine surgery.	Case report	1/43-year-old man with a history of neck pain undergoing anterior cervical spine surgery in the supine position	N/A	N/A	N/A	Intraoperative neurological monitoring was useful in identifying and reversing the patient's impending nerve injury.	VB
200	Silverstein JW, EP T, CNCT, et al. Contemporaneous evaluation of intraoperative ulnar and median nerve somatosensory evoked potentials for patient positioning: A review of four cases. <i>The Neurodiagnostic Journal</i> . 2016;56(2):67-82.	Expert opinion	N/A	N/A	N/A	N/A	Somatosensory evoked potentials are a valuable tool for assessing changes in peripheral nerve pathways caused by patient positioning during spinal surgeries. These changes, left undiagnosed, may lead to postoperative neurological sequelae.	VB
201	Chung I, Glow JA, Dimopoulos V, et al. Upper-limb somatosensory evoked potential monitoring in lumbosacral spine surgery: a prognostic marker for position-related ulnar nerve injury. <i>Spine Journal: Official Journal of the North American Spine Society</i> .	Quasi-experimental	230/Consecutive patients undergoing elective, posterior lumbosacral spinal procedures	Upper-limb and lower-limb SSEP monitoring	Baseline levels	A \geq 50% decrease in SSEPs	Upper limb SSEP monitoring detected position-related ulnar neuropathy in 5.2% of patients undergoing lumbosacral spine surgery.	IIB
202	La Neve JE, Zitney GP. Use of somatosensory evoked potentials to detect and prevent impending brachial plexus injury during surgical positioning for the treatment of supratentorial pathologies. <i>The Neurodiagnostic Journal</i> . 2014;54(3): 260-273.	Case report	3/Patients undergoing cranial surgery in the supine position	N/A	N/A	N/A	These cases highlight the importance of vigilant monitoring in the period after final positioning and demonstrate the usefulness of SSEP monitoring as a tool to aid in the detection and prevention of position-related nerve injuries.	VA

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203	Davis Scott F, Khalek Mohamed Abdel, Giles Jerry, Fox Charles, Lirette Lesley, Kandil Emad. Detection and Prevention of Impending Brachial Plexus Injury Secondary to Arm Positioning Using Ulnar Nerve Somatosensory Evoked Potentials During Transaxillary	Case report	1/ 13-year-old female patient undergoing robotic-assisted transaxillary subtotal thyroidectomy	N/A	N/A	N/A	The use of ulnar nerve SSEPs to detect and prevent position-related injury should be routinely performed during robotic-assisted transaxillary subtotal thyroidectomy.	VB
204	Jellish WS, Sherazee G, Patel J, et al. Somatosensory evoked potentials help prevent positioning-related brachial plexus injury during skull base surgery. <i>Otolaryngology - Head & Neck Surgery</i> . 2013;149(1): 168-173.	Nonexperimental	65/Patients between the ages of 15 and 77 undergoing elective lateral skull base surgery positioned in supine with head rotated to contralateral side secured with a Mayfield headrest	SSEP monitoring	Baseline levels	Changes in measurements caused by positioning	Upper extremity nerve stress can be detected in real time using SSEP monitoring and may be of value in protecting patients from nerve injury	IIIA
205	Ying T, Wang X, Sun H, Tang Y, Yuan Y, Li S. Clinical usefulness of somatosensory evoked potentials for detection of peripheral nerve and brachial plexus injury secondary to malpositioning in microvascular decompression. <i>J Clin Neurophysiol</i> . 2015;32(6):512-515.	Nonexperimental	485/Patients who underwent microvascular decompression surgery with SSEP monitoring	N/A	N/A	Prevention of positioning injury	Continuous intraoperative SSEP monitoring of ulnar and median nerve function is a valid and useful technique to minimize intraoperative neurologic injuries during surgery.	IIIA
206	Schwartz DM, Sestokas AK, Hilibrand AS, et al. Neurophysiological identification of position-induced neurologic injury during anterior cervical spine surgery. <i>J Clin Monit Comput</i> . 2006;20(6):437-444.	Nonexperimental	69 of 3806/Patients showing intraoperative evidence of impending neurologic injury secondary to positioning	N/A	N/A	Detection of emerging potential neurologic injury	Transcranial electric motor evoked potential monitoring helps validate SSEP monitoring and provides additional coverage for emerging motor nerve injury that may escape identification by SSEP monitoring alone.	IIIB
207	Bhalodia VM, Sestokas AK, Tomak PR, Schwartz DM. Transcranial electric motor evoked potential detection of compressional peroneal nerve injury in the lateral decubitus position. <i>Journal of Clinical Monitoring & Computing</i> . 2008;22(4): 319-326.	Case report	2/One 65-year-old man, and one 39-year-old man undergoing spine surgery in the lateral position	N/A	N/A	N/A	These cases illustrate the usefulness of TcMEP monitoring to identify emerging peroneal nerve compression secondary to lateral positioning.	VB

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208	Eager M, Shimer A, Jahangiri FR, Shen F, Arlet V. Intraoperative neurophysiological monitoring (IONM): Lessons learned from 32 case events in 2069 spine cases. <i>Neurodiagnostic Journal</i> . 2011;51(4): 247-263.	Nonexperimental	32/Spinal procedures with possible intraoperative neurophysiological monitoring events	N/A	N/A	Potential neurological injury	This review reinforces the importance of neurophysiological monitoring for spine surgery. Several postoperative neurologic deficits were avoided by intraoperative intervention.	IIIA
209	Bennicoff G. Perioperative care of the morbidly obese patient in the lithotomy position. <i>AORN J</i> . 2010;92(3): 297-309.	Expert opinion	N/A	N/A	N/A	N/A	Caring for a patient who is morbidly obese and who requires surgery in the lithotomy position can be especially challenging, and the possibility of injury to the patient or team members exists.	VB
210	Rosevear HM, Lightfoot AJ, Zahs M, Waxman SW, Winfield HN. Lessons learned from a case of calf compartment syndrome after robot-assisted laparoscopic prostatectomy. <i>Journal of Endourology</i> . 2010;24(10): 1597-1601.	Case report	1/57-year-old man undergoing robotic-assisted prostatectomy in the supine with Trendelenburg split-leg position on a fracture table	N/A	N/A	N/A	The perioperative team should verify there are no pressure points between the robotic arms and the patient.	VA
211	Pandey R, Elakkumanan LB, Garg R, et al. Brachial Plexus Injury After Robotic-Assisted Thoracoscopic Thymectomy. <i>J Cardiothorac Vasc Anesth</i> . 2009;23(4): 584-586.	Case report	1/18-year-old man undergoing arthroscopic shoulder surgery in the lateral position	N/A	N/A	N/A	Somatosensory evoked potential monitoring may be used to prevent injury. Patient position should avoid hyperabduction and also provide space for robotic arm movement.	VB
212	Hobaika AB, Horiguchi CH. Radial nerve lesion after malposition and sedation by continuous target controlled infusion of propofol for extracorporeal shock wave lithotripsy. <i>Middle East J Anesthesiol</i> . 2013;22(2): 235-236.	Case report	1/36-year-old female undergoing left-sided ESWL	N/A	N/A	N/A	The injury to the patient's radial nerve may have been related to incorrect positioning of the limb or contact of the limb with the lithotripter machine.	VC
213	Neutral position of a joint definition of neutral position of a joint by medical dictionary. http://medical-dictionary.thefreedictionary.com/neutral+position+of+joint . Accessed 8/4/2016.	N/A	N/A	N/A	N/A	N/A	The position of a joint where the distal element is not inverted/everted, adducted/abducted, or extended (dorsiflexed)/flexed (plantar-flexed).	N/A

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214	Bradshaw AD, Advincula AP. Optimizing patient positioning and understanding radiofrequency energy in gynecologic surgery. <i>Clinical Obstetrics & Gynecology</i> . 2010;53(3): 511-520.	Expert opinion	N/A	N/A	N/A	N/A	Understanding neuroanatomical relationships can help the perioperative team optimally position patients and minimize the incidence of postoperative neuropathy while maintaining functional and unobstructed access to the patient and surgical field.	VB
215	Clark JM, Friedell ML, Gupta BR, Davenport WC, Amponsah K. Perioperative compartment syndrome of the hand. <i>Am Surg</i> . 2011;77(1): 116-118.	Case report	2/One 76-year-old woman who underwent surgery for rectal prolapse, and one 63-year-old woman who underwent left nephrectomy	N/A	N/A	N/A	Prevention of hand compartment syndrome begins with positioning the patient's hands at the side with draw sheets loosely tucked around the dorsum of the hand. An arm board should be used if the patient's hands cannot be comfortably positioned at the sides. If swelling and cyanosis of the hand is noted postoperatively compartment syndrome should be considered.	VA
216	Hida A, Arai T, Nakanishi K, Nagaro T. Bilateral brachial plexus injury after liver transplantation. <i>Journal of Anesthesia</i> . 2008;22(3): 308-311.	Case report	1/35-year-old man with hepatitis C cirrhosis undergoing a liver transplantation	N/A	N/A	N/A	A 90° abduction of the arms may have resulted in excessive stretching of the brachial nerves.	VB
217	Akinbingol G, Borman H, Maral T. Bilateral brachial plexus palsy after a prolonged surgical procedure of reduction mammoplasty, abdominoplasty, and liposuction. <i>Ann Plast Surg</i> . 2002;49(2):219-220.	Case report	1/Obese 56-year-old woman undergoing reduction mammoplasty, abdominoplasty, and liposuction	N/A	N/A	N/A	When operating on overweight patients, arm abduction should be reduced during positioning.	VC
218	Tekin Levent, Akarsu Selim, Carli Alparslan, et al. Brachial plexus lesion due to malpositioning during thyroid surgery: a case report. <i>J PHYS MED REHABIL SCI</i> . 2011;14(3-4): 80-84.	Case report	1/20-year-old man undergoing thyroid surgery in the supine position	N/A	N/A	N/A	Poor positioning of the patient's arm resulted in a brachial plexus lesion.	VB
219	Sabiniewicz R, Ereciński J, Zipsier M. Brachial plexus injury as an unusual complication after aortic stent implantation. <i>Cardiol Young</i> . 2011;21(2): 227-228.	Case report	1/15-year-old girl undergoing aortic stent implantation in the supine position with arms raised over her head	N/A	N/A	N/A	The patient's brachial plexus injury caused by compression against skeletal structures.	VB

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220	Cristian DA, Grama FA, Burcos T, Poalelungi A. Brachial plexus injury after a left-side modified radical mastectomy associated with patient positioning in the operating room. <i>Gineco.eu</i> . 2013;9(3): 136-137.	Case report	1/65-year-old woman undergoing left-sided modified radical mastectomy	N/A	N/A	N/A	A number of factors including incorrect patient positioning can cause brachial plexus injury.	VB
221	Chowet AL, Lopez JR, Brock-Utne JG, Jaffe RA. Wrist hyperextension leads to median nerve conduction block: implications for intra-arterial catheter placement. <i>Anesthesiology</i> . 2004;100(2): 287-291.	Quasi-experimental	12/Volunteers	Median nerve conduction studies in the hyperextended right wrist	Median nerve conduction studies in the neutral left wrist	Action potential amplitudes sufficient to qualify as conduction block	Wrist hyperextension is likely to result in profound impairment of median nerve function. Prolonged hyperextension may be associated with significant changes in median nerve conduction. The wrists should be promptly returned to neutral position following arterial line placement.	IIB
222	Huber D. Preventing deep tissue injury of the foot and ankle in the operating theatre. <i>Wounds UK</i> . 2013;9(2): 34-38.	Expert opinion	N/A	N/A	N/A	N/A	Preventing heel and ankle pressure injury requires offloading the heels, flexing the knees 5° to 10° while preventing popliteal compression, distributing the weight of the legs along the calf with minimal pressure on the Achilles tendon, and preventing pressure on the lateral malleolus.	VB
223	Huber D, Huber J, DeYoung E. The association between popliteal vein compression and deep venous thrombosis: Results of a pilot study. <i>Phlebology</i> . 2013;28(6):305-307.	Nonexperimental	54/Patients undergoing ultrasonic scanning for DVT	Popliteal vein measurements in patients with popliteal vein compression	Popliteal vein measurements in patients without popliteal vein compression	Occurrence of DVT	There is an association between the presence of popliteal vein compression and an increased likelihood of developing a DVT.	IIIB
224	Huber DE, Huber JP. Popliteal vein compression under general anaesthesia. <i>Eur J Vasc Endovasc Surg</i> . 2009;37(4):464-469.	Nonexperimental	50/Patients undergoing general anesthesia in the supine position	N/A	N/A	Popliteal vein compression	Knee hyperextension leads to popliteal vein compression or occlusion. The likelihood of compression increases in patients with higher BMIs.	IIIB
225	Levine A, Huber J, Huber D. Changes in popliteal vein diameter and flow velocity with knee flexion and hyperextension. <i>Phlebology</i> . 2011;26(7):307-310.	Nonexperimental	15/Patients undergoing vascular ultrasound	Measurement of popliteal vein diameter with knee hyperextension	Measurement of popliteal vein diameter with knee flexion	Changes in vein diameter	There is a functional narrowing of the popliteal vein during hyperextension of the knee.	IIIB

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226	O'Connor D, Breslin D, Barry M. Well-leg compartment syndrome following supine position surgery. <i>Anaesthesia & Intensive Care</i> . 2010;38(3): 595.	Case report	1/27-year-old patient undergoing upper limb vascular reconstruction in the supine position	N/A	N/A	N/A	Well-leg compartment syndrome should be suspected in patients with lower limb symptoms after prolonged operations.	VB
227	Wong VK, Stotts NA, Hopf HW, Dowling GA, Froelicher ES. Changes in heel skin temperature under pressure in hip surgery patients. <i>Adv Skin Wound Care</i> . 2011;24(12): 562-570.	Quasi-experimental	18/Patients who underwent hip surgery in one of two different hospitals	Measurement of heel temperature when heels were returned to the bed surface for 15 minutes, and suspended again above the bed surface for 15 minutes	Measurement of heel temperature after heel suspension above the bed surface for 20 minutes	Changes in measurements	Heel temperature increased with postoperative loading and unloading. Keeping the heels off the bed surface at all times may avoid heel skin temperature changes and prevent tissue damage.	IIC
228	Donnelly J, Winder J, Kernohan WG, Stevenson M. An RCT to determine the effect of a heel elevation device in pressure ulcer prevention post-hip fracture. <i>J Wound Care</i> . 2011;20(7):309-12, 314-8.	Randomized controlled trial	239/Patients with fractured hips	Pressure reducing surfaces with heel elevation	Pressure reducing surfaces without heel elevation	Pressure injury development	The findings suggest that offloading reduces the incidence of heel pressure injuries.	IA
229	Primiano Mike, Friend Michael, McClure Connie, et al. Pressure ulcer prevalence and risk factors during prolonged surgical procedures. <i>AORN J</i> . 2011;94(6): 555-566.	Nonexperimental	258/Patients undergoing same day surgery for procedures scheduled for more than three hours	N/A	N/A	Pressure injury development within 72 hours postoperatively	Positioning methods and support surfaces are two key components that may influence pressure injury development.	IIIA
230	O'Shea E, Power K. Well leg compartment syndrome following prolonged surgery in the supine position. <i>Canadian Journal of Anaesthesia</i> . 2008;55(11): 794-795.	Case report	1/43-year-old woman undergoing prolonged surgery in the supine position	N/A	N/A	N/A	The injury may have resulted from the use of latex-covered heel positioners.	VB
231	Physiologic - definition of physiologic by the free dictionary http://www.thefreedictionary.com/physiologic . Accessed 8/23/2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
232	Albrecht P, Grosse J, Neukaeter W. Femoral neuropathy caused by hyperlordotic positioning. <i>Journal of Anesthesia</i> . 2014;28(5): 800.	Case report	1/32-year-old man undergoing general anesthesia for prolonged dental surgery in a hyperlordotic position	N/A	N/A	N/A	The hyperlordotic position led to angulation and prolonged strain on the femoral nerve.	VC

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233	Ghomi A, Kramer C, Askari R, Chavan NR, Einarsson JI. Trendelenburg position in gynecologic robotic-assisted surgery. <i>Journal of Minimally Invasive Gynecology</i> . 2012;19(4): 485-489.	Nonexperimental	20/Women undergoing robotic-assisted gynecological surgery	N/A	N/A	Degree of Trendelenburg required for adequate visualization	Robotic-assisted gynecological surgery can be effectively performed without the use of steep Trendelenburg position.	IIC
234	Brodsky JB. Positioning the morbidly obese patient for anesthesia. <i>Obes Surg</i> . 2002;12(6):751-758.	Expert opinion	N/A	N/A	N/A	N/A	Positioning the extremely obese patient is a challenge. A thorough understanding of the pathophysiology of obesity, and the different surgical positions is essential for safe patient management.	VB
235	Ideno S, Miyazawa N, Yamamoto S. Muscle injury following laparoscopic appendectomy. <i>Journal of Anesthesia</i> . 2014;28(5): 801.	Case report	1/13-year-old boy undergoing laparoscopic appendectomy in Trendelenburg position	N/A	N/A	N/A	In pediatric cases, the pressure gradient could affect limb perfusion because normal blood pressure is lower in children than in adults. Additional intermittent measurement of blood pressure at the lower extremity could be effective for monitoring limb perfusion, or the team should consider intermittent reversal of the head-down position or limiting the duration of that position.	VB
236	Kamel I, Barnette R. Positioning patients for spine surgery: Avoiding uncommon position-related complications. <i>World Journal of Orthopedics</i> . 2014;5(4): 425-443.	Expert opinion	N/A	N/A	N/A	N/A	Understanding the etiology, mechanism, and pattern of injury is important for preventing peripheral nerve injury. Education of perioperative team members and collaboration while positioning is the best and safest approach to preventing postoperative vision loss.	VA
237	Awad H, Santilli S, Ohr M, et al. The effects of steep trendelenburg positioning on intraocular pressure during robotic radical prostatectomy. <i>Anesthesia & Analgesia</i> . 2009;109(2): 473-478.	Quasi-experimental	33/Patients undergoing elective robotic prostatectomy who were ASA class I or II	Intraocular pressure measurements in 25° Trendelenburg position	Intraocular pressure measurements in supine position	Differences in intraocular pressure measurements	Intraocular pressure reached peak levels at the end of steep Trendelenburg position, on average 13 mm Hg higher than the preanesthesia induction level.	IIB
238	Borahay MA, Patel PR, Walsh TM, et al. Intraocular pressure and steep Trendelenburg during minimally invasive gynecologic surgery: is there a risk? <i>Journal of Minimally Invasive Gynecology</i> . 2013;20(6): 819-824.	Quasi-experimental	10/Female patients scheduled for elective robotic-assisted and laparoscopic hysterectomies	Measurement of intraocular pressure after general anesthesia and intubation, after one hour of steep Trendelenburg position, after two hours of steep Trendelenburg position, and after return to supine position	Intraocular pressure measurements before anesthesia	Differences in intraocular pressure measurements	Intraocular pressure increases significantly when patients are placed in steep Trendelenburg position. Given the aging population in whom the risk for glaucoma is significant, preoperative ocular health assessment should be considered in some cases.	IIB

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239	Taketani Y, Mayama C, Suzuki N, et al. Transient but significant visual field defects after robot-assisted laparoscopic radical prostatectomy in deep Trendelenburg position. <i>PLoS ONE</i> . 2015;10(4): e0123361.	Nonexperimental	25/Men undergoing robotic-assisted radical prostatectomy in the Trendelenburg position	N/A	N/A	Differences in intraocular pressure measurements	Transient, but significant unilateral visual field defects were found in 28% of subjects examined. The probable cause is the increased intraocular pressure and altered perfusion during surgery. Ophthalmological examinations are therefore suggested before and after robotic-assisted radical prostatectomy.	IIIB
240	Astuto M, Minardi C, Uva MG, Gullo A. Intraocular pressure during laparoscopic surgery in paediatric patients. <i>Br J Ophthalmol</i> . 2011;95(2): 294-295.	Quasi-experimental	Not stated/Children without ocular pathologies undergoing an abdominal procedure	Measurement of intraocular pressure in 5° and 10° Trendelenburg position	Measurement of intraocular pressure in supine position	Differences in intraocular pressure measurements	There was a significant increase in intraocular pressure in the Trendelenburg procedure after pneumoperitoneum introduction, which returned to baseline levels in the supine position after pneumoperitoneum evacuation.	IIC
241	Mondzelewski TJ, Schmitz JW, Christman MS, et al. Intraocular Pressure During Robotic-assisted Laparoscopic Procedures Utilizing Steep Trendelenburg Positioning. <i>J Glaucoma</i> . 2015;24(6): 399-404.	Nonexperimental	18/Patients undergoing robotic-assisted radical prostatectomy	N/A	N/A	Differences in intraocular pressure measurements	Significant elevations of intraocular pressure are experienced during robotic surgery in the Trendelenburg position.	IIIB
242	Molloy BL. Implications for postoperative visual loss: steep trendelenburg position and effects on intraocular pressure. <i>AANA J</i> . 2011;79(2): 115-121.	Nonexperimental	37/Patients undergoing procedures incorporating Trendelenburg position for a minimum of 120 minutes	N/A	N/A	Differences in intraocular pressure measurements	There is a direct correlation between the duration of surgery in the Trendelenburg position with an increase in intraocular pressure.	IIIB
243	Rewari V, Ramachandran R. Prolonged steep Trendelenburg position: Risk of postoperative upper airway obstruction. <i>Journal of Robotic Surgery</i> . 2013;7(4): 405-406.	Expert opinion	N/A	N/A	N/A	N/A	Prolonged steep Trendelenburg positioning poses a risk for postoperative upper airway obstruction.	VB
244	Kalmar AF, Dewaele F, Foubert L, et al. Cerebral haemodynamic physiology during steep Trendelenburg position and CO2 pneumoperitoneum. <i>Br J Anaesth</i> . 2012;108(3): 478-484.	Nonexperimental	21/Consecutive patients who underwent robotic radical prostatectomy	N/A	N/A	Differences in cerebral perfusion measurements	Prolonged steep Trendelenburg positioning and pneumoperitoneum does not compromise cerebral perfusion.	IIIB

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245	Choi SH, Lee SJ, Rha KH, Shin SK, Oh YJ. The effect of pneumoperitoneum and Trendelenburg position on acute cerebral blood flow-carbon dioxide reactivity under sevoflurane anaesthesia. <i>Anaesthesia</i> . 2008;63(12): 1314-1318.	Quasi-experimental	25/Consecutive male patients undergoing robotic-assisted laparoscopic radical prostatectomy	Measurement of cerebral blood flow in the Trendelenburg position with pneumoperitoneum	Measurement of cerebral blood flow in the supine position without pneumoperitoneum	Differences in cerebral blood flow	Cerebral blood flow was unchanged in the Trendelenburg position.	IIA
246	Closhen D, Treiber AH, Berres M, et al. Robotic assisted prostatic surgery in the Trendelenburg position does not impair cerebral oxygenation measured using two different monitors: A clinical observational study. <i>Eur J Anaesthesiol</i> . 2014;31(2): 104-109.	Quasi-experimental	29/Patients between 59 and 71 years, with BMI between 22 kg/m ² and 30 kg/m ² , and ASA class I, II, or III undergoing robotic-assisted prostatic surgery	Measurement of near-infrared spectroscopy in Trendelenburg position	Measurement of near-infrared spectroscopy in supine position	Differences in cerebral oxygen saturation greater than 5%	Both monitors showed a clinically insignificant decrease in cerebral oxygen saturation of less than 5% over four hours in a steep Trendelenburg position combined with pneumoperitoneum in patients undergoing robotic-assisted prostatic surgery. This extreme positioning seems to be acceptable with regard to cerebral oxygenation.	IIA
247	Park EY, Koo BN, Min KT, Nam SH. The effect of pneumoperitoneum in the steep Trendelenburg position on cerebral oxygenation. <i>Acta Anaesthesiol Scand</i> . 2009;53(7): 895-899.	Nonexperimental	32/Male patients, ASA class I and II undergoing robotic-assisted radical prostatectomy in the Trendelenburg position	Measurement of cerebral oxygenation using near-infrared spectroscopy five minutes after a 30° Trendelenburg position, five minutes after pneumoperitoneum in the supine position, 30, 60, and 120 minutes after pneumoperitoneum in the Trendelenburg position, and after desufflation in supine position	Measurement of cerebral oxygenation using near-infrared spectroscopy immediately after induction	Differences in cerebral oxygenation measurements	Cerebral oxygenation increased slightly, which suggests that the procedure did not induce cerebral ischemia.	IIIB
248	Lahaye L, Grasso M, Green J, Biddle CJ. Cerebral tissue O2 saturation during prolonged robotic surgery in the steep Trendelenburg position: an observational case series in a diverse surgical population. <i>Journal of Robotic Surgery</i> . 2015;9(1): 19-25.	Quasi-experimental	42/Patients undergoing robotic surgery in the Trendelenburg position	Measurement of oxygen saturation throughout the surgical procedure in Trendelenburg position with pneumoperitoneum	Measurement of oxygen saturation before induction of anesthesia in supine position without pneumoperitoneum	Cerebral desaturation events	Robotic surgery in the Trendelenburg position with pneumoperitoneum was associated with significant and prolonged cerebral desaturation in four patients, with 11 patients experiencing episodic events. The majority (64%) did not experience cerebral desaturation.	IIB
249	Barr C, Madhuri TK, Prabhu P, Butler-Manuel S, Tailor A. Cerebral oedema following robotic surgery: a rare complication. <i>Archives of Gynecology & Obstetrics</i> . 2014;290(5): 1041-1044.	Case report	1/51-year-old obese woman diagnosed with adenocarcinoma of the cervix undergoing robotic surgery	N/A	N/A	N/A	This rare case of cerebral edema following robotic surgery was associated with prolonged surgery in the early learning curve of this modality, a steep Trendelenburg position, high intra-abdominal CO ₂ pressure and fluid resuscitation.	VB

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250	Chin JH, Seo H, Lee EH, et al. Sonographic optic nerve sheath diameter as a surrogate measure for intracranial pressure in anesthetized patients in the Trendelenburg position. <i>BMC Anesthesiol</i> . 2015;15:43-015-0025-9. eCollection 2015.	Quasi-experimental	21/Patients scheduled for robotic-assisted radical prostatectomy	Sonographic optic nerve sheath diameter measurements 3 minutes after steep Trendelenburg, and 3 minutes after steep Trendelenburg combined with pneumoperitoneum	Sonographic optic nerve sheath diameter measurements in the supine position after induction of anesthesia	Differences in sonographic optic nerve sheath diameter measurements	Use of the isolated steep Trendelenburg position, for even a short duration, increased the sonographic optic nerve sheath diameter measurements.	IIB
251	Shah SB, Bhargava AK, Choudhury I. Noninvasive intracranial pressure monitoring via optic nerve sheath diameter for robotic surgery in steep Trendelenburg position. <i>Saudi journal of anaesthesia</i> . 2015;9(3): 239-246.	Randomized controlled trial	252/Patients undergoing robotic-assisted surgery in Trendelenburg position who are ASA class I and II	Measurement of optic nerve sheath diameter 10 minutes after induction and every hour thereafter, after return to supine position, and at one, three, and 24 hours postoperatively	Measurement of optic nerve sheath diameter at baseline	Differences in optic sheath diameter measurements	Trendelenburg position with pneumoperitoneum results in increasing venous congestion within and outside the cranium leading to cerebral edema and raised intracranial pressure.	IA
252	Kim MS, Bai SJ, Lee JR, Choi YD, Kim YJ, Choi SH. Increase in intracranial pressure during carbon dioxide pneumoperitoneum with steep Trendelenburg positioning proven by ultrasonographic measurement of optic nerve sheath diameter. <i>Journal of Endourology</i> .	Nonexperimental	20/Patients undergoing robotic-assisted prostatectomy	N/A	N/A	Differences in optic sheath diameter measurements	In patients undergoing robotic-assisted prostatectomy, an increase of 12.5% in optic nerve sheath diameter during pneumoperitoneum with steep Trendelenburg was observed, thus, an increase in intracranial pressure could be predicted. In 15% of the enrolled patients, the optic nerve sheath diameter increased to values equivalent to an intracranial pressure above 20 mm Hg without deterioration of cerebral oxygen saturation or any neurologic complications.	IIIB
253	Kim SH, Kim HJ, Jung KT. Position does not affect the optic nerve sheath diameter during laparoscopy. <i>Korean Journal of Anesthesiology</i> . 2015;68(4): 358-363.	Nonexperimental	57/Female patients, ASA class I and II undergoing laparoscopic cholecystectomy in reverse Trendelenburg (n = 30), and in the Trendelenburg position (n = 27)	N/A	N/A	Differences in optic sheath diameter measurements	Optic nerve sheath diameter increased slightly until 15 minutes, but there were no significant differences according to the position.	IIIC

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254	Gkegkes ID, Karydis A, Tyritzis SI, Iavazzo C. Ocular complications in robotic surgery. <i>International Journal of Medical Robotics and Computer Assisted Surgery</i> . 2015;11(3): 269-274.	Systematic review	8/Articles representing 142 patients who sustained ocular complications following robotic surgery	N/A	N/A	Risk factors for ocular complications following robotic surgery	The most frequent complication was increased intraocular pressure. Corneal abrasion, ischemic optic neuropathy, and postoperative visual loss were also reported. Meticulous preoperative ophthalmological assessment, restriction of intravenous fluids, rest stops, eyelid taping, and ocular dressings are the major protective measures suggested by the literature.	III B
255	Grosso A, Scozzari G, Bert F, Mabilia MA, Siliquini R, Morino M. Intraocular pressure variation during colorectal laparoscopic surgery: standard pneumoperitoneum leads to reversible elevation in intraocular pressure. <i>Surg Endosc</i> . 2013;27(9): 3370-3376.	Quasi-experimental	41/Colorectal surgery patients with Trendelenburg positioning (n = 29), and without Trendelenburg positioning (n = 12)	Measurement of intraocular pressure at eight different time points during, and after surgery	Measurement of intraocular pressure before surgery	Differences in intraocular pressure measurements	A trend was observed toward greater intraocular pressure increases in patients with Trendelenburg positioning.	IIB
256	Grosso A, Ceruti P, Morino M, Marchini G, Amisano M, Fioretto M. Comment on the paper by mondzelewski and colleagues: "Intraocular pressure during robotic-assisted laparoscopic procedures utilizing steep trendelenburg positioning." <i>J glaucoma</i> . 2015;24(6):399–404. <i>J Glaucoma</i> .	Expert opinion	N/A	N/A	N/A	N/A	Surgeons should collaborate with ophthalmologists to prevent ocular injury following laparoscopic procedures involving pneumoperitoneum and Trendelenburg position.	VB
257	Hoshikawa Y, Tsutsumi N, Ohkoshi K, et al. The effect of steep Trendelenburg positioning on intraocular pressure and visual function during robotic-assisted radical prostatectomy. <i>Br J Ophthalmol</i> . 2014;98(3): 305-308.	Quasi-experimental	31/Patients undergoing robotic-assisted radical prostatectomy	Measurements of intraocular pressure after induction while supine, every hour after steep Trendelenburg position, before arousal in supine position, and 30 minutes after arousal in supine position	Measurements of intraocular pressure before induction in supine position	Differences in intraocular pressure measurements	While intraocular pressure increased in a time-dependent fashion, visual function showed no significant change postoperatively and no complications were seen.	IIB
258	De Leon A, Thörn S-E, Ottosson J, Wattwil M. Body positions and esophageal sphincter pressures in obese patients during anesthesia. <i>Acta Anaesthesiol Scand</i> . 2010;54(4): 458-463.	Quasi-experimental	17/Patients 27 to 63 years with a BMI \geq 35 kg/m ² undergoing laparoscopic bariatric surgery	Measurements of upper esophageal sphincter and lower esophageal sphincter pressures in the reverse Trendelenburg (20°), and Trendelenburg (20°) positions	Measurements of upper esophageal sphincter and lower esophageal sphincter pressures in the supine position	Differences in esophageal sphincter pressure measurements	Lower esophageal sphincter pressures increased during the Trendelenburg position before anesthesia.	IIB

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259	Choi DK, Lee IG, Hwang JH. Arterial to end-tidal carbon dioxide pressure gradient increases with age in the steep Trendelenburg position with pneumoperitoneum. <i>Korean Journal of Anesthesiology</i> . 2012;63(3): 209-215.	Quasi-experimental	92/Consecutive patients undergoing robotic-assisted laparoscopic prostatectomy in the steep Trendelenburg position.	Measurement of heart rate, mean arterial pressure, peak inspiratory pressure, lung compliance, minute ventilation in patients older than 65 years.	Measurement of heart rate, mean arterial pressure, peak inspiratory pressure, lung compliance, minute ventilation in patients 45 to 65 years.	Differences in measurements	The magnitude of arterial to end-tidal carbon dioxide pressure gradient during pneumoperitoneum in the steep Trendelenburg position increased with age, which could be attributed to age-related respiratory physiological changes.	IIA
260	Kilic OF, Borgers A, Kohne W, Musch M, Kropfl D, Groeben H. Effects of steep Trendelenburg position for robotic-assisted prostatectomies on intra- and extrathoracic airways in patients with or without chronic obstructive pulmonary disease. <i>Br J Anaesth</i> .	Quasi-experimental	75/Patients without (n = 55) and with (n = 20) COPD undergoing robotic-assisted prostatectomy	Measurement of lung function on the morning of surgery, and 40 and 120 minutes, and 24 hours after extubation in patients with COPD	Measurement of lung function on the morning of surgery, and 40 and 120 minutes, and 24 hours after extubation in patients without COPD	Differences in lung function measurements	Robotic-assisted prostatectomy in the steep Trendelenburg position led to an increase in upper airway resistance directly after surgery that normalized within 24 hours. In patients without COPD, vital capacity and forced expiratory volume were reduced after surgery and recovered within five days, while in patients with COPD, the alteration lasted beyond 5 days.	IIB
261	Wysham WZ, Kim KH, Roberts JM, et al. Obesity and perioperative pulmonary complications in robotic gynecologic surgery. <i>American Journal of Obstetrics & Gynecology</i> . 2015;213(1): 33.e1-33.e7.	Nonexperimental	146 of 1032/Obese patients from two academic institutions who developed postoperative complications	N/A	N/A	Pulmonary complications/ Any type of complication	Only age was significantly associated with a higher risk of pulmonary complications. Older age, higher estimates of blood loss, and longer case length were associated with a higher rate of any type of complication.	IIIB
262	Chin YS. Bradycardia caused by position change. <i>Journal of Anesthesia</i> . 2012;26(3): 475-476.	Case report	1/22-year-old woman undergoing single-port laparoscopic left ovarian cystectomy	N/A	N/A	N/A	Although the view of the pelvic organs is best in the head-down position, this position can be fatal to some patients who present with bradycardia. Therefore, the risk of bradycardia should be considered before implementing the Trendelenburg position.	VB

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263	Darlong V, Kunhabdulla NP, Pandey R, et al. Hemodynamic changes during robotic radical prostatectomy. <i>Saudi Journal of anaesthesia</i> . 2012;6(3): 213-218.	Quasi-experimental	15/Male patients, ASA class I or II, undergoing robotic-assisted radical prostatectomy	Measurement of hemodynamic parameters after five minutes of anesthesia, after five minutes of pneumoperitoneum, after five minutes of 45° Trendelenburg with pneumoperitoneum, after 20 minutes of Trendelenburg with pneumoperitoneum, and then hourly until end of surgery, and in the supine position after deflation of pneumoperitoneum	Measurement of hemodynamic parameters at preinduction	Differences in hemodynamic parameters	The steep Trendelenburg position and pneumoperitoneum lead to a significant decrease in stroke volume and cardiac output.	IIB
264	Lowenstein L, Mustafa M, Burke YZ, Mustafa S, Segal D, Weissman A. Steep Trendelenburg position during robotic sacrocolpopexy and heart rate variability. <i>European Journal of Obstetrics, Gynecology, & Reproductive Biology</i> . 2014;178: 66-69.	Nonexperimental	19/Women undergoing robotic sacrocolpopexy	N/A	N/A	Differences in hemodynamic measurements	Steep Trendelenburg position during robotic urogynecology surgery resulted in significant changes in heart rate variability and other hemodynamic parameters.	IIIB
265	Zorko N, Mekis D, Kamenik M. The influence of the Trendelenburg position on haemodynamics: comparison of anaesthetized patients with ischaemic heart disease and healthy volunteers. <i>J Int Med Res</i> . 2011;39(3): 1084-1089.	Quasi-experimental	20/Patients with ischemic heart disease undergoing elective coronary artery bypass graft surgery (n = 10), and healthy volunteers (n = 10)	Hemodynamic measurements after placement in 20° Trendelenburg position	Hemodynamic measurements in the supine position	Differences in measurements	Placing anesthetized patients in the Trendelenburg position resulted in a significant increase in cardiac output and mean arterial pressure.	IIC
266	Russo A, Marana E, Viviani D, et al. Diastolic function: the influence of pneumoperitoneum and Trendelenburg positioning during laparoscopic hysterectomy. <i>Eur J Anaesthesiol</i> . 2009;26(11): 923-927.	Nonexperimental	20/Healthy women, ASA class I, undergoing laparoscopic hysterectomy in the Trendelenburg position (n = 10), and open hysterectomy in the supine position (n = 10)	N/A	N/A	Differences in cardiac function measurements	Pneumoperitoneum has an important effect on left ventricular end-diastolic volume; it also affects diastolic function with a delay in deceleration time and isovolumetric relaxation time without any effects on intracavitary pressures.	IIIB
267	Meininger D, Westphal K, Bremerich DH, et al. Effects of posture and prolonged pneumoperitoneum on hemodynamic parameters during laparoscopy. <i>World J Surg</i> . 2008;32(7): 1400-1405.	Nonexperimental	10/Patients undergoing laparoscopic-assisted prostatectomy in steep Trendelenburg position	N/A	N/A	Differences in hemodynamic measurements	Patients undergoing laparoscopic-assisted radical prostatectomy with four hours of pneumoperitoneum in the Trendelenburg position experienced no significant hemodynamic depression related to position or pneumoperitoneum.	IIIB

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268	Kalmar AF, Foubert L, Hendrickx JF, et al. Influence of steep Trendelenburg position and CO(2) pneumoperitoneum on cardiovascular, cerebrovascular, and respiratory homeostasis during robotic prostatectomy. <i>Br J Anaesth</i> . 2010;104(4): 433-439.	Nonexperimental	31/Consecutive patients who underwent robotic radical prostatectomy	N/A	N/A	Differences in hemodynamic and pulmonary parameters	The combination of prolonged steep Trendelenburg position and carbon dioxide pneumoperitoneum was well tolerated. Hemodynamic and pulmonary parameters remained within safe limits.	IIIB
269	Lestar M, Gunnarsson L, Lagerstrand L, Wiklund P, Odeberg-Wernerman S. Hemodynamic perturbations during robot-assisted laparoscopic radical prostatectomy in 45degree Trendelenburg position. <i>Anesthesia & Analgesia</i> . 2011;113(5): 1069-1075.	Nonexperimental	16/Patients ASA class I or II, undergoing robotic-assisted radical prostatectomy in 45° Trendelenburg position	N/A	N/A	Differences in hemodynamic measurements	Pneumoperitoneum and 45° Trendelenburg position caused two- to three-fold increases in filling pressures without effects on cardiac performance. Lung compliance was halved.	IIIC
270	Haas S, Haese A, Goetz AE, Kubitz JC. Haemodynamics and cardiac function during robotic-assisted laparoscopic prostatectomy in steep Trendelenburg position. <i>The International Journal Of Medical Robotics + Computer Assisted Surgery: MRCAS</i> . 2011;7(4): 408-	Quasi-experimental	10/Patients scheduled for robotic-assisted prostatectomy in steep Trendelenburg position	Measurement of hemodynamic parameters and cardiac function at 10 and 60 minutes after pneumoperitoneum and steep Trendelenburg	Measurement of hemodynamic parameters and cardiac function before positioning	Differences in measurements	The steep Trendelenburg position may improve hemodynamic function and does not deteriorate left or right ventricular function, but may aggravate mitral valve insufficiency.	IIIB
271	Mekiš D, Kamenik M. Influence of body position on hemodynamics in patients with ischemic heart disease undergoing cardiac surgery. <i>Wien Klin Wochenschr</i> . 2010;122(SUPPL. 2): 59-62.	Nonexperimental	16/Patients with ischemic heart disease and poor ventricular function undergoing coronary artery bypass graft surgery	N/A	N/A	Differences in hemodynamic measurements	There was a hemodynamic response similar to hemorrhage after placing the patients in 20° reverse Trendelenburg and improved hemodynamics in the Trendelenburg position.	IIIB
272	Wen T, Deibert CM, Siringo FS, Spencer BA. Positioning-related complications of minimally invasive radical prostatectomies. <i>Journal of Endourology</i> . 2014;28(6): 660-667.	Nonexperimental	175,699/Patients with a diagnosis of prostate cancer who underwent robotic prostatectomy during the study period	N/A	N/A	Complications associated with positioning	The steep Trendelenburg position used during robotic prostatectomy was not shown to be associated with positioning-related complications	IIIB

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273	Gould C, Cull T, Wu YX, Osmundsen B. Blinded Measure of Trendelenburg Angle in Pelvic Robotic Surgery. <i>Journal of Minimally Invasive Gynecology</i> . 2012;19(4): 465-468.	Quasi-experimental	86/Patients undergoing pelvic robotic surgery	Measurement of angle of Trendelenburg used during procedure	Historical angle of 40°	Degree of Trendelenburg required for adequate visualization	A mean Trendelenburg of 28° was adequate to complete most gynecological robotic procedures	IIB
274	Schramm P, Treiber AH, Berres M, et al. Time course of cerebrovascular autoregulation during extreme Trendelenburg position for robotic-assisted prostatic surgery. <i>Anaesthesia</i> . 2014;69(1): 58-63.	Nonexperimental	23/Male patients undergoing robotic-assisted prostatectomy in the Trendelenburg position	N/A	N/A	Differences in hemodynamic measurements	Cerebrovascular autoregulation deteriorated with longer duration of Trendelenburg position and pneumoperitoneum.	IIIB
275	Kadono Y, Yaegashi H, Machioka K, et al. Cardiovascular and respiratory effects of the degree of head-down angle during robot-assisted laparoscopic radical prostatectomy. <i>The International Journal Of Medical Robotics + Computer Assisted Surgery: MRCAS</i> .	Randomized controlled trial	47/ASA class I patients undergoing retropubic radical prostatectomy or robotic-assisted radical prostatectomy	Robotic-assisted procedure and use of 20°, 25°, or 30° Trendelenburg position	Open procedure in supine position	Effects of Trendelenburg on cardiovascular and respiratory homeostasis	The degree of Trendelenburg affected cardiovascular and respiratory parameters. Pneumoperitoneum with Trendelenburg influenced parameters to a greater degree, with stronger effects in steeper Trendelenburg.	IB
276	Raz O, Boesel TW, Arianayagam M, et al. The effect of the modified Z trendelenburg position on intraocular pressure during robotic assisted laparoscopic radical prostatectomy: a randomized, controlled study. <i>J Urol</i> . 2015;193(4): 1213-1219.	Randomized controlled trial	50/Patients undergoing robotic-assisted radical prostatectomy under general anesthesia	Measurement of intraocular pressure, blood pressure, and endotracheal carbon dioxide in the modified Trendelenburg position at 18 time points	Measurement of intraocular pressure, blood pressure, and endotracheal carbon dioxide in the Trendelenburg position at 18 time points	Differences in measurements	Modifying the Trendelenburg position has a significant positive effect on patient neuro-ocular safety by lowering intraocular pressure and accelerating recovery to normal levels.	IB
277	Shveiky D, Aseff JN, Iglesia CB. Brachial plexus injury after laparoscopic and robotic surgery. <i>Journal of Minimally Invasive Gynecology</i> . 2010;17(4): 414-420.	Expert opinion	N/A	N/A	N/A	N/A	Knowledge of the anatomy and the mechanisms of injury, as well as adhering to recommended prevention measures, will minimize brachial plexus injury.	VB

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278	Addison AB, Inarra E, Watts S. Bilateral otorrhagia: a rare complication of laparoscopic abdominopelvic surgery. <i>BMJ Case Reports</i> . 2014;2014.	Case report	1/80-year-old woman with a history of hypertension, low rectal carcinoma, and no prior otological symptoms admitted for elective abdominoperineal resection	N/A	N/A	N/A	A combination of pneumoperitoneum combined with an extended period of time in the steep Trendelenburg position led to increased intrathoracic cephalic and intracranial pressures resulting in venous congestion and subsequent vascular and tissue injury. The change in position from steep Trendelenburg to supine with resultant sudden increase in venous return may have led to the otological hemorrhage in this patient.	VB
279	Pandey R, Garg R, Darlong V, Punj J, Chandralekha, Kumar A. Unpredicted neurological complications after robotic laparoscopic radical cystectomy and ileal conduit formation in steep trendelenburg position: two case reports. <i>Acta Anaesthesiol Belg</i> . 2010;6	Case report	2/One 60-year-old woman, and one 75-year-old man undergoing robotic-assisted urological procedures in Trendelenburg position	N/A	N/A	N/A	Brain edema is a potential complication of prolonged surgeries in the Trendelenburg position.	VB
280	Pinkney TD, King AJ, Walter C, Wilson TR, Maxwell-Armstrong C, Acheson AG. Raised intraocular pressure (IOP) and perioperative visual loss in laparoscopic colorectal surgery: a catastrophe waiting to happen?	Systematic Review	8/Studies providing data on the actual values of intraocular pressure measurements and a clear indication of patient positioning	N/A	N/A	Increases in intraocular pressure associated with patient position	Patients undergoing laparoscopic colorectal surgery in a prolonged head-down position are likely to experience increased intraocular pressure and are thus at risk of perioperative vision loss. Patients having a laparoscopic abdominoperineal excision with prone positioning for the perineal component are likely those at greatest risk.	IIIB
281	Mizrahi H, Hugkulstone CE, Vyakarnam P, Parker MC. Bilateral ischaemic optic neuropathy following laparoscopic proctocolectomy: a case report. <i>Ann R Coll Surg Engl</i> . 2011;93(5): e53-4.	Case report	1/58-year-old man undergoing proctocolectomy in the Lloyd-Davies position	N/A	N/A	N/A	In prolonged laparoscopic procedures, short periods of leveling the OR bed with a release of pneumoperitoneum may help prevent ocular complications.	VB
282	Kumar G, Vyakarnam P. Postoperative vision loss after colorectal laparoscopic surgery. <i>Surg Laparosc Endosc Percutan Tech</i> . 2013;23(2): e87-8.	Case report	1/57-year-old man undergoing laparoscopic low anterior resection with end-colostomy for treatment of rectosigmoidal adenocarcinoma	N/A	N/A	N/A	This case demonstrates the association between postoperative loss of vision and laparoscopic surgery with prolonged Trendelenburg position.	VB

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283	Nuzzi R, Tridico F. Ocular Complications in Laparoscopic Surgery: Review of Existing Literature and Possible Prevention and Treatment. <i>Semin Ophthalmol</i> . 2015.	Literature review	N/A	N/A	N/A	N/A	A collaborative approach is recommended to prevent and manage ocular complications related to laparoscopic surgery.	VB
284	Codd RJ, Evans MD, Sagar PM, Williams GL. A systematic review of peripheral nerve injury following laparoscopic colorectal surgery. <i>Colorectal Disease</i> . 2013;15(3): 278-282.	Systematic review	8/Studies with a total of 10 cases of peripheral nerve injury following laparoscopic colorectal surgery	N/A	N/A	Postoperative nerve injury/ Duration of operation/ Position of patient/ Outcome of nerve injury	The surgeon and surgical team must be aware of the risk of peripheral nerve injury when positioning patients for laparoscopic colorectal procedures.	IIIB
285	Mattei A, Di Pierro GB, Rafeld V, Konrad C, Beutler J, Danuser H. Positioning injury, rhabdomyolysis, and serum creatine kinase-concentration course in patients undergoing robot-assisted radical prostatectomy and extended pelvic lymph node dissection. <i>Journal of Endourology</i> . 2013;27(1):45-51.	Nonexperimental	60/Patients undergoing robotic-assisted radical prostatectomy and extended pelvic lymph node dissection	N/A	N/A	Positioning injury and rhabdomyolysis	Clinically relevant positioning injuries and rhabdomyolysis can occur in patients who are subjected to prolonged extreme Trendelenburg position during robotic-assisted radical prostatectomy and extended pelvic lymph node dissection.	IIIB
286	Klauschie J, Wechter ME, Jacob K, et al. Use of anti-skid material and patient-positioning to prevent patient shifting during robotic-assisted gynecologic procedures.. <i>Journal of Minimally Invasive Gynecology</i> . 2010;17(4): 504-507.	Nonexperimental	22/Women undergoing robotic-assisted gynecological procedures	N/A	N/A	Degree of patient slippage	Minimal patient shifting was observed with the use of the convoluted foam. There was no significant association between patient shifting and BMI or duration of position.	IIIC
287	Talab SS, Elmi A, Sarma J, Barrisford GW, Tabatabaei S. Safety and effectiveness of SAF-R, a novel patient positioning device for robot-assisted pelvic surgery in trendelenburg position. <i>Journal of Endourology</i> . 2016;30(3):286-292.	Nonexperimental	16/Patients undergoing robotic-assisted pelvic surgery in Trendelenburg position	N/A	N/A	Degree of patient slippage	The SAF-R surgical board is a safe, reliable, and timesaving positioning device for patients undergoing robotic pelvic surgery in the Trendelenburg position.	IIIC
288	Wechter ME, Kho RM, Chen AH, Magrina JF, Pettit PD. Preventing slide in Trendelenburg position: Randomized trial comparing foam and gel pads. <i>Journal of Robotic Surgery</i> . 2013;7(3): 267-271.	Randomized controlled trial	60/Women undergoing surgery in the Trendelenburg position	Measurement of degree of patient slippage on the viscoelastic gel pad	Measurement of degree of patient slippage on the convoluted foam pad	Degree of patient slippage	Trendelenburg-related slide is equivalent on either convoluted foam or viscoelastic gel pad.	IA

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289	Nakayama JM, Gerling GJ, Horst KE, Fitz VW, Cantrell LA, Modesitt SC. A simulation study of the factors influencing the risk of intraoperative slipping. <i>Clinical Ovarian and other Gynecologic Cancer</i> . 2015;7(1-2): 24-28.	Nonexperimental	2/Mannequins	N/A	N/A	Degree of mannequin slippage	The combination of operative position, patient weight, and bed surface influence slipping propensity. In lithotomy position, heavier patients were more prone to slip. The inverse was true in supine position. The convoluted foam, vacuum-packed positioning device, and sheet provided the most anti-slip surfaces.	IIIB
290	Hewer CL. The physiology and complications of the trendelenburg position. <i>Can Med Assoc J</i> . 1956;74(4):285-288.	Expert opinion	N/A	N/A	N/A	N/A	Neck and lumbar bolsters may be helpful in preventing sliding in the Trendelenburg position.	VB
291	Kalmar Alain F, Andre M De Wolf, Jan FAHendrickx. Anesthetic Considerations for Robotic Surgery in the Steep Trendelenburg Position. <i>ADV ANESTH</i> . 2012;30: 75-96.	Expert opinion	N/A	N/A	N/A	N/A	The human body has a remarkable, yet incompletely understood capacity to withstand the effects of pneumoperitoneum and steep Trendelenburg position during general anesthesia.	VA
292	Wu C-Y, Yeh Y-C, Wang M-C, Lai C-H, Fan S-Z. Changes in endotracheal tube cuff pressure during laparoscopic surgery in head-up or head-down position. <i>BMC Anesthesiology</i> . 2014;14.	Quasi-experimental	85/Patients undergoing elective abdominal laparoscopic surgery in the Trendelenburg (n = 38), reverse Trendelenburg (n = 32) position, and non-laparoscopic abdominal surgery in the supine position (n = 15)	Measurement of endotracheal tube cuff pressure before and after abdominal insufflation in Trendelenburg and reverse Trendelenburg position	Measurement of endotracheal tube cuff pressure before and after abdominal insufflation in supine position	Differences in measurements	An increase of endotracheal tube cuff pressure may occur during laparoscopic surgery, especially in the Trendelenburg position.	IIB
293	Coppieters MW, Van de Velde M, Stappaerts KH. Positioning in anesthesia: toward a better understanding of stretch-induced perioperative neuropathies. <i>Anesthesiology</i> . 2002;97(1): 75-81.	Quasi-experimental	25/Male volunteers	Brachial plexus tension test in three different positions	Brachial plexus tension test in neutral position	Differences in range of motion/ Differences in pain intensity/ Type of elicited symptoms	Even during careful positioning of all upper limb joints, complete prevention of perioperative neuropathy may not be possible.	IIB
294	Suozzi BA, Brazell HD, O'Sullivan DM, Tulikangas PK. A comparison of shoulder pressure among different patient stabilization techniques. <i>American Journal of Obstetrics & Gynecology</i> . 2013;209(5): 478.e1-478.e5.	Nonexperimental	23/Volunteer participants	N/A	N/A	Differences in pressure measurements	Shoulder pressure increases as the angle of Trendelenburg position increases. Of the three support systems tested, the Allen Hug-u-Vac transmitted less pressure to the shoulders at 30° Trendelenburg position than the other two devices.	IIIB

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295	Devarajan J, Byrd JB, Gong MC, et al. Upper and middle trunk brachial plexopathy after robotic prostatectomy. <i>Anesthesia & Analgesia</i> . 2012;115(4): 867-870.	Case report	3/One 63-year-old man with a BMI of 32 kg/m ² undergoing a 5.5-hour prostatectomy, one 65-year-old man with a BMI of 22 kg/m ² undergoing a 3.4-hour prostatectomy, and one 44-year-old man with a BMI of 23 kg/m ² undergoing a 4-hour prostatectomy	N/A	N/A	N/A	When shoulder restraints are used to secure the patient, the compensatory movement of the shoulder girdle of an abducted arm is impeded. This may result in injurious stretching and compression of the brachial plexus.	VA
296	Eteuati J, Hiscock R, Hastie I, Hayes I, Jones I. Brachial plexopathy in laparoscopic-assisted rectal surgery: a case series. <i>Techniques in Coloproctology</i> . 2013;17(3): 293-297.	Case report	5/One 32-year-old female, one 21-year-old female, one 77-year-old male, one 62-year-old male, and one 41-year-old male undergoing laparoscopic surgery	N/A	N/A	N/A	Patients undergoing laparoscopic-assisted anterior resection are placed in the Lloyd-Davies position with both arms at the side.	VB
297	Vaughan RW, Wise L. Intraoperative arterial oxygenation in obese patients. <i>Ann Surg</i> . 1976;184(1):35-42.	Quasi-experimental	64/Extremely obese patients undergoing jejunoileal bypass in the supine and 15° Trendelenburg position	Measurement of arterial oxygenation in the 15° Trendelenburg position	Measurement of arterial oxygenation in the supine position	Differences in arterial oxygenation measurements	The Trendelenburg position should not be used with obese patients.	IIB
298	An J, Shin SK, Kwon J-Y, Kim KJ. Incidence of venous air embolism during myomectomy: The effect of patient position. <i>Yonsei Med J</i> . 2013;54(1): 209-214.	Randomized controlled trial	84/Female patients, class ASA I or II, undergoing myomectomy	Measurement of the degree of VAE in the 10° reverse Trendelenburg position	Measurement of the degree of VAE in the supine position	Incidence and grade of VAE	The incidence and grade of VAE in the 10° reverse Trendelenburg group were significantly lower than those in the supine group during abdominal myomectomy.	IA
299	Ghai A, Saini S, Kiran S, Kamal K, Kad N, Bhawna. Influence of lithotomy position on the haemodynamic changes in patients with coronary artery disease. <i>Journal of Anaesthesiology Clinical Pharmacology</i> . 2008;24(3): 359-360.	Case report	1/78-year-old male patient, ASA class II, undergoing a cystoscopy	N/A	N/A	N/A	During lithotomy position, the elevation of the patient's legs autotransfuses as much as 1500 mL of blood from the periphery to the central circulation. Patients with severe pre-existing depressed cardiac function may not tolerate such acute variations of myocardial preload.	VB
300	Roeder RA, Geddes LA, Corson N, Pell C, Otlewski M, Kemeny A. Heel and calf capillary-support: pressure in lithotomy positions. <i>AORN J</i> . 2005;81(4): 821-2, 824-7, 830.	Nonexperimental	46/Adult participants	N/A	N/A	Differences in ankle blood pressure measurements	Support pressure for the heel is greater than capillary perfusion pressure when patients are lying flat, and the support pressure increases as the elevation of the lithotomy position increases.	IIB
301	Wilde S. Compartment syndrome. The silent danger related to patient positioning and surgery. <i>Br J Perioper Nurs</i> . 2004;14(12): 546-550.	Expert opinion	N/A	N/A	N/A	N/A	Perioperative team members involved in prolonged surgical procedures should ensure that the patient is not positioned in unnatural positions for longer than is absolutely necessary.	VC

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
302	Bauer EC, Koch N, Janni W, Bender HG, Fleisch MC. Compartment syndrome after gynecologic operations: evidence from case reports and reviews. <i>European Journal of Obstetrics, Gynecology, & Reproductive Biology</i> . 2014;173: 7-12.	Literature review	N/A	N/A	N/A	N/A	Diagnosis of compartment syndrome is often delayed due to a lack of knowledge of the condition and its signs and symptoms.	VA
303	Karmanioliou I, Staikou C. Compartment syndrome as a complication of the lithotomy position. <i>West Indian Med J</i> . 2010;59(6): 698-701.	Expert opinion	N/A	N/A	N/A	N/A	Measures for preventing compartment syndrome include careful placement of the patient's legs and limited degrees of leg elevation.	VA
304	Rao MM, Jayne D. Lower limb compartment syndrome following laparoscopic colorectal surgery: a review. <i>Colorectal Disease</i> . 2011;13(5): 494-499.	Literature review	N/A	N/A	N/A	N/A	Preventive measures are identified that may help reduce the incidence of acute lower limb compartment syndrome.	VB
305	Pridgeon S, Bishop CV, Adshead J. Lower limb compartment syndrome as a complication of robot-assisted radical prostatectomy: The UK experience. <i>BJU Int</i> . 2013;112(4): 485-488.	Nonexperimental-Survey	17 of 22/Urology units from the United Kingdom	N/A	N/A	Incidence of lower limb compartment syndrome events/ Identification of risk factors for compartment syndrome	Long operating times, surgical inexperience, poor patient positioning, obesity, and vascular disease appear to be risk factors for compartment syndrome.	IIIB
306	Raza A, Byrne D, Townell N. Lower limb (well leg) compartment syndrome after urological pelvic surgery. <i>J Urol</i> . 2004;171(1): 5-11.	Literature review	N/A	N/A	N/A	N/A	Perioperative team members should remain vigilant during the procedure to prevent patient injury.	VB
307	Bauer EC, Koch N, Erichsen CJ, et al. Survey of compartment syndrome of the lower extremity after gynecological operations. <i>Langenbecks Archives of Surgery</i> . 2014;399(3): 343-348.	Nonexperimental-Survey	59 of 168/Gynecological departments in Germany	N/A	N/A	Cases of compartment syndrome	Compartment syndrome is clearly associated with long lasting gynecological operations in lithotomy position.	IIIB
308	Chin KY, Hemington-Gorse SJ, Darcy CM. Bilateral well leg compartment syndrome associated with lithotomy (Lloyd Davies) position during gastrointestinal surgery: a case report and review of literature. <i>Eplasty</i> . 2009;9: e48.	Case report	1/44-year-old woman with ulcerative colitis undergoing proctectomy, pouch formation, and ileostomy	N/A	N/A	N/A	Clinicians should be aware of the risk factors for developing well-leg compartment syndrome and assess patients for these risks.	VB

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309	Galyon SW, Richards KA, Pettus JA, Bodin SG. Three-limb compartment syndrome and rhabdomyolysis after robotic cystoprostatectomy. <i>J Clin Anesth</i> . 2011;23(1): 75-78.	Case report	1/53-year-old man, ASA class III, undergoing laparoscopic-assisted cystoprostatectomy	N/A	N/A	N/A	The risk of well-limb compartment syndrome may be reduced by selective patient choice, limiting lithotomy-Trendelenburg and overall operating time, careful maintenance of limb perfusion, and avoidance of compression stockings.	VB
310	Awab A, El Mansoury D, Benkabbou A, et al. Acute compartment syndrome following laparoscopic colorectal surgery. <i>Colorectal Disease</i> . 2012;14(2): e76.	Case report	2/One 55-year-old woman, and one 74-year-old man undergoing laparoscopic colorectal surgery	N/A	N/A	N/A	The extended duration of the procedure, the position, and the quality of the OR bed appear to be the determinants for compartment syndrome.	VC
311	Keene R, Froelich JM, Milbrandt JC, Idusuyi OB. Bilateral gluteal compartment syndrome following robotic-assisted prostatectomy. <i>Orthopedics</i> . 2010;33(11): 852.	Case report	1/61-year-old man who underwent prolonged urological surgery in the lithotomy position	N/A	N/A	N/A	Prevention of gluteal compartment syndrome should focus on padding, intraoperative repositioning, and restricting the length of the procedure.	VA
312	Raman SR, Jamil Z. Well leg compartment syndrome after robotic prostatectomy: A word of caution. <i>Journal of Robotic Surgery</i> . 2009;3(2): 105-107.	Case report	1/45-year-old male undergoing robotic prostatectomy in the lithotomy position under general anesthesia	N/A	N/A	N/A	Patients should be placed in the lithotomy position with minimal elevation of the ankles above the level of the heart. The duration of Trendelenburg position with lithotomy should be minimized.	VB
313	Enomoto T, Ohara Y, Yamamoto M, Oda T, Ohkohchi N. Well leg compartment syndrome after surgery for ulcerative colitis. <i>International Journal of Surgery Case Reports</i> . 2016;23:25-28.	Case report	1/28-year-old man undergoing surgery for ulcerative colitis in the lithotomy position	N/A	N/A	N/A	A risk factor for development of compartment syndrome is prolonged time in the high lithotomy position. Consideration should be given to lowering the patient's legs during the operation.	VA
314	Oman SA, Schwarz D, Muntz HG. Lower limb compartment syndrome as a complication of radical hysterectomy. <i>Gynecologic Oncology Reports</i> . 2016;16:39-41.	Case report	1/39-year-old woman undergoing robotic-assisted laparoscopic radical hysterectomy	N/A	N/A	N/A	Risk reduction strategies for preventing compartment syndrome should be incorporated into the positioning plan.	VA
315	Stornelli N, Wydra FB, Mitchell JJ, Stahel PF, Fabbri S. The dangers of lithotomy positioning in the operating room: Case report of bilateral lower extremity compartment syndrome after a 90-minutes surgical procedure. <i>Patient Safety in Surgery</i> . 2016;10:18.	Case report	1/23-year-old female undergoing laparoscopic salpingectomy for a ruptured ectopic pregnancy	N/A	N/A	N/A	Diligence is necessary to prevent compartment syndrome when implementing the lithotomy position.	VA

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316	Koç G, Tazeh NN, Joudi FN, Winfield HN, Tracy CR, Brown JA. Lower extremity neuropathies after robot-assisted laparoscopic prostatectomy on a split-leg table. <i>Journal of Endourology</i> . 2012;26(8): 1026-1029.	Nonexperimental	377/Patients undergoing robotic-assisted laparoscopic prostatectomy using a split-leg table	N/A	N/A	Development of lower extremity neuropathy	Intraoperative time was found to be a significant risk factor for predicting postoperative neuropathy. Split-leg positioning appears to put the femoral nerve at risk for injury.	IIIA
317	Chikazawa K, Netsu S, Akashi K, Suzuki Y, Konno R, Motomatsu S. Delayed diagnosis of single compartment muscle contusion after radical hysterectomy in the lithotomy position: A case report. <i>International Journal of Surgery Case Reports</i> . 2016;26:199-201.	Case report	1/50-year-old woman undergoing radical hysterectomy in the lithotomy position	N/A	N/A	N/A	The duration of compression of the lower legs was sufficient through the use of serial compression stockings and intermittent pneumatic compression devices to cause a muscle contusion.	VB
318	Lawrenz B, Kraemer B, Wallwiener D, Witte M, Fehm T, Becker S. Lower extremity compartment syndrome after laparoscopic radical hysterectomy: brief report of an unusual complication of laparoscopic positioning requirements.	Case report	1/30-year-old woman undergoing laparoscopic hysterectomy	N/A	N/A	N/A	All perioperative team members must be aware of the potential for compartment syndrome to occur postoperatively and take measures to prevent it.	VB
319	Boesgaard-Kjer DH, Boesgaard-Kjer D, Kjer JJ. Well-leg compartment syndrome after gynecological laparoscopic surgery. <i>Acta Obstet Gynecol Scand</i> . 2013;92(5): 598-600.	Case report	2/One 45-year-old woman with a BMI of 47 kg/m ² , and one 32-year-old woman with a BMI of 41 kg/m ² undergoing laparoscopic gynecologic surgery	N/A	N/A	N/A	Several circumstances predispose to this condition as a consequence of increased intra-compartmental pressure, including positioning of the legs, a prolonged operation, and external compression and vascular insults.	VB
320	Ulrich D, Bader AA, Zotter M, Koch H, Pristauz G, Tamussino K. Well-leg compartment syndrome after surgery for gynecologic cancer. <i>J Gynecol Surg</i> . 2010;26(4): 261-262.	Case report	1/38-year-old woman undergoing gynecologic surgery in the lithotomy position	N/A	N/A	N/A	The cause of the compartment syndrome in this patient was likely multifactorial. Injury of the right iliac artery may have contributed to ischemia in combination with the prolonged surgery time in lithotomy and Trendelenburg position.	VC
321	Nakamura K, Aoki H, Hirakawa T, Murata T, Kanuma T, Minegishi T. Compartment syndrome with thrombosis of common iliac artery after gynecologic surgery. <i>Obstetrics & Gynecology</i> . 2008;112(2 Pt 2): 486-488.	Case report	1/34-year-old woman undergoing radical hysterectomy with pelvic and para-aortic lymph node resection in the lithotomy position	N/A	N/A	N/A	The lithotomy position may cause insufficient arterial circulation in both the pelvis and the legs.	VB

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322	Yang RH, Chu YK, Huang CW. Compartment syndrome following robotic-assisted prostatectomy: rhabdomyolysis in bone scintigraphy. <i>Clin Nucl Med</i> . 2013;38(5): 365-366.	Case report	1/56-year-old man undergoing robotic assisted prostatectomy in the lithotomy position	N/A	N/A	N/A	Prolonged or exaggerated lithotomy position is likely to expose patients to the risk of rhabdomyolysis and acute renal failure. Prolonged surgery is the most important risk factor for such complications.	VC
323	Guella A, Al Oraifi I. Rhabdomyolysis and acute renal failure following prolonged surgery in the lithotomy position. <i>Saudi Journal of Kidney Diseases & Transplantation</i> . 2013;24(2): 330-332.	Case report	1/80-year-old man undergoing cystoscopy and cystolitholapaxy	N/A	N/A	N/A	Rhabdomyolysis and acute renal failure can develop and prolonged surgery is the most important risk factor for such complications.	VB
324	Sadeghian H, Arasteh H, Motiei-Langroudi R. Bilateral femoral neuropathy after transurethral lithotomy in the lithotomy position: Report of a case. <i>Journal of Clinical Neuromuscular Disease</i> . 2016;17(4):225-226.	Case report	1/20-year-old man undergoing transurethral lithotomy in the lithotomy position	N/A	N/A	N/A	Even in short procedures special care should be used for positioning.	VB
325	Mizuno J, Takahashi T. Male sex, height, weight, and body mass index can increase external pressure to calf region using knee-crutch-type leg holder system in lithotomy position. <i>THE CLIN RISK MANAGE</i> . 2016;12:305-312.	Nonexperimental	21/Healthy volunteers	N/A	N/A	Differences in external pressure measurements	External pressure applied to the calf region is higher in males than in females when supported by a knee crutch leg holder. External pressure increases with increase in height, weight, and BMI.	IIIB
326	Hsu K-L, Chang C-W, Lin C-J, Chang C-H, Su W-R, Chen S-M. The dangers of hemilithotomy positioning on traction tables: Case report of a well-leg drop foot after contralateral femoral nailing. <i>Patient Safety in Surgery</i> . 2015.	Case report	1/28-year-old woman undergoing femoral nailing in hemi-lithotomy position	N/A	N/A	N/A	This case highlights the need to monitor patient positioning even during the most common orthopedic procedures. The authors recommend repositioning the patient's extremities at regular intervals during prolonged procedures.	VB
327	Noordin S, Allana S, Wajid. Well leg compartment syndrome: the debit side of hemilithotomy position. <i>Journal of Ayub Medical College, Abbottabad: JAMC</i> . 2009;21(1): 166-168.	Case report	1/35-year-old man undergoing orthopedic surgery in hemilithotomy position on a fracture table	N/A	N/A	N/A	Positions other than hemi-lithotomy should be used whenever possible.	VA

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328	Sajid MS, Shakir AJ, Khatri K, Baig MK. Lithotomy-related neurovascular complications in the lower limbs after colorectal surgery. <i>Colorectal Disease</i> . 2011;13(11): 1203-1213.	Literature review	N/A	N/A	N/A	N/A	Measures should be taken to reduce the risk of compartment syndrome in patients undergoing prolonged colorectal surgery in the lithotomy position.	VB
329	Sharma N, Doble A. A case of compartment syndrome of the thighs following urethroplasty. <i>British Journal of Medical and Surgical Urology</i> . 2009;2(2): 82-84.	Case report	1/36-year old man undergoing urethroplasty in the exaggerated lithotomy position	N/A	N/A	N/A	Reducing the time the patient is in lithotomy position is critical in reducing the risk of compartment syndrome.	VB
330	Sharma N, Doble A. Response to the letter to the editor 'Well leg compartment syndrome following radical cystectomy and urinary diversion in the supine position. <i>British Journal of Medical and Surgical Urology</i> . 2009;2(6): 260.	Expert opinion	N/A	N/A	N/A	N/A	Perioperative team members should alert the surgeon of the time the patient's legs have been elevated. It may appropriate in cases with prolonged leg elevation to lower the legs to a horizontal position after two hours to allow reperfusion and for the pedal pulses to be checked.	VB
331	Bradshaw AD, Advincula AP. Postoperative neuropathy in gynecologic surgery. <i>Obstetrics & Gynecology Clinics of North America</i> . 2010;37(3): 451-459.	Expert opinion	N/A	N/A	N/A	N/A	Perioperative team members should be familiar with the location of the nerves that are at greatest risk of injury during gynecologic surgery.	VB
332	Mizuno J, Takahashi T. Factors that increase external pressure to the fibular head region, but not medial region, during use of a knee-crutch/leg-holder system in the lithotomy position. <i>Therapeutics & Clinical Risk Management</i> . 2015;11: 255-261.	Nonexperimental	21/Healthy volunteers	N/A	N/A	Differences in external pressure measurements	The external pressure to the fibular head increases with increasing weight, BMI, and fibular head circumference.	IIIB
333	Wilson M, Ramage L, Yoong W, Swinhoe J. Femoral neuropathy after vaginal surgery: a complication of the lithotomy position. <i>Journal of Obstetrics & Gynaecology</i> . 2011;31(1): 90-91.	Case report	2/One 41-year-old woman, and one 65-year-old woman undergoing gynecological procedures in the lithotomy position	N/A	N/A	N/A	Lithotomy position should be maintained with moderate flexion and minimal abduction and external rotation at the hip. Moreover, assistants should not lean against the inner thigh of the patient during the procedure, as this can cause external hip rotation.	VB

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334	Tondare AS, Nadkarni AV, Sathe CH, Dave VB. Femoral neuropathy: A complication of lithotomy position under spinal anesthesia. <i>Can Anaesth Soc J</i> . 1983;30(1):84-86.	Case report	3/Patients undergoing vaginal hysterectomy in the lithotomy position	N/A	N/A	N/A	Extreme abduction or external rotation of the hip can lead to ischemia of the femoral nerve as it is kinked beneath the inguinal ligament.	VB
335	Pannucci CJ, Henke PK, Cederna PS, et al. The effect of increased hip flexion using stirrups on lower-extremity venous flow: a prospective observational study. <i>Am J Surg</i> . 2011;202(4): 427-432.	Nonexperimental	12/Healthy patients	N/A	N/A	Improved venous flow	Intraoperative positioning of lower extremities represents a modifiable risk factor for DVT. When stirrups are used, hip flexion of 90° maximizes drainage from the legs.	IIIB
336	Navarro-Vicente F, Garcia-Granero A, Frasson M, et al. Prospective evaluation of intraoperative peripheral nerve injury in colorectal surgery. <i>Colorectal Disease</i> . 2012;14(3): 382-385.	Nonexperimental	8/Patients who experienced intraoperative nerve injury	N/A	N/A	Common elements related to nerve injury	Adequate positioning and safe use of positioning devices may prevent intraoperative peripheral nerve injury during laparoscopic procedures.	IIIB
337	Yamada Y, Fujimura T, Fukuhara H, et al. Measuring contact pressure of lower extremities in patients undergoing robot-assisted radical prostatectomy. <i>Urol Int</i> . 2016;96(3):268-273.	Nonexperimental	138/Patients undergoing robotic-assisted radical prostatectomy in the lithotomy position	N/A	N/A	Differences in contact pressure measurements of lower extremities	The contact pressure of the lower extremities increased after robotic-assisted radical prostatectomy and the increase was correlated with BMI.	IIIB
338	Vijay MK, Vijay P, Kundu AK. Rhabdomyolysis and myoglobinuric acute renal failure in the lithotomy/exaggerated lithotomy position of urogenital surgeries. <i>Urology annals</i> . 2011;3(3): 147-150.	Case report	4/Patients undergoing urethroplasty in the lithotomy position	N/A	N/A	N/A	The duration of surgery is the most important factor affecting development of rhabdomyolysis and acute renal failure.	VC
339	Liu X, Wang X, Meng X, Wang H, An Z. Effects of patient position on lower extremity venous pressure during different types of hysterectomy. <i>Journal of Obstetrics & Gynaecology Research</i> . 2015;41(1): 114-119.	Nonexperimental	99/Female patients undergoing hysterectomy	N/A	N/A	Changes in venous pressure measurements	Modified lithotomy position and conventional lithotomy position in combination with pneumoperitoneum may result in increased lower extremity venous pressure during hysterectomy. Elevated pressure can be altered by changing intraoperative position.	IIIB

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340	AORN guidance statement: Safe patient handling and movement in the perioperative setting. In: <i>Guidelines for perioperative practice</i> . Denver, CO: AORN, Inc.; 2015:733-753.	Clinical practice guideline	N/A	N/A	N/A	N/A	The recommendations in this guideline were developed with the goal of reducing job-related musculoskeletal disorders in perioperative nurses.	IVB
341	Pearce A. Bilateral lower limb compartment syndrome following radical cystectomy and urinary diversion in the supine position. <i>British Journal of Medical and Surgical Urology</i> . 2009;2(6): 258-259.	Case report	1/62-year-old man in the supine position	N/A	N/A	N/A	The intermittent reperfusion of muscles associated with the cycling of sequential compression devices may exacerbate compartment syndrome by worsening extravasation through damaged endothelium and increasing compartment pressures.	VB
342	Pfeffer SD, Halliwill JR, Warner MA. Effects of lithotomy position and external compression on lower leg muscle compartment pressure.see comment. <i>Anesthesiology</i> . 2001;95(3): 632-636.	Nonexperimental	25/Healthy volunteers	N/A	N/A	Changes in intracompartmental pressure measurements	Lithotomy position is associated with changes in intracompartmental pressure that is dependent upon the method of leg support used. Intermittent external compression can reduce intracompartmental pressure during surgery in the lithotomy position.	IIIB
343	Chung JH, Ahn KR, Park JH, et al. Lower leg compartment syndrome following prolonged orthopedic surgery in the lithotomy position - A case report. <i>Korean Journal of Anesthesiology</i> . 2010;59(Suppl): S49-52.	Case report	1/20-year-old male patient undergoing arthroscopic surgery of the right knee	N/A	N/A	N/A	To avoid compartment syndrome in an operation performed in the lithotomy position, the intraoperative blood pressure should not be significantly reduced, external pressure should be avoided by use of padding, the leg position should be kept at the level of the atrium, the duration of the procedure should be reduced as much as possible, and the patient should be continuously monitored.	VA
344	Meyer RS, White KK, Smith JM, Groppo ER, Mubarak SJ, Hargens AR. Intramuscular and blood pressures in legs positioned in the hemilithotomy position : Clarification of risk factors for well-leg acute compartment syndrome. <i>J Bone Joint Surg Am</i> . 2002;84-A(10):1829-1835.	Nonexperimental	8/Volunteers positioned on a fracture table	N/A	N/A	Differences in intramuscular pressures	The hemi-lithotomy position creates a risk of compartment syndrome.	IIIB

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345	Tan V, Pepe MD, Glaser DL, Seldes RM, Heppenstall RB, Esterhai JL, Jr. Well-leg compartment pressures during hemilithotomy position for fracture fixation. <i>J Orthop Trauma</i> . 2000;14(3):157-161.	Nonexperimental	10/Patients undergoing intramedullary nailing of a fractured femur in the hemilithotomy position	N/A	N/A	Differences in calf compartment pressure measurements	The use of the well leg holder to maintain hemi-lithotomy position increases the calf compartment pressures significantly. This position should be avoided.	IIIB
346	Peruto CM, Ciccotti MG, Cohen SB. Shoulder arthroscopy positioning: lateral decubitus versus beach chair. <i>Arthroscopy</i> . 2009;25(8): 891-896.	Expert opinion	N/A	N/A	N/A	N/A	The lateral position puts neurovascular structures at greater risk than the semi-sitting position. The risk of cardiovascular complications is greater for patients in the semi-sitting position than the lateral position, with hypertension and obesity further increasing those risks.	VA
347	Li X, Eichinger JK, Hartshorn T, Zhou H, Matzkin EG, Warner JP. A comparison of the lateral decubitus and beach-chair positions for shoulder surgery: advantages and complications. <i>J Am Acad Orthop Surg</i> . 2015;23(1): 18-28.	Expert opinion	N/A	N/A	N/A	N/A	Complications associated with the semi-sitting position include cervical hypoperfusion, cervical traction neuropraxia, blindness, and cardiac and embolic events. Complications associated with the lateral position include traction injuries, thromboembolic events, difficulty with airway management, and the need to convert to an open procedure.	VA
348	Lindroos AC, Niiya T, Randell T, Romani R, Hernesniemi J, Niemi T. Sitting position for removal of pineal region lesions: the Helsinki experience. <i>World Neurosurgery</i> . 2010;74(4-5): 505-513.	Nonexperimental	72/Anesthesiology reports of pineal region tumor surgery using the supracerebellar approach in the sitting position	N/A	N/A	Incidence of VAE and hemodynamic stability	There is a risk of hypotension and VAE in the sitting position.	IIIB
349	Gardner BM. The beach chair position. <i>South African Family Practice</i> . 2015;57(2): S6-S9.	Expert opinion	N/A	N/A	N/A	N/A	The semi-sitting position is commonly used for shoulder surgery. Avoiding the potentially catastrophic complications of cerebrovascular events that may occur requires vigilance and meticulous attention to detail.	VA
350	Cogan A, Boyer P, Soubeyrand M, Hamida FB, Vannier JL, Massin P. Cranial nerves neuropraxia after shoulder arthroscopy in beach chair position. <i>Orthopaedics & traumatology, surgery & research</i> . 2011;97(3): 345-348.	Case report	1/66-year-old man undergoing arthroscopic rotator cuff repair in the semi-sitting position	N/A	N/A	N/A	There are neurological risks associated with the semi-sitting position and precautions should be implemented to prevent complications.	VB

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351	Basaldella L, Orotolani V, Corbanese U, Sorbara C, Longatti P. Massive venous air embolism in the semi-sitting position during surgery for a cervical spinal cord tumor: anatomic and surgical pitfalls. <i>Journal of Clinical Neuroscience</i> . 2009;16(7): 972-975.	Case report	1/52-year-old man placed in the semi-sitting position for removal of a spinal cord tumor	N/A	N/A	N/A	The procedure was interrupted by a massive VAE that was effectively managed by the surgical team.	VC
352	Dilmen OK, Akcil EF, Tureci E, et al. Neurosurgery in the sitting position: retrospective analysis of 692 adult and pediatric cases.. <i>Turkish Neurosurgery</i> . 2011;21(4): 634-640.	Nonexperimental	692/Adults (n = 601) and pediatric patients (n = 91) undergoing neurosurgery in the sitting position	N/A	N/A	Incidence of VAE	Results suggest that if the sitting position is a neurosurgical necessity it can be used with vigilant attention to detect any occurrence of VAE using end tidal carbon dioxide monitoring.	IIIB
353	Friedman DJ, Parnes NZ, Zimmer Z, Higgins LD, Warner JJ. Prevalence of cerebrovascular events during shoulder surgery and association with patient position. <i>Orthopedics</i> . 2009;32(4).	Nonexperimental	93/Members of the American Shoulder and Elbow Surgeons Society	N/A	N/A	Cerebrovascular events in the semi-sitting and lateral positions	No significant differences were observed in the number of cerebrovascular events between positions.	IIIC
354	Meex I, Genbrugge C, De Deyne C, Jans F. Cerebral tissue oxygen saturation during arthroscopic shoulder surgery in the beach chair and lateral decubitus position. <i>Acta Anaesthesiol Belg</i> . 2015;66(1): 11-17.	Expert opinion	N/A	N/A	N/A	N/A	Near infrared spectroscopy may be useful to provide early warning signs of cerebral hypoperfusion.	VA
355	Lee SW, Choi SE, Han JH, Park SW, Kang WJ, Choi YK. Effect of beach chair position on bispectral index values during arthroscopic shoulder surgery. <i>Korean Journal of Anesthesiology</i> . 2014;67(4): 235-239.	Nonexperimental	30/Patients undergoing arthroscopic shoulder surgery	N/A	N/A	Differences in bispectral index measurements associated with position change	Bispectral index measurements are significantly decreased in the semi-sitting position compared with the supine position, and this might affect interpretation of the depth of anesthesia.	IIIB
356	Pant S, Bokor DJ, Low AK. Cerebral oxygenation using near-infrared spectroscopy in the beach-chair position during shoulder arthroscopy under general anesthesia. <i>Arthroscopy</i> . 2014;30(11): 1520-1527.	Systematic Review	9/Articles	N/A	N/A	Correlation between cerebral desaturation events and the semi-sitting position	There was a strong correlation between cerebral desaturation events and degree of elevation in the semi-sitting position as measured by near-infrared spectroscopy.	IIIB

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
357	Mazzon D, Danelli G, Poole D, et al. Beach chair position, general anesthesia and deliberate hypotension during shoulder surgery. <i>Minerva Anesthesiol</i> . 2009;75(5): 281-282.	Expert opinion	N/A	N/A	N/A	N/A	It is advisable to limit the semi-sitting position during general anesthesia to 45° while avoiding deliberate hypotension and maintaining normal blood pressure.	VB
358	Moerman AT, De Hert SG, Jacobs TF, De Wilde LF, Wouters PF. Cerebral oxygen desaturation during beach chair position. <i>Eur J Anaesthesiol</i> . 2012;29(2): 82-87.	Nonexperimental	20/Consecutive adult patients undergoing elective shoulder surgery under general anesthesia	N/A	N/A	Differences in oxygen saturation measurements	The prevalence for significant cerebral oxygen desaturation during shoulder surgery in the semi-sitting position underlines the need for close monitoring.	IIIB
359	Triplet JJ, Lonetta CM, Levy JC, Everding NG, Moor MA. Cerebral desaturation events in the beach chair position: correlation of noninvasive blood pressure and estimated temporal mean arterial pressure. <i>Journal of Shoulder & Elbow Surgery</i> . 2015;24(1): 133	Nonexperimental	57/Patients undergoing arthroscopic shoulder surgery in the semi-sitting position	N/A	N/A	Correlations between blood pressure and arterial pressure measurements with cerebral desaturation events	Brachial noninvasive blood pressure and estimated temporal mean arterial pressure are unreliable methods for identifying cerebral desaturation events in the semi-sitting position.	IIIB
360	Murphy GS, Szokol JW, Marymont JH, et al. Cerebral oxygen desaturation events assessed by near-infrared spectroscopy during shoulder arthroscopy in the beach chair and lateral decubitus positions. <i>Anesthesia & Analgesia</i> . 2010;111(2): 496-505.	Nonexperimental	124/Patients undergoing elective shoulder surgery in the semi-sitting (n = 61) and lateral (n = 63) position	N/A	N/A	Number of cerebral desaturation events	Shoulder surgery in the semi-sitting position is associated with significant reductions in cerebral oxygenation compared with the lateral position.	IIIB
361	Meex I, Vundelinckx J, Buyse K, et al. Cerebral tissue oxygen saturation values in volunteers and patients in the lateral decubitus and beach chair positions: A prospective observational study. <i>Can J Anaesth</i> . 2016;63(5):537-543.	Nonexperimental	85/Volunteers	N/A	N/A	Changes in cerebral tissue oxygen saturation measurements	More than 55% of patients undergoing arthroscopic shoulder surgery in the semi-sitting position experience cerebral desaturation events. In volunteers without anesthesia, no desaturation events were observed.	IIIB

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362	Salazar D, Hazel A, Tauchen AJ, Sears BW, Marra G. Neurocognitive deficits and cerebral desaturation during shoulder arthroscopy with patient in beach-chair position: A review of the current literature. <i>American Journal of Orthopedics</i> . 2016;45(3):E63-8.	Systematic review	10/Studies	N/A	N/A	Cerebral desaturation events/ Neurocognitive deficits	Incidence of reported intraoperative cerebral desaturation events varied significantly. There was only one case of a postoperative neurocognitive deficit.	IIIB
363	Dippmann C, Winge S, Nielsen HB. Severe cerebral desaturation during shoulder arthroscopy in the beach-chair position. <i>Arthroscopy</i> . 2010;26(9 Suppl): S148-50.	Case report	2/One 46-year-old man, and one 58-year-old man undergoing arthroscopic shoulder surgery	N/A	N/A	N/A	During surgery in the semi-sitting position, hypotension must be avoided, and cerebral oxygenation should be monitored in all patients.	VB
364	Salazar D, Sears B, Acosta A, et al. Effect of head and neck positioning on cerebral perfusion during shoulder arthroscopy in beach chair position. <i>Journal of Surgical Orthopaedic Advances</i> . 2014;23(2): 83-89.	Nonexperimental	51/Consecutive patients undergoing arthroscopic shoulder surgery in the semi-sitting position	N/A	N/A	Differences in cerebral desaturation measurements	Frequent evaluations of the head and neck position as well as careful positioning may reduced the risk of position-related complications.	IIIB
365	Laflam A, Joshi B, Brady K, et al. Shoulder surgery in the beach chair position is associated with diminished cerebral autoregulation but no differences in postoperative cognition or brain injury biomarker levels compared with supine positioning: the anes	Nonexperimental	218/Patients undergoing shoulder surgery	N/A	N/A	Differences in cerebral oximetry index measurements	Patients undergoing surgery in the semi-sitting position are more likely to have a higher cerebral oximetry index indicating diminished cerebral autoregulation than those in the lateral position	IIIB
366	Hanouz J, Fiant A, Gérard J. Middle cerebral artery blood flow velocity during beach chair position for shoulder surgery under general anesthesia. <i>J Clin Anesth</i> . 2016;33:31-36.	Nonexperimental	53/Consecutive patients undergoing shoulder surgery under general anesthesia in the semi-sitting position	N/A	N/A	Differences in cerebral artery velocity measurements	Semi-sitting position resulted in a transient decrease in mean arterial pressure requiring fluid challenge and vasopressors and a moderate decrease in middle cerebral artery blood flow velocity.	IIIB
367	Buget MI, Atalar AC, Edipoglu IS, et al. Patient state index and cerebral blood flow changes during shoulder arthroscopy in beach chair position. <i>Brazilian Journal of Anesthesiology</i> . 2016;66(5):470-474.	Nonexperimental	35/Patients undergoing shoulder arthroscopy in the semi-sitting position	N/A	N/A	Differences in arterial pressure, cerebral blood flow, and patient state index measurements	Semi-sitting position was associated with a decrease in cerebral blood flow and patient state index values. The decrease in patient state index value was transient and values returned to normal within 20 minutes.	IIIB

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368	McCulloch TJ, Liyanagama K, Petchell J. Relative hypotension in the beach-chair position: effects on middle cerebral artery blood velocity. <i>Anaesthesia & Intensive Care</i> . 2010;38(3): 486-491.	Nonexperimental	19/Patients undergoing arthroscopic shoulder surgery in the semi-sitting position	N/A	N/A	Differences in cerebral hemodynamics measurements	Cerebral arterial pressure was frequently below the lower limit of autoregulation; however, the changes were not so great as to indicate cerebral ischemia.	IIIB
369	Yadeau JT, Liu SS, Bang H, et al. Cerebral oximetry desaturation during shoulder surgery performed in a sitting position under regional anesthesia. <i>Canadian Journal of Anaesthesia</i> . 2011;58(11): 986-992.	Nonexperimental	99/Patients undergoing shoulder surgery in the semi-sitting position in an ambulatory surgery center	N/A	N/A	Number of blood pressure and cerebral desaturation events	Despite frequent hypotension in the semi-sitting position, cerebral desaturation events were uncommon.	IIIB
370	Tange K, Kinoshita H, Minonishi T, et al. Cerebral oxygenation in the beach chair position before and during general anesthesia. <i>Minerva Anesthesiol</i> . 2010;76(7): 485-490.	Nonexperimental	30/Patients undergoing arthroscopic shoulder surgery	N/A	N/A	Differences in cerebral oxygenation measurements	The semi-sitting position does not alter cerebral oxygenation in patients with normal brain tissue oxygen index.	IIIB
371	Pin-on P, Schroeder D, Munis J. The hemodynamic management of 5177 neurosurgical and orthopedic patients who underwent surgery in the sitting or "beach chair" position without incidence of adverse neurologic events. <i>Anesthesia & Analgesia</i> . 2013;116(6): 1	Nonexperimental	5177/Patients who underwent orthopedic shoulder surgery or neurological surgery in the sitting position	N/A	N/A	Differences in intraoperative blood pressure measurements	The average reduction in blood pressure ranged from 12% to 19% depending on the type of surgery and the method of measurement; however the average reduction was not clinically significant.	IIIA
372	Lee JH, Min KT, Chun YM, Kim EJ, Choi SH. Effects of beach-chair position and induced hypotension on cerebral oxygen saturation in patients undergoing arthroscopic shoulder surgery. <i>Arthroscopy</i> . 2011;27(7): 889-894.	Nonexperimental	28/Patients undergoing arthroscopic shoulder surgery	N/A	N/A	Changes in oxygen saturation and arterial pressure measurements	The semi-sitting position combined with induced hypotension significantly decreased cerebral oxygen saturation in patients undergoing arthroscopic shoulder surgery in semi-sitting position.	IIIB
373	Mori Y, Yamada M, Akahori T, et al. Cerebral oxygenation in the beach chair position before and during general anesthesia in patients with and without cardiovascular risk factors. <i>J Clin Anesth</i> . 2015;27(6): 457-462.	Nonexperimental	91/Patients with cardiovascular risk factors undergoing elective surgery in the semi-sitting position	N/A	N/A	Differences in cerebral oxygen saturation measurements correlating with positional changes	The semi-sitting position decreased mean arterial blood pressure and heart rate; however, tissue oxygen index values were within normal limits	IIIB

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374	Amukoa P, Reed A, Thomas JM. Use of the sitting position for pineal tumour surgery in a five-year-old child. <i>Southern African Journal of Anaesthesia and Analgesia</i> . 2011;17(6): 388-392.	Expert opinion	N/A	N/A	N/A	N/A	The sitting position still has a role in modern neurosurgical practice, but should only be used following consideration of its potential complications.	VB
375	Rains DD, Rooke GA, Wahl CJ. Pathomechanisms and complications related to patient positioning and anesthesia during shoulder arthroscopy. <i>Arthroscopy</i> . 2011;27(4): 532-541.	Literature Review	N/A	N/A	N/A	N/A	The lateral position has been associated with peripheral neuropraxia, brachial plexopathy, direct nerve injury and airway compromise. The semi-sitting position has been associated with cervical neuropraxia, pneumothorax, and the potential for end-organ hypoperfusion injuries.	VB
376	Vermeersch G, Menovsky T, De Ridder D, De Bodt M, Saldien V, Van de Heyning P. Life-threatening macroglossia after posterior fossa surgery: a surgical positioning problem? <i>B-ENT</i> . 2014;10(4): 309-313.	Case report	1/55-year-old woman undergoing cranial surgery in the lateral position	N/A	N/A	N/A	The macroglossia in this case resulted from lymphatic drainage blockage caused by a combination of head positioning, extreme neck flexion, and the pressure of the endotracheal tube on the tongue and floor of the mouth.	VB
377	Rhee YG, Cho NS. Isolated unilateral hypoglossal nerve palsy after shoulder surgery in beach-chair position. <i>Journal of Shoulder & Elbow Surgery</i> . 2008;17(4): e28-30.	Case report	2/One 41-year old man, and one 71-year-old man undergoing shoulder surgery in the semi-sitting position	N/A	N/A	N/A	The most probable cause for the hypoglossal nerve injuries was the change of position during surgery.	VB
378	Liang BA. Judgment notwithstanding the verdict: the anesthesiologist's duty to monitor head position in the perioperative period. <i>J Clin Anesth</i> . 2009;21(5): 369-370.	Expert opinion	N/A	N/A	N/A	N/A	The only way to ensure that the patient's head remains in correct position is by visual monitoring.	VA
379	Ng AK, Page RS. Greater auricular nerve neuropraxia with beach chair positioning during shoulder surgery. <i>Int J Shoulder Surg</i> . 2010;4(2):48-50.	Case report	2/Patients undergoing shoulder surgery in the semi-sitting position	N/A	N/A	N/A	The use of a horseshoe-shaped head positioner is not recommended.	VB
380	LaPrade CM, Foad A. Greater auricular nerve palsy after arthroscopic anterior-inferior and posterior-inferior labral tear repair using beach-chair positioning and a standard universal headrest. <i>American Journal of Orthopedics</i> . 2015;44(4): 1	Case report	1/18-year-old man undergoing arthroscopic shoulder surgery in the semi-sitting position	N/A	N/A	N/A	The location of the headrest in relation to the great auricular nerve should be monitored, especially in cases where the operative time may be prolonged.	VB

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381	Wang J-C, Wong T-T, Chen H-H, Chang P-Y, Yang T-F. Bilateral sciatic neuropathy as a complication of craniotomy performed in the sitting position: Localization of nerve injury by using magnetic resonance imaging. <i>Child's Nervous System</i> . 2012;28(1): 159-16	Case report	1/12-year-old boy undergoing cranial surgery in the sitting position	N/A	N/A	N/A	The patient's thin body habitus and the prolonged duration of the procedure were predisposing factors for the patient's sciatic compressive palsy.	VB
382	Kiermeir D, Banic A, Rosler K, Erni D. Sciatic neuropathy after body contouring surgery in massive weight loss patients. <i>J Plast Reconstr Aesthet Surg</i> . 2010;63(5):e454-7.	Case report	2/One 39-year-old female, and one 23-year-old female undergoing body contouring procedures	N/A	N/A	N/A	The patient's sciatic neuropathy may have been related to nerve compression associated with the semirecumbent position combined with hip flexion and abduction necessary for simultaneous abdominal closure and access to the inner thighs.	VB
383	Rawlani V, Lee MJ, Dumanian GA. Bilateral sciatic neurapraxia following combined abdominoplasty and mastopexy. <i>Plast Reconstr Surg</i> . 2010;125(1):31e-32e.	Case report	1/28-year-old woman undergoing abdominoplasty and mastopexy in sitting position	N/A	N/A	N/A	Time in the sitting position should be minimized and the OR bed well padded. If the hips must be flexed, the knees should also be flexed.	VC
384	Satin AM, DePalma AA, Cuellar J, Gruson KI. Lateral femoral cutaneous nerve palsy following shoulder surgery in the beach chair position: a report of 4 cases. <i>American Journal of Orthopedics</i> . 2014;43(9): E206-9.	Case report	4/One 62-year-old obese female, one 34-year-old obese female, one 35-year-old obese male, and one 58-year-old obese male undergoing arthroscopic shoulder surgery in the semi-sitting position	N/A	N/A	N/A	The neuropraxia resulted from external compression on the lateral femoral cutaneous nerve by the patients' abdominal pannus.	VA
385	Kwak HJ, Lee JS, Lee DC, Kim HS, Kim JY. The effect of a sequential compression device on hemodynamics in arthroscopic shoulder surgery using beach-chair position. <i>Arthroscopy</i> . 2010;26(6): 729-733.	Randomized controlled trial	50/Patients undergoing elective shoulder arthroscopy under general anesthesia in the semi-sitting position	Sequential compression devices activated before anesthesia	Sequential compression devices not activated	Changes in hemodynamic measurements	The use of sequential compression devices reduced the incidence of hypotension associated with the semi-sitting position from 64% to 28%.	IA
386	Woo K-Y, Kim E-J, Lee J-H, Lee SG, Ban JS. Recurrent paroxysmal supraventricular tachycardia in the beach chair position for shoulder surgery under general anesthesia. <i>Korean Journal of Anesthesiology</i> . 2014;65(6 SUPPL.): S75-S76.	Case report	1/81-year-old woman undergoing shoulder surgery in the semi-sitting position	N/A	N/A	N/A	Blood pooling in the lower extremities during the semi-sitting position and decreased intravascular volume due to bleeding may have been the main factors in the occurrence of the patient's recurrent paroxysmal supraventricular tachycardia.	VB

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387	Prabhakar H, Singh GP, Ali Z, Bindra A. Surgery in sitting position in patient with ventriculoperitoneal shunt in situ may be hazardous! <i>Child's Nervous System</i> . 2009;25(12):1531-1532.	Case report	1/4-year-old girl undergoing occipital craniotomy in the sitting position	N/A	N/A	N/A	The authors recommend avoiding the sitting position in patients with ventriculoperitoneal shunts.	VB
388	Pandey V, Varghese E, Rao M, et al. Nonfatal air embolism during shoulder arthroscopy. <i>Am J Orthop</i> . 2013;42(6):272-274.	Case report	1/23-year-old man undergoing shoulder surgery in the semi-sitting position	N/A	N/A	N/A	This case emphasizes the importance of the perioperative team being prepared to manage VAE events.	VB
389	Mirski MA, Lele AV, Fitzsimmons L, Toung TJ. Diagnosis and treatment of vascular air embolism. <i>Anesthesiology</i> . 2007;106(1):164-177.	Expert opinion	N/A	N/A	N/A	N/A	Vascular air embolism is a potentially life-threatening event that is increasingly more common in situations other than surgery performed in the sitting position. Clinicians must be competent to manage this silent, but deadly complication.	VB
390	Natal BL. Venous air embolism treatment & management. Medscape Web site. http://emedicine.medscape.com/article/761367-treatment . Published 12/8/15. Updated 2015. Accessed 11/7/2016.	Expert opinion	N/A	N/A	N/A	N/A	Management of VAE, once suspected, includes identification of the source of air, prevention of further air entry, a reduction in the amount of air entrained, and hemodynamic support.	VB
391	Rushatamukayanunt P, Seanho P, Muangman S, Raksakietisak M. Severe venous air embolism related to positioning in posterior cranial fossa surgery in siriraj hospital. <i>Journal of the Medical Association of Thailand</i> . 2016;99(5):511-516.	Nonexperimental	192/Patients undergoing posterior cranial fossa craniotomy	N/A	N/A	VAE events	The incidence of severe VAE was significantly higher in the sitting position group compared with the horizontal positions group.	IIIB
392	Sandwell S, Kimmell KT, Silberstein HJ, et al. 349 safety of the sitting cervical position for elective spine surgery. <i>Neurosurgery</i> . 2016;63(Suppl 1):203.	Nonexperimental	580/Patients who underwent posterior cervical surgeries in the sitting or prone position	N/A	N/A	VAE events	No events were reported for either group.	IIIC
393	Perello L, Gracia I, Fabregas N. Bone embolism during neurosurgery in sitting position. <i>J Neurosurg Anesthesiol</i> . 2013;25(1): 93.	Case report	1/49-year-old woman undergoing cranial surgery in the sitting position	N/A	N/A	N/A	Material aspirated through the central venous catheter was bone fragments.	VC

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394	Operating room crisis checklists: Crisis checklist package. Project Check Web site. http://www.projectcheck.org/crisis-checklist-templates.html . Updated 2013. Accessed 12/15, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
395	Furuno Y, Sasajima H, Goto Y, et al. Strategies to prevent positioning-related complications associated with the lateral suboccipital approach. <i>Journal of Neurological Surgery Part B Skull Base</i> . 2014;75(1): 35-40.	Nonexperimental	71/Patients with cranial lesions undergoing surgery in the lateral position	N/A	N/A	Position-related complications	Strategies to prevent positioning-related complications associated with the lateral position include atraumatic positioning of the neck, avoiding trunk rotation, and protecting peripheral nerves in all four extremities.	IIIB
396	Woernle CM, Sarnthein J, Foit NA, Krayenbuhl N. Enhanced serum creatine kinase after neurosurgery in lateral position and intraoperative neurophysiological monitoring. <i>Clinical Neurology & Neurosurgery</i> . 2013;115(3): 266-269.	Quasi-experimental	150/Patients operated on in the supine (n = 50), prone (n = 50), and lateral (n = 50) positions	Preoperative and postoperative creatine kinase levels with the patient in supine and prone positions	Preoperative and postoperative creatine kinase levels with the patient in lateral position	Differences in serum creatine kinase levels	There is a strong association between elevated serum creatine kinase levels and the lateral position that may be related to the elevated body pressure on the OR bed.	IIIB
397	Achar SK, Paul C, Varghese E. Unilateral pulmonary edema after laparoscopic nephrectomy. <i>Journal of Anaesthesiology Clinical Pharmacology</i> . 2011;27(4): 556-558.	Case report	1/61-year-old man diagnosed with right renal cell carcinoma	N/A	N/A	N/A	Prolonged lateral position, pneumoperitoneum, ventilation-perfusion mismatch, and Starling's forces led to the patient's dependent lung edema in the postoperative period.	VB
398	Danish SF, Wilden JA, Schuster J. Iatrogenic paraplegia in 2 morbidly obese patients with ankylosing spondylitis undergoing total hip arthroplasty. <i>Journal of Neurosurgery Spine</i> . 2008;8(1): 80-83.	Case report	2/One extremely obese 59-year-old man, and one extremely obese 60-year-old man undergoing hip arthroplasty procedures in the supine position with a modified lateral approach	N/A	N/A	N/A	Morbidly obese patients with ankylosing spondylosis and a fragile kyphotic spine may be susceptible to symptomatic vertebral fracture during positioning.	VB
399	Hemmerling TM, Kazan R, Bracco D. Inter-hemispheric cerebral oxygen saturation differences during thoracic surgery in lateral head positioning. <i>Br J Anaesth</i> . 2009;102(1): 141-142.	Quasi-experimental	29/Consecutive patients undergoing thoracic surgery	Near-infrared spectroscopy measurements conducted every two hours throughout the surgery	Near-infrared spectroscopy measurements in upper and lower hemispheres	Differences in cerebral saturation measurements	In the lateral position, the upper hemisphere shows significantly higher cerebral saturation values.	IIC

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400	Kim TK, Yoon JR, Lee MH. Rhabdomyolysis after laparoscopic radical nephrectomy -A case report. <i>Korean Journal of Anesthesiology</i> . 2010;59(Suppl): S41-4.	Case report	1/51-year-old man undergoing laparoscopic radical nephrectomy	N/A	N/A	N/A	Body parts under pressure should be padded. The kidney rest may need to be lowered during the procedure.	VB
401	De Tommasi C, Cusimano MD. Rhabdomyolysis after neurosurgery: a review and a framework for prevention. <i>Neurosurg Rev</i> . 2013;36(2): 195-202.	Case report	3/One 54-year-old hypertensive woman with a BMI of 44 kg/m ² undergoing a craniotomy, one 57-year-old woman with diabetes, hypertension, and a BMI of 37.4 kg/m ² undergoing excision of a petroclival tumor, and one 66-year-old hypertensive woman with a BMI of 30.7 kg/m ² undergoing decompression of cranial nerves V and IX	N/A	N/A	N/A	Obese patients undergoing long neurosurgical procedures, particularly in the lateral position, should be evaluated for rhabdomyolysis.	VA
402	Dakwar E, Rifkin SI, Volcan IJ, Goodrich JA, Uribe JS. Rhabdomyolysis and acute renal failure following minimally invasive spine surgery: Report of 5 cases. <i>Journal of Neurosurgery: Spine</i> . 2011;14(6): 785-788.	Case report	5/Patients developing rhabdomyolysis and acute renal failure after minimally invasive spine surgery	N/A	N/A	N/A	There is a possibility of postoperative rhabdomyolysis and acute renal failure after minimally invasive spine surgery, particularly if the patient is morbidly obese and the procedure is prolonged.	VB
403	Rowell J, Lynn AM, Filardi TZ, Celix J, Ojemann JG. Acute unilateral enlargement of the parotid gland immediately post craniotomy in a pediatric patient: A case report. <i>Child's Nervous System</i> . 2010;26(9): 1239-1242.	Case report	1/5-year-old boy undergoing craniotomy in the lateral position	N/A	N/A	N/A	The injury was likely caused by trapping the salivary duct between the teeth on the right side of the mouth and the horseshoe headrest that the right cheek rested on.	VA
404	Ameri E, Behtash H, Omidi-Kashani F. Isolated long thoracic nerve paralysis - a rare complication of anterior spinal surgery: a case report. <i>Journal of Medical Case Reports</i> . 2009;3: 7366.	Case report	1/23-year-old woman	N/A	N/A	N/A	During positioning of patients into the lateral position, the course of the long thoracic nerve must be protected from any external pressure.	VB

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405	Jain V, Davies M. Axillary artery compression in park bench position during a microvascular decompression. <i>J Neurosurg Anesthesiol</i> . 2011;23(3): 264.	Case report	1/Adult man undergoing microvascular decompression surgery in the lateral position with his neck flexed and his head rotated toward the floor	N/A	N/A	N/A	When the patient is in the park bench position, especially if the patient is obese, it is prudent to monitor the circulation in both hands by pulse oximeter or palpation of peripheral pulses	VC
406	Newton G, White E. Femoral artery occlusion in obese patients in the lateral position. <i>Anaesthesia</i> . 2010;65(8): 863.	Case report	2/Obese, elderly patients undergoing surgery in the lateral position	N/A	N/A	N/A	Perioperative team members should remain vigilant during the procedure to prevent patient injury.	VC
407	Edgcombe H, Carter K, Yarrow S. Anaesthesia in the prone position. <i>Br J Anaesth</i> . 2008;100(2): 165-183.	Literature review	N/A	N/A	N/A	N/A	The prone position is associated with a variety of complications, some of which can be prevented.	VA
408	Kwee MM, Ho YH, Rozen WM. The prone position during surgery and its complications: a systematic review and evidence-based guidelines. <i>Int Surg</i> . 2015;100(2): 292-303.	Clinical practice guideline	N/A	N/A	N/A	N/A	Postoperative vision loss and cardiovascular complications, including hypovolemia and cardiac arrest, had the most studies and the highest level of evidence.	IVA
409	Koh JC, Lee JS, Han DW, Choi S, Chang CH. Increase in airway pressure resulting from prone position patient placing may predict intraoperative surgical blood loss. <i>Spine</i> . 2013;38(11): E678-82.	Nonexperimental	33/Patients, class ASA I or II undergoing posterior lumbar interbody fusion surgery	N/A	N/A	Correlation of blood loss with measurements of airway pressure	Increase in airway pressures resulting from placement into a prone position may predict intraoperative surgical blood loss.	IIIB
410	DePasse JM, Palumbo MA, Haque M, Ebersson CP, Daniels AH. Complications associated with prone positioning in elective spinal surgery. <i>World Journal of Orthopedics</i> . 2015;6(3): 351-359.	Literature review	N/A	N/A	N/A	N/A	Prone positioning complications can cause serious patient morbidity. Awareness of these potential complications, careful patient positioning, efficient use of anesthesia time, and avoidance of intraoperative hypotension may help reduce the incidence of complications.	VA
411	Postoperative Visual Loss Study Group. Risk factors associated with ischemic optic neuropathy after spinal fusion surgery. <i>Anesthesiology</i> . 2012;116(1):15-24.	Nonexperimental	395/Patients who did (n = 80) and did not (n = 315) develop postoperative vision loss following spinal surgery in the prone position	N/A	N/A	Risk-factors associated with postoperative vision loss	Obesity, male sex, Wilson frame use, longer anesthetic times, greater estimated blood loss, and decreased colloid administration were significantly and independently associated with ischemic optic neuropathy after spinal surgery.	IIIA
412	Akinci IO, Tunali U, Kyzy AA, et al. Effects of prone and jackknife positioning on lumbar disc herniation surgery. <i>J Neurosurg Anesthesiol</i> . 2011;23(4): 318-322.	Randomized controlled trial	40/Patients between 18 and 70 years, ASA class I or II, undergoing elective lumbar discectomy	Measurement of lung mechanics, intra-abdominal pressure, and blood loss at the surgical site during prone position	Measurement of lung mechanics, intra-abdominal pressure, and blood loss at the surgical site during jack-knife position	Differences in measurements	The Jackknife position causes less intra-abdominal pressure elevation and less surgical site bleeding compared with the prone position	IC

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413	Chalhoub V, Tohmé J, Richa F, Dagher C, Yazbeck P. Inferior vena cava filter migration during the prone position for spinal surgery: a case report. <i>Canadian Journal of Anesthesia</i> . 2015;62(10): 1114-1118.	Case report	1/54-year-old man with multiple unstable fractures following trauma undergoing spine surgery in the prone position	N/A	N/A	N/A	The prone position during surgery can induce anatomic and hemodynamic changes in the inferior vena cava. This may contribute to the migration of inferior vena cava filters.	VB
414	Han IH, Son DW, Nam KH, Choi BK, Song GS. The effect of body mass index on intra-abdominal pressure and blood loss in lumbar spine surgery. <i>Journal of Korean Neurosurgical Society</i> . 2012;51(2): 81-85.	Quasi-experimental	30/Patients undergoing spinal surgery (10 normal weight, BMI 18.5 kg/m ² to 22.9 kg/m ² ; 10 overweight, BMI 23 kg/m ² to 24.9 kg/m ² ; 10 obese, BMI 25 kg/m ² to 29.9 kg/m ²)	Measurements of intra-abdominal pressure and intraoperative blood loss in the prone position	Measurements of intra-abdominal pressure and blood loss in the supine position	Differences in intra-abdominal pressures/ Differences in intraoperative blood loss	Body mass index affects intra-abdominal pressure in the in the prone position more than in the supine position during lumbar surgery. Intraoperative blood loss was found to increase with intra-abdominal pressure and with BMI.	IIB
415	Borodiciene Jurgita, Gudaityte Jurate, Macas Andrius. Lithotomy versus jack-knife position on haemodynamic parameters assessed by impedance cardiography during anorectal surgery under low dose spinal anaesthesia: a randomized controlled trial.	Randomized controlled trial	104/ASA class I or II patients undergoing elective minor anorectal surgery	Measurement of cardiac output, cardiac index, systemic vascular resistance, and stroke index at arrival to the OR, positioning, start and end of surgery, and return to bed in lithotomy position	Measurement of cardiac output, cardiac index, systemic vascular resistance, and stroke index at arrival to the OR, positioning, start and end of surgery, and return to bed in jack-knife position	Differences in measurements	Use of the jack-knife position after low-dose spinal anesthesia produces transitory, but statistically significant reduction of cardiac output and cardiac index with increase of systemic vascular resistance, compared to lithotomy position.	IA
416	Chui J, Craen RA. An update on the prone position: Continuing professional development. <i>Canadian Journal of Anaesthesia</i> . 2016;63(6):737-767.	Literature review	N/A	N/A	N/A	N/A	Increased age, elevated BMI, the presence of comorbidities, and long duration of surgery appear to be the most important risk factors for complications associated with prone positioning.	VA
417	Shriver MF, Zeer V, Alentado VJ, Mroz TE, Benzel EC, Steinmetz MP. Lumbar spine surgery positioning complications: a systematic review. <i>Neurosurgical Focus</i> . 2015;39(4): E16.	Systematic review	34/Published case reports, randomized controlled trials, prospective and retrospective cohort studies	N/A	N/A	Identification of complications associated with positioning during lumbar spine surgery	Vision loss was the most commonly reported complication. Other complications included conjunctival swelling, ischemic orbital compartment syndrome, nerve palsies, thromboembolic complications, pressure injury, lower extremity compartment syndrome, and shoulder dislocation.	IIIB
418	Degerli S, Acar B, Sahap M, Polat A, Horasanli E. Investigation of middle ear pressure changes during prone position under general anesthesia without using nitrous oxide. <i>J Craniofac Surg</i> . 2013;24(6): 1950-1952.	Quasi-experimental	20/Patients undergoing general anesthesia in the prone position	Measurement of middle ear pressure after intubation, after turning to the prone position, at the end of the prone position, and after returning to the supine position	Measurement of middle ear pressure before induction	Differences in middle ear pressure measurements	The significant middle ear pressure changes during the prone position under general anesthesia depend on a number of factors, including inhaler agents, pressure changes in mucosal blood vessels resulting from venous congestion, and the mastoid bone volume.	IIB

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419	Closhen D, Engelhard K, Dette F, Werner C, Schramm P. Changes in cerebral oxygen saturation following prone positioning for orthopaedic surgery under general anaesthesia: a prospective observational study. <i>Eur J Anaesthesiol</i> . 2015;32(6): 381-386.	Quasi-experimental	75/Patients between 18 and 80 years undergoing general anesthesia during orthopedic surgery (n = 4), and volunteers studied while awake (n = 35)	Measurement of near-infrared spectroscopy in supine and prone position in patients under general anesthesia	Measurement of near-infrared spectroscopy in supine and prone position in awake volunteers	Differences in cerebral oxygen saturation more than 5%	Both monitors detected a small increase in cerebral oxygen saturation of less than 5% in patients undergoing orthopedic surgery in the prone position and in the awake volunteers. This small increase is of limited clinical relevance and prone positioning may be regarded as safe in terms of the maintenance of oxygen saturation.	IIA
420	Babakhani B, Heroabadi A, Hosseinatababaei N, et al. Cerebral oxygenation under general anesthesia can be safely preserved in patients in prone position: A prospective observational study. <i>J Neurosurg Anesthesiol</i> . 2016.	Nonexperimental	50/Consecutive patients undergoing lumbar spine surgery in the prone position	N/A	N/A	Differences in bilateral regional cerebral oxygen saturation measurements	Cerebral oxygenation of anesthetized patients in prone position can be preserved. Bradycardia and hypotension should be prevented and treated.	IIIB
421	Deiner S, Chu I, Mahanian M, Lin HM, Hecht AC, Silverstein JH. Prone position is associated with mild cerebral oxygen desaturation in elderly surgical patients. <i>PLoS ONE</i> . 2014;9(9): e106387.	Quasi-experimental	205/Patients undergoing spinal surgery in the prone position (n = 63), and patients undergoing surgery in the supine position (n = 142)	N/A	N/A	Incidents of cerebral desaturation	Older spine surgery patients in the prone position were more than twice as likely to experience mild cerebral desaturation as other patients in the supine position.	IIB
422	Brown ZE, Gorges M, Cooke E, Malherbe S, Dumont GA, Ansermino JM. Changes in cardiac index and blood pressure on positioning children prone for scoliosis surgery. <i>Anaesthesia</i> . 2013;68(7): 742-746.	Quasi-experimental	30/Children ASA class I or II, aged 13 to 18 years undergoing scoliosis repair	Measurements of cardiac index and mean arterial blood pressure in prone position	Measurements of cardiac index and mean arterial blood pressure in supine position	Differences in cardiac index and mean arterial blood pressure measurements	Turning prone resulted in a median reduction in cardiac index with a large degree of inter-subject variability. The changes in mean arterial blood pressure were not significant.	IIB
423	Shifa J, Abebe W, Bekele N, Habte D. A case of bilateral visual loss after spinal cord surgery. <i>The Pan African medical journal</i> . 2016;23:119.	Case report	1/17-year-old male undergoing laminectomy in prone position under general anesthesia	N/A	N/A	N/A	Preoperative identification of patients with risk factors, close intraoperative monitoring, and correct positioning is advised.	VA
424	Li A, Swinney C, Veeravagu A, Bhatti I, Ratliff J. Postoperative visual loss following lumbar spine surgery: A review of risk factors by diagnosis. <i>World Neurosurg</i> . 2015;84(6):2010-2021.	Literature review	N/A	N/A	N/A	N/A	Ischemic optic neuropathy risks may be influenced by a longer operative time in the prone position with anemia, hypotension, and blood transfusion. The risk for central retinal artery occlusion is usually due to incorrect positioning. Prone positioning and obesity were found to be most commonly associated with cortical blindness.	VA

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425	Nickels TJ, Manlapaz MR, Farag E. Perioperative visual loss after spine surgery. <i>World Journal of Orthopaedics</i> . 2014;5(2): 100-106.	Expert opinion	N/A	N/A	N/A	N/A	There are no effective treatment options for postoperative vision loss and the diagnosis is often irreversible, so efforts must focus on prevention and modification of risk factors.	VA
426	Dereine T, van Pesch V, Van Boven M, Hantson P. Transient perioperative visual loss after an elective neurosurgical procedure. <i>Acta Anaesthesiol Belg</i> . 2013;64(3): 109-113.	Case report	1/63-year-old woman undergoing an elective neurosurgical procedure	N/A	N/A	N/A	This case illustrates the individual risk for visual injury after prone positioning during neurosurgical interventions.	VB
427	Grant GP, Szirth BC, Bennett HL, et al. Effects of prone and reverse trendelenburg positioning on ocular parameters. <i>Anesthesiology</i> . 2010;112(1): 57-65.	Quasi-experimental	10/Healthy volunteers	Measurement of intraocular pressure, choroidal thickness, and optic nerve diameter at initial prone positioning and hourly thereafter over 5 hours	Measurement of intraocular pressure, choroidal thickness, and optic nerve diameter at initial supine position	Changes in intraocular pressure measurements	Prolonged prone positioning increases intraocular pressure, choroid layer thickness, and optic nerve diameter.	IIB
428	Carey TW, Shaw KA, Weber ML, DeVine JG. Effect of the degree of reverse Trendelenburg position on intraocular pressure during prone spine surgery: a randomized controlled trial. <i>Spine Journal: Official Journal of the North American Spine Society</i> . 2014;14	Randomized controlled trial	19/Patients with no history of eye pathology undergoing prone spine surgery at a military medical center	Measurements of intraocular pressure, mean arterial pressure, estimated blood loss, fluid resuscitation, and ophthalmologic complications during surgery, beginning at 30 minutes, 60 minutes, and 60 minute increments thereafter in reverse Trendelenburg position	Measurements of intraocular pressure, mean arterial pressure, estimated blood loss, fluid resuscitation, and ophthalmologic complications during surgery, beginning at 30 minutes, 60 minutes, and 60 minute increments thereafter in prone position	Differences in intraocular pressure measurements	Reverse Trendelenburg positioning elicits decreased intraocular pressures compared with prone positioning for surgery times less than 120 minutes. No significant complications were associated with reverse Trendelenburg positioning.	IC
429	Emery SE, Daffner SD, France JC, et al. Effect of head position on intraocular pressure during lumbar spine fusion: A randomized, prospective study. <i>J BONE JOINT SURG (AM)</i> . 2015;97(22):1817-1823.	Nonexperimental	52/Patients undergoing lumbar spine surgery in the prone position	N/A	N/A	Changes in intraocular pressure measurements	Head elevation for adult lumbar spine fusion performed with the patient prone resulted in significantly lower intraocular pressure measurements than those seen when the patient's head was in neutral position.	IB
430	Lee LA, Newman NJ, Wagner TA, Dettori JR, Dettori NJ. Postoperative ischemic optic neuropathy. <i>Spine</i> . 2010;35(9 Suppl): S105-16.	Literature review	N/A	N/A	N/A	N/A	Ischemic optic neuropathy may be associated with prone position of more than five hours surgical duration and blood loss of more than 1000 mL.	VA

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431	Akhaddar A, Boucetta M. Subconjunctival hemorrhage as a complication of intraoperative positioning for lumbar spinal surgery. <i>Spine Journal: Official Journal of the North American Spine Society</i> . 2012;12(3): 274.	Case report	1/42-year-old woman undergoing lumbar spine surgery in the prone position	N/A	N/A	N/A	Subconjunctival hemorrhage as seen in this patient is a rare complication of patient positioning for posterior spinal surgery.	VC
432	Russell DJ, Dutton JJ. Bilateral spontaneous subperiosteal orbital hemorrhages following endoscopic retrograde cholangiopancreatography. <i>Ophthalm Plast Reconstr Surg</i> . 2011;27(3): e49-e50.	Case report	1/42-year-old man undergoing endoscopic surgery in the prone position	N/A	N/A	N/A	Increased venous pressure from Valsalva, prone positioning, and mild coagulopathy may have contributed to the hemorrhages in this patient.	VC
433	Guillaume JE, Gowreesunker P. Horner's syndrome in the prone position--a case report. <i>Acta Anaesthesiol Belg</i> . 2013;64(3): 119-121.	Case report	1/42-year-old woman undergoing a circular abdominoplasty and liposuction procedure	N/A	N/A	N/A	Horner syndrome can occur after non-cervical surgery in the prone position.	VC
434	Stang-Veldhouse KN, Yeu E, Rothenberg DM, Mizzen TR. Unusual presentation of perioperative ischemic optic neuropathy following major spine surgery. <i>J Clin Anesth</i> . 2010;22(1): 52-55.	Case report	1/44-year-old man undergoing lumbar spinal surgery in the prone position	N/A	N/A	N/A	Patients should be screened preoperatively for risk factors such as diabetes, hypertension, and small cup-to-disc ratio on fundoscopic examination should be considered.	VB
435	Quraishi NA, Wolinsky JP, Gokaslan ZL. Transient bilateral post-operative visual loss in spinal surgery. <i>European Spine Journal</i> . 2012;21(Suppl 4): S495-8.	Case report	1/44-year-old man undergoing lumbar spinal surgery in the prone position	N/A	N/A	N/A	Even when all recommendations for correct positioning are met, devastating injuries can still occur.	VB
436	Goni V, Tripathy SK, Goyal T, Tamuk T, Panda BB, Shashidhar BK. Cortical blindness following spinal surgery: Very rare cause of perioperative vision loss. <i>Asian Spine Journal</i> . 2012;6(4): 287-290.	Case report	1/38-year-old man undergoing spinal surgery following a motor vehicle accident	N/A	N/A	N/A	The specific pathogenesis of postoperative vision loss remains elusive. Important causes include ischemic optic neuropathy, retinal vascular occlusion, and cortical blindness.	VB
437	Reddy A, Foroozan R, Edmond JC, Hinckley LK. Dilated superior ophthalmic veins and posterior ischemic optic neuropathy after prolonged spine surgery. <i>Journal of Neuro-Ophthalmology</i> . 2008;28(4): 327-328.	Case report	1/55-year-old man undergoing lumbar spine surgery in the prone position	N/A	N/A	N/A	This case suggests an association between increased orbital venous pressure during surgery and the development of postoperative posterior ischemic optic neuropathy.	VB

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438	Kendrick H. Post-operative vision loss (POVL) following surgical procedures. <i>Journal of Anesthesia and Clinical Research</i> . 2012;3(1).	Literature review	N/A	N/A	N/A	N/A	There is an increased risk of postoperative vision loss when both preoperative and intraoperative risk factors are present.	VB
439	Agah M, Ghasemi M, Roodneshin F, Radpay B, Moradian S. Prone position in percutaneous nephrolithotomy and postoperative visual loss. <i>Urology Journal</i> . 2011;8(3): 191-196.	Nonexperimental	20/Patients undergoing percutaneous nephrolithotomy in the prone position	N/A	N/A	Differences in intraocular pressure measurements	Intraocular pressure dropped significantly after anesthesia and increased in prone position. There was a linear relationship between intraocular pressure rise and duration in the prone position. Intraocular pressure doubled within two hours.	IIIB
440	Szmuk P, Steiner JW, Pop RB, et al. Intraocular pressure in pediatric patients during prone surgery. <i>Anesthesia & Analgesia</i> . 2013;116(6): 1309-1313.	Nonexperimental	30/Pediatric patients undergoing surgery in the prone position	N/A	N/A	Differences in intraocular pressure measurements	Changing position from supine to prone significantly increased intraocular pressure. Moreover, the intraocular pressure continued to increase during surgery and reached potentially harmful levels.	IIIB
441	Yoshimura K, Hayashi H, Tanaka Y, Nomura Y, Kawaguchi M. Evaluation of predictive factors associated with increased intraocular pressure during prone position spine surgery. <i>Journal of Anesthesia</i> . 2015;29(2): 170-174.	Nonexperimental	56/Patients undergoing spinal surgery in the prone position	N/A	N/A	Differences in intraocular pressure measurements	Intraocular pressures > 23 mm Hg were found to be a significant predictor for increased intraocular pressure > 30 mm Hg. These intraocular pressure values may be used as a predictor of high intraocular pressure in anesthetized patients.	IIIB
442	Eddama M. Re: Raised intraocular pressure and perioperative visual loss in laparoscopic colorectal surgery: a catastrophe waiting to happen? A systematic review of evidence from other surgical specialties. <i>Techniques in Coloproctology</i> . 2013;17(2): 247.	Expert opinion	N/A	N/A	N/A	N/A	Positioning patients in a way that causes an increase in intraocular pressure for a prolonged period of time could lead to postoperative visual loss.	VA
443	Nazerali RS, Song KR, Wong MS. Facial pressure ulcer following prone positioning. <i>Journal of Plastic, Reconstructive & Aesthetic Surgery</i> . 2010;63(4): e413-4.	Case report	1/31-year-old man undergoing surgery in the prone position	N/A	N/A	N/A	The use of appropriate padding and minimizing the length of time in prone position are two variables that can reduce facial pressure injury development.	VB

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444	Sherman CE, Rose PS, Pierce LL, Yaszemski MJ, Sim FH. Prospective assessment of patient morbidity from prone sacral positioning. <i>Journal of Neurosurgery Spine</i> . 2012;16(1): 51-56.	Organizational experience	N/A	N/A	N/A	Identification of variables of patient morbidity	Morbid obesity and procedure times in excess of 10 hours are risk factors for positioning-related complications.	VB
445	Dahab R, Barrett C, Pillay R, De Matas M. Anterior thigh compartment syndrome after prone positioning for lumbosacral fixation. <i>European Spine Journal</i> . 2012;21(Suppl 4): S554-6.	Case report	1/47-year-old woman undergoing spinal surgery in the prone position	N/A	N/A	N/A	The patient's compartment syndrome was caused by ischemia of the lower limb that reversed when the patient was returned to the supine position at the end of the procedure.	VB
446	Gupta R, Batra S, Chandra R, Sharma VK. Compartment syndrome with acute renal failure: a rare complication of spinal surgery in knee-chest position. <i>Spine</i> . 2008;33(8): E272-3.	Case report	1/35-year-old man reporting to the ED after spinal surgery in the knee-chest position	N/A	N/A	N/A	The knee-chest position can lead to a disturbance of arterial microcirculation and the capillary network, with subsequent edema causing a decrease in muscle perfusion.	VB
447	Minami K, Iida M, Iida H. Case report: central venous catheterization via internal jugular vein with associated formation of perioperative venous thrombosis during surgery in the prone position. <i>Journal of Anesthesia</i> . 2012;26(3): 464-466.	Case report	1/76-year-old woman undergoing spinal surgery	N/A	N/A	N/A	The prone patient's slightly flexed neck may have kinked the internal jugular vein causing engorgement with venous blood and subsequent venous thrombosis.	VB
448	Harman F, Yayci F, Deren S, et al. Acute cerebellar ischemia after lumbar spinal surgery: a rare clinical entity. <i>Journal of Anesthesia</i> . 2012;26(6): 947-948.	Case report	1/69-year-old man, ASA class II, undergoing spinal surgery	N/A	N/A	N/A	Neutral alignment of the neck is necessary to prevent ischemia-related complications following spinal surgery.	VC
449	Hojlund J, Sandmand M, Sonne M, et al. Effect of head rotation on cerebral blood velocity in the prone position. <i>Anesthesiology Research and Practice</i> . 2012.	Quasi-experimental	22/Healthy volunteers	Measurements of cerebral blood velocity with the patient's head rotated to the side	Measurements of cerebral blood velocity with the patient's head in neutral position	Differences in cerebral blood velocity measurements	Prone position with the head rotated to the side affects both cerebral blood flow and cerebrovenous drainage, indicating that optimal brain perfusion requires head centering.	IIB
450	Ooi EI, Aham A, Zahidin AZ, Bastion ML. Unilateral visual loss after spine surgery in the prone position for extradural haematoma in a healthy young man. <i>BMJ Case Reports</i> . 2013.	Case report	1/22-year-old man undergoing spine surgery post-traumatic tracheostomy	N/A	N/A	N/A	The patient's head was incorrectly positioned during prone surgery resulting in excessive pressure of the headrest onto the right eye causing postoperative vision loss.	VC

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451	Pin-On P, Boonsri S. Postoperative visual loss in orthopedic spine surgery in the prone position: a case report. <i>Journal of the Medical Association of Thailand</i> . 2015;98(3): 320-324.	Case report	1/64-year-old man undergoing lumbar spine surgery in the prone position	N/A	N/A	N/A	The most probable cause of the injury was obstruction of venous return from the left orbit, which led to increased intraocular pressure and postoperative vision loss.	VB
452	Yu YH, Chen WJ, Chen LH, Chen WC. Ischemic orbital compartment syndrome after posterior spinal surgery. <i>Spine</i> . 2008;33(16): E569-72.	Case report	1/68-year-old man undergoing spinal surgery in the prone position	N/A	N/A	N/A	The patient was in the prone and head-down position and there was direct orbital compression by the headrest leading to postoperative vision loss.	VB
453	Andersen JD, Baake G, Wiis JT, Olsen KS. Effect of head rotation during surgery in the prone position on regional cerebral oxygen saturation: A prospective controlled study. <i>Eur J Anaesthesiol</i> . 2014;31(2): 98-103.	Quasi-experimental	48/Patients (34 women; 14 men), 18 to 80 years undergoing spinal surgery estimated to last longer than two hours in prone position	Near-infrared spectroscopy measurements conducted during anesthesia with the head rotated left, rotated right, and returned to neutral position	Near-infrared spectroscopy measurements conducted during anesthesia with the head in neutral position	Differences in regional cerebral oxygen saturation measurements	A neutral head position should be used.	IIB
454	Nuri Deniz M, Erakgun A, Sertoz N, Guven Yilmaz S, Ates H, Erhan E. The effect of head rotation on intraocular pressure in prone position: a randomized trial. <i>Rev Bras Anesthesiol</i> . 2013;63(2): 209-212.	Randomized controlled trial	45/Patients undergoing percutaneous nephrolithotomy	Measurement of intraocular pressures in patients in prone position with the head rotated 45° to the right	Measurement of intraocular pressure in patients in prone position with head in neutral position	Differences in intraocular pressure measurements	Prone positioning increases intraocular pressure. In patients positioned in prone position with a head rotation 45° laterally, intraocular pressure in the upper positioned eye was significantly lower.	IB
455	Uribe AA, Baig MN, Puente EG, Vilorio A, Mendel E, Bergese SD. Current intraoperative devices to reduce visual loss after spine surgery. <i>Neurosurgical Focus</i> . 2012;33(2): E14.	Expert opinion	N/A	N/A	N/A	N/A	eliminating the potential for eye compression with face positioning devices could potentially prevent postoperative vision loss.	VB
456	Grover VK, Jangra K. Perioperative vision loss: A complication to watch out. <i>Journal of Anaesthesiology Clinical Pharmacology</i> . 2012;28(1): 11-16.	Literature review	N/A	N/A	N/A	N/A	Perioperative vision loss is a serious complication with medicolegal implications. Perioperative professionals assisting with or performing spinal procedures in the prone position should take adequate precautions during	VA
457	Grisell M, Place HM. Face tissue pressure in prone positioning: a comparison of three face pillows while in the prone position for spinal surgery. <i>Spine</i> . 2008;33(26): 2938-2941.	Quasi-experimental	66/Consecutive elective thoracic or lumbar surgery patients from 18- to 65-years	Measurement of facial interface pressures at the forehead and chin at times 0, 5, 15, and 60 minutes of positioning with the ROHO and OSI face positioners	Measurement of facial interface pressures at the forehead and chin at times 0, 5, 15, and 60 minutes of positioning with the ProneView Protective Helmet	Differences in facial interface pressure measurements	The ProneView Protective Helmet was superior to both the OSI and ROHO face positioners in decreasing forehead and chin interface pressures during prone position surgery.	IIB

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458	McMichael JC, Place HM. Face tissue pressures in prone positioning: a comparison of 3 pillows. <i>Journal of Spinal Disorders & Techniques</i> . 2008;21(7): 508-513.	Nonexperimental	15/Volunteer participants	N/A	N/A	Differences in forehead and chin interface pressure measurements	At all time points, the head positioner made of disposable foam with face plate and mirror and the neoprene pillow demonstrated significantly lower face-pillow interface pressures than the polyurethane pillow.	IIC
459	Levan Pierre, OÃ¿Rourke Michael, Presta Michael, Bryam Scott. The Use of Mobile Smartphone Technology to Enhance Positioning of a Prone Patient for Thoracic Spine Surgery. <i>INTERNET J ANESTHESIOLOG</i> . 2012;30(3): 1-1.	Case report	1/66-year-old man undergoing spinal surgery in prone position on the Jackson table	N/A	N/A	N/A	The use of a smart phone aided in monitoring the patient in prone position.	VB
460	Asok T, Aziz S, Faisal HA, Tan AK, Mallika PS. Central retinal artery occlusion and ophthalmoplegia following spinal surgery in the prone position. <i>Med J Malaysia</i> . 2009;64(4): 323-324.	Case report	1/14-year-old boy undergoing spinal surgery in the prone position	N/A	N/A	N/A	Although postoperative vision loss can occur in the absence of external ocular compression, avoidance of mechanical injury to the globe is extremely important for preventing injury.	VB
461	Song J-S, Yim J-H, Lee K-B. Unilateral blindness after posterior cervical spinal surgery: A case report. <i>Neurosurgery Quarterly</i> . 2015;25(1): 78-81.	Case report	1/69-year-old man undergoing cervical spine surgery in the prone position	N/A	N/A	N/A	A prolonged prone position during spinal surgery can cause external compression of the eye.	VC
462	Epstein NE. Perioperative visual loss following prone spinal surgery: A review. <i>Surgical neurology international</i> . 2016;7(Suppl 13):S347-60.	Literature review	N/A	N/A	N/A	N/A	Routinely using a 3-pin head holder will completely avoid ophthalmic compression, while maintaining the neck in a neutral position, and avoiding increased intraocular pressure.	VB
463	Kitthaweasin K, Moontawee K, Thanathane O. Sudden visual loss and total ophthalmoplegia after brain surgery. <i>Neuro-Ophthalmology</i> . 2009;33(1-2): 59-61.	Case report	1/19-year-old woman undergoing craniotomy in prone position	N/A	N/A	N/A	Adequate intraoperative eye protection is mandatory to reduce the risk of ophthalmic complications.	VB
464	Takahashi Y, Kakizaki H, Selva D, Leibovitch I. Bilateral orbital compartment syndrome and blindness after cerebral aneurysm repair surgery. <i>Ophthal Plast Reconstr Surg</i> . 2010;26(4): 299-301.	Case report	1/56-year-old man undergoing cranial surgery in the jack-knife position	N/A	N/A	N/A	Attention to factors such as direct compression from skin flaps, congestion from head positioning, and adequate intraoperative eye protection can reduce the risk of orbital compartment syndrome or allow faster management when diagnosed.	VC

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REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
465	Woodruff C, English M, Zaouter C, Hemmerling TM. Postoperative visual loss after plastic surgery: case report and a novel continuous real-time video monitoring system for the eyes during prone surgery. <i>Br J Anaesth</i> . 2011;106(1): 149-151.	Case report	1/62-year-old male undergoing plastic surgery in the prone position	N/A	N/A	N/A	The eyes must be continuously monitored when patients are in the prone position.	VC
466	Yu HD, Chou AH, Yang MW, Chang CJ. An analysis of perioperative eye injuries after nonocular surgery. <i>Acta Anaesthesiologica Taiwanica: Official Journal of the Taiwan Society of Anesthesiologists</i> . 2010;48(3): 122-129.	Nonexperimental	17 of 75,120/Cases identified to have sustained postoperative eye injury	N/A	N/A	Type of eye injury/ Risk factors for eye injury	Operations in the lateral or prone position, preoperative anemia, and intraoperative deliberate hypotension are precipitating factors for eye injury.	IIIB
467	Walker BJ, Rampersad SE. Iatrogenic endotracheal tube obstruction with foam face padding. <i>Paediatr Anaesth</i> . 2009;19(5): 544-545.	Case report	1/23-month-old boy undergoing surgery in the prone position	N/A	N/A	N/A	Visual inspection of foam face positioners used during prone positioning is necessary to prevent small pieces of foam from entering the endotracheal tube.	VB
468	Chae Y-J, Kim J-Y, Yoo J-Y, Choi Y-H, Park K-S. Tongue bite in a patient with tracheostomy after prone position-A case report. <i>Korean Journal of Anesthesiology</i> . 2011;60(5): 365-368.	Case report	1/22-year-old man undergoing spine surgery post-traumatic tracheostomy	N/A	N/A	N/A	To reduce the risk of tongue protrusion in the prone position, pressure to the neck should be minimized and a neutral head position used.	VB
469	Minonishi T, Kinoshita H, Hirayama M, et al. The supine-to-prone position change induces modification of endotracheal tube cuff pressure accompanied by tube displacement. <i>J Clin Anesth</i> . 2013;25(1): 28-31.	Nonexperimental	132/Intubated patients, ASA class I, II, or III undergoing lumbar spine surgery	N/A	N/A	Differences in endotracheal tube depth and intracuff pressure	After position change, 91.7% of patients had endotracheal tube displacement.	IIIB
470	Lee JA, Jeon YS, Jung HS, Kim HG, Kim YS. Acute compartment syndrome of the forearm and hand in a patient of spine surgery - A case report. <i>Korean Journal of Anesthesiology</i> . 2010;59(1): 53-55.	Case report	1/38-year-old woman undergoing spine surgery in the prone position	N/A	N/A	N/A	Incorrect placement of chest supports can cause compartment syndrome.	VB

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471	Cho KT, Lee HJ. Prone position-related meralgia paresthetica after lumbar spinal surgery : a case report and review of the literature. <i>Journal of Korean Neurosurgical Society</i> . 2008;44(6): 392-395.	Case report	1/51-year-old woman undergoing posterior lumbar interbody fusion	N/A	N/A	N/A	To decrease the incidence of prone position-related melagia paresthetica, the patient should be positioned symmetrically and every effort should be made to reduce the length of surgery, minimize intraoperative blood loss, and avoid hypotension during surgery.	VA
472	Chikhani M, Evans DL, Blatcher AW, et al. The effect of prone positioning with surgical bolsters on liver blood flow in healthy volunteers. <i>Anaesthesia</i> . 2016;71(5):550-555.	Nonexperimental	10/Volunteers	N/A	N/A	Differences in cardiac output and plasma disappearance rate	There is an acute and reversible change in hepatocellular function and cardiac output associated with the supine position.	IIIB
473	Debbarma S, Garg S, Kumar K, Anuradha S, Dewan R. Obesity and respiratory complications. <i>Journal International Medical Sciences Academy</i> . 2008;21(3): 151-153.	Expert opinion	N/A	N/A	N/A	N/A	Respiratory alterations and complications in obese patients can be broadly classified into three main categories: 1) alteration in respiratory system mechanics, 2) sleep-related respiratory complications, and, 3) respiratory complications during critical illness.	VB
474	Archer TL, Suresh P, Shapiro AE. Cardiac output measurement, by means of electrical velocimetry, may be able to determine optimum maternal position during gestation, labour and caesarean delivery, by preventing vena caval compression and maximizing cardiac	Expert opinion	N/A	N/A	N/A	N/A	Measurement of cardiac output during labor by means of electrical velocimetry may represent a method for determining sufficient uterine displacement.	VB
475	Saravanakumar K, Hendrie M, Smith F, Danielian P. Influence of reverse trendelenburg position on aortocaval compression in obese pregnant women. <i>International Journal of Obstetric Anesthesia</i> . 2016;26:15-18.	Nonexperimental	6/Obese, pregnant women	N/A	N/A	Differences in measurements of inferior vena cava or aorta diameter	A nonstatistically significant improvement of aortocaval compression was noted with the addition of 15° reverse Trendelenburg tilt to the supine position with pelvic tilt in obese pregnant women.	IIIC

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476	Lee SW, Khaw KS, Ngan Kee WD, Leung TY, Critchley LA. Haemodynamic effects from aortocaval compression at different angles of lateral tilt in non-labouring term pregnant women. <i>Br J Anaesth</i> . 2012;109(6): 950-956.	Nonexperimental	157/Non-laboring pregnant patients scheduled for elective cesarean section	N/A	N/A	Differences in hemodynamic measurements	Aortocaval compression can be minimized by a left lateral tilt of 15° or more.	IIIB
477	Baird EJ, Arkoosh VA. Hemodynamic effects of aortocaval compression and uterine contractions in a parturient with left ventricular outflow tract obstruction. <i>Anesthesiology</i> . 2012;117(4): 879-879.	Case report	1/21-year-old pregnant woman at 37 weeks gestation	N/A	N/A	N/A	At term gestation, there is nearly complete obstruction of the inferior vena cava in the supine position. Left uterine displacement resolved the aortal compression.	VC
478	Zhou ZQ, Shao Q, Zeng Q, Song J, Yang JJ. Lumbar wedge versus pelvic wedge in preventing hypotension following combined spinal epidural anaesthesia for caesarean delivery. <i>Anaesthesia & Intensive Care</i> . 2008;36(6): 835-839.	Randomized controlled trial	60/Pregnant women undergoing cesarean section	Use of a pelvic wedge	Use of a lumbar wedge	Incidence of hypotension	A lumbar wedge was more effective than a pelvic wedge in preventing hypotension.	IB
479	National Guideline Clearinghouse Perioperative care of the pregnant woman. Evidence-based clinical practice guideline. Accessed on 11/17/2015.	Clinical practice guideline	N/A	N/A	N/A	N/A	Assessments and interventions that are appropriate for pregnant women undergoing nonobstetric surgical procedures should be initiated.	IVA
480	Higuchi H, Takagi S, Zhang K, Furui I, Ozaki M. Effect of lateral tilt angle on the volume of the abdominal aorta and inferior vena cava in pregnant and nonpregnant women determined by magnetic resonance imaging. <i>Anesthesiology</i> . 2015;122(2):286-293.	Nonexperimental	20/Pregnant (n = 10), and nonpregnant (n = 10) volunteers	N/A	N/A	Degree of aortocaval compression	Aortic volume in pregnant women did not differ from nonpregnant women in supine position with 15° left lateral tilt, but was significantly increased at 30° and 45° left lateral tilt.	IIIA
481	Harvey NL, Hodgson RL, Kinsella SM. Does body mass index influence the degree of pelvic tilt produced by a Crawford wedge? <i>International Journal of Obstetric Anesthesia</i> . 2013;22(2): 129-132.	Nonexperimental	60/Pregnant women undergoing cesarean section (20 with a BMI ≤ 25 kg/m ² ; 20 with a BMI of 25.1 to 35 kg/m ² ; 20 with a BMI > 35 kg/m ²)	N/A	N/A	Differences in pelvic tilt measurements	Variability of pelvic tilt increased with BMI and was greatest in pregnant women with a BMI > 35 kg/m ² .	IIIB

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482	Kinsella SM, Harvey NL. A comparison of the pelvic angle applied using lateral table tilt or a pelvic wedge at elective caesarean section. <i>Anaesthesia</i> . 2012;67(12): 1327-1331.	Nonexperimental	34/Pregnant women undergoing elective cesarean section	N/A	N/A	Differences in pelvic tilt measurements	Lateral OR bed tilt and a pelvic wedge were equally effective in producing sufficient tilt of the pelvis.	IIIB
483	Cluver C, Novikova N, Hofmeyr GJ, Hall DR. Maternal position during caesarean section for preventing maternal and neonatal complications. <i>Cochrane Database of Systematic Reviews</i> . 2013;3: 007623.	Systematic review with meta-analysis	11/Studies with a total of 857 women undergoing cesarean section	N/A	N/A	Incidence of air embolism, maternal hypotension, and maternal hypertension	There is limited evidence to support or clearly disprove the value of the use of tilting or flexing the OR bed, the use of wedges and cushions or the use of mechanical displacers. A left lateral tilt may be better than a right lateral tilt and manual displacers may be better than a left lateral tilt.	IA
484	Defining adult overweight and obesity overweight & obesity CDC https://www.cdc.gov/obesity/adult/defining.html . Accessed 8/10/2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
485	Donohoe CL, Feeney C, Carey MF, Reynolds JV. Perioperative evaluation of the obese patient. <i>J Clin Anesth</i> . 2011;23(7): 575-586.	Expert opinion	N/A	N/A	N/A	N/A	Obesity is a condition of chronic systemic inflammation and is associated with an increased burden of comorbidities.	VA
486	Yamane T, Date T, Tokuda M, et al. Hypoxemia in inferior pulmonary veins in supine position is dependent on obesity. <i>American Journal of Respiratory & Critical Care Medicine</i> . 2008;178(3): 295-299.	Nonexperimental	40/Patients with normal cardiopulmonary function undergoing catheter ablation for atrial fibrillation in the supine position	N/A	N/A	Differences in blood gas, spirometry, and pulmonary scintigraphy measurements	The findings demonstrate that, in the supine position, even moderate obesity is associated with appreciable regional hypoxemia.	IIIB
487	Cheema UY, Vogler CN, Thompson J, Sattovia SL, Vallurupalli S. Protracted hypocalcemia following post-thyroidectomy lumbar rhabdomyolysis secondary to evolving hypoparathyroidism. <i>Ear Nose Throat J</i> . 2015;94(3): 113-116.	Case report	1/Extremely obese, 51-year-old woman undergoing thyroidectomy	N/A	N/A	N/A	The patient's extreme obesity, the supine position, and the prolonged surgery contributed to the development of rhabdomyolysis.	VB
488	Lee BJ, Kang JM, Kim DO. Laryngeal exposure during laryngoscopy is better in the 25 degrees back-up position than in the supine position. <i>Br J Anaesth</i> . 2007;99(4):581-586.	Nonexperimental	40/Adult patients undergoing elective surgery	N/A	N/A	Laryngeal view	The laryngeal view improved significantly when the head of the OR bed was elevated 25°.	IIIB

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489	Collins JS, Lemmens HJ, Brodsky JB, Brock-Utne JG, Levitan RM. Laryngoscopy and morbid obesity: A comparison of the "sniff" and "ramped" positions. <i>Obes Surg</i> . 2004;14(9):1171-1175.	Randomized controlled trial	60/Extremely obese patients undergoing elective bariatric surgery	Supine position augmented with a firm 7-cm wedge-shaped positioning device	Supine position	Ease of mask ventilation/ Ease of intubation	The head-elevated position is superior to the supine position for intubating extremely obese patients.	IB
490	Rao SL, Kunselman AR, Schuler HG, DesHarnais S. Laryngoscopy and tracheal intubation in the head-elevated position in obese patients: A randomized, controlled, equivalence trial. <i>Anesth Analg</i> . 2008;107(6):1912-1918.	Randomized controlled trial	85/Adults with BMI > 30 kg/m ² undergoing elective surgery	Head-elevated position using blankets or elevating the head of the OR bed	Supine position	Ease of mask ventilation/ Ease of intubation	The two methods are equivalent.	IA
491	Cattano D, Melnikov V, Khalil Y, Sridhar S, Hagberg CA. An evaluation of the rapid airway management positioner in obese patients undergoing gastric bypass or laparoscopic gastric banding surgery. <i>Obes Surg</i> . 2010;20(10):1436-1441.	Quasi-experimental	51/Adult surgical patients undergoing gastric bypass or laparoscopic gastric banding surgery	Supine position augmented with an inflatable wedge-shaped positioning device	Supine position	Ease of mask ventilation/ Ease of intubation	Ease of ventilation and laryngeal view were both improved with the inflatable wedge-shaped positioning device.	IIIB
492	Banicek J, McGarvey D. The effect of patient positioning during lengthy surgery on postoperative health. <i>Nurs Times</i> . 2010;106(3):15.	Case report	1/53-year-old man undergoing colon resection in the lithotomy position	N/A	N/A	N/A	Assess patients who have received epidural anesthesia for sensory and motor block pain and unusual symptoms such as pins and needles, or numbness in the legs.	VC
493	O'Brien DD, Shanks AM, Talsma A, Brenner PS, Ramachandran SK. Intraoperative risk factors associated with postoperative pressure ulcers in critically ill patients: A retrospective observational study. <i>Crit Care Med</i> . 2014;42(1):40-47.	Nonexperimental	2695/Patients undergoing surgical procedures and receiving care in one of three ICUs using an electronic documentation application	N/A	N/A	Pressure injury development	Postoperative pressure injury occurred in 10.7% of critically ill patients. Intraoperative use of blood products was associated with postoperative pressure injury.	IIIB
494	Perianesthesia nursing standards practice recommendations and interpretive statements 2017-2018. Cherry Hill, NJ: American Society of PeriAnesthesia Nurses; 2017:164.	Clinical practice guideline	N/A	N/A	N/A	N/A	These standards provide a framework for care of a diverse patient population in all perianesthesia settings.	IVB

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495	Minnich L, Bennett J, Mercer J. Partnering for perioperative skin assessment: A time to change a practice culture. <i>J Perianesth Nurs</i> . 2014;29(5):361-366.	Organizational experience	N/A	N/A	N/A	Pressure injury development	After implementation of a new process to prevent pressure injury, the incidence of hospital acquired pressure injury dropped from 7.1% to 3.3%.	VA
496	Gezginci E, Ozkaptan O, Yalcin S, Akin Y, Rassweiler J, Gozen AS. Postoperative pain and neuromuscular complications associated with patient positioning after robotic assisted laparoscopic radical prostatectomy: a retrospective non-placebo and non-randomized	Nonexperimental	534/Patients who underwent robotic-assisted radical prostatectomy	N/A	N/A	Postoperative pain or neuromuscular complications	Patients with previous operations, comorbidities, and high ASA classifications are at greater risk of neuromuscular complications associated with robotic-assisted radical prostatectomy. Patients with lower BMI and having an implant have higher levels of postoperative pain.	IIIB
497	Kalin A, Hariharan V, Tudor F. Unicompartament compartment syndrome following laparoscopic colonic resection. <i>BMJ Case Reports</i> . 2013.	Case report	1/43-year-old man who underwent laparoscopic colorectal surgery in the lithotomy position	N/A	N/A	N/A	Any patient with increasing and abnormal or unexpected pain following laparoscopic surgery and higher use of analgesia than anticipated should trigger an assessment for compartment syndrome.	VB
498	Hoff JM, Varhaug P, Midelfart A, Lund-Johansen M. Acute visual loss after spinal surgery. <i>Acta Ophthalmologica</i> . 2010;88(4): 490-492.	Case report	1/56 year-old man undergoing cervical spinal surgery	N/A	N/A	N/A	Ischemic optic neuropathy is the most common cause of visual loss after spine surgery and safe practices should be established and implemented for protecting the patient's eyes.	VB
499	Price TP, Ivashchenko A, Schurr MJ. Perioperative visual loss after excision and autografting of a thermal burn to the back. <i>Burns</i> . 2014;40(4): e31-4.	Case report	1/45-year-old man undergoing deep partial- and full-thickness autografting in the prone position	N/A	N/A	N/A	Intraoperative contributors for the postoperative vision loss in this patient included prone positioning, Wilson frame use, prolonged duration of operation, extensive blood loss, and anemia.	VB
500	Yilmaz M, Kalemci O. Visual loss after lumbar discectomy due to cortical infarction: Case report. <i>Journal of Neurological Sciences</i> . 2013;30(2): 422-426.	Case report	1/53-year-old woman undergoing spinal surgery in the prone position	N/A	N/A	N/A	The patient's risk factors for anemia and hypotension may help to explain the postoperative vision loss.	VC

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501	State operations manual appendix A - survey protocol, regulations and interpretive guidelines for hospitals. rev. 151. Centers for Medicare & Medicaid Services Web site. https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_a_hospitals.pdf . Published 11/20/15. Updated 2015. Accessed 11/28, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
502	State operations manual appendix L - guidance for surveyors: Ambulatory surgical centers. rev. 137. Centers for Medicare & Medicaid Services Web site. https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/som107ap_l_ambulatory.pdf . Published 4/01/15. Updated 2015. Accessed 11/28, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
503	42 CFR 482. conditions of participation for hospitals. U.S. Government Publishing Office Web site. http://www.ecfr.gov/cgi-bin/text-idx?SID=11400468294f28398439cedf7ee475b8&mc=true&node=pt42.5.482&rgn=div5 . Published 11/23/16. Updated 2016. Accessed 11/28, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
504	42 CFR 416. ambulatory surgical services. U.S. Government Publishing Office Web site. http://www.ecfr.gov/cgi-bin/text-idx?SID=a4e058e08c40f1254bab0236388c4d96&mc=true&node=pt42.3.416&rgn=div5 . Published 11/23/16. Updated 2016. Accessed 11/28, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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505	RC.01.01.01: The hospital maintains complete and accurate medical records for each individual patient. In: Hospital accreditation standards. 2016th ed. Oak Brook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
506	MS.16: Medical record maintenance. In: NIAHO interpretive guidelines and surveyor guidance. Version 11 ed. Milford, OH: DNV GL - Healthcare; 2014:37.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
507	RC.01.01.01: The organization maintains complete and accurate clinical records. In: Standards for ambulatory care. Oak Brook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
508	Clinical records and health information. In: Accreditation handbook for ambulatory health care. Skokie, IL: Accreditation Association for Ambulatory Health Care, Inc.; 2016:51-53.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
509	Medical records: Operating room records. In: Regular standards and checklist for accreditation of ambulatory surgery facilities. Version 14.4 ed. Gurnee, IL: American Association for Accreditation of Ambulatory Surgery Facilities, Inc.; 2016:60-63.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
510	Medical records: Procedure room records. In: Procedural standards and checklist for accreditation of ambulatory surgery facilities. Version 3 ed. Gurnee, IL: American Association for Accreditation of Ambulatory Surgery Facilities; 2011:64-66.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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511	Guideline for health care information management. In: Guidelines for perioperative practice. 2017th ed. Denver, CO: AORN, Inc.; 2017:591-616.	Clinical practice guideline	N/A	N/A	N/A	N/A	Highly reliable data collection is not only necessary to chronicle the patient response to nursing interventions, but also to demonstrate the health care organization's progress toward quality care outcomes.	IVA
512	Jordan C, Thomas MB, Evans ML, Green A. Public policy on competency: How will nursing address this complex issue? <i>J Contin Educ Nurs</i> . 2008;39(2):86-91.	Expert opinion	N/A	N/A	N/A	N/A	The primary responsibility for maintaining ongoing competency remains with the individual.	VB
513	HR.01.05.03: Staff participate in ongoing education and training. In: Comprehensive accreditation manual: CAMH for hospitals. 2016th ed. Oak Brook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
514	MS.10: Continuing education. In: NIAHO interpretive guidelines and surveyor guidance. Version 11 ed. Milford, OH: DNV GL - Healthcare; 2014:30.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
515	HR.01.05.03: Staff participate in ongoing education and training. In: Comprehensive accreditation manual: CAMAC for ambulatory care. 2016th ed. Oak Brook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
516	Governance. In: Accreditation handbook for ambulatory health care. 2016th ed. Skokie, IL: Accreditation Handbook for Ambulatory Health Care, Inc.; 2016:33-40.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
517	Personnel: Personnel records; individual personnel files. In: Regular standards and checklist for accreditation of ambulatory surgery facilities. 2016th ed. Gurnee, IL: American Association for Accreditation of Ambulatory Surgery Facilities, Inc.; 2016:74-75.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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518	LD.04.01.07: The hospital has policies and procedures that guide and support patient care, treatment, and services. In: Hospital accreditation standards. 2016th ed. Oak Brook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
519	SS.1:Organization. In: NIAHO interpretive guidelines and surveyor guidance. Version 11 ed. Milford, OH: DNV GL - Healthcare; 2014:80-82.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
520	LD.04.01.07: The organization has policies and procedures that guide and support patient care, treatment, or services. In: Standards for ambulatory care. 2016th ed. Oak Brook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
521	Personnel: Personnel records. In: Procedural standards and checklist for accreditation of ambulatory surgery facilities. Version 3 ed. Gurnee, IL: American Association for Accreditation of Ambulatory Surgery Facilities, Inc.; 2011:77-79.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
522	PI.03.01.01: The hospital improves performance on an ongoing basis. In: Hospital accreditation standards. 2016th ed. Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
523	QM.1: Quality management system. In: NIAHO interpretive guidelines and surveyor guidance. Version 11 ed. Milford, OH: DNV GL - Healthcare; 2014:10-17.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
524	PI.03.01.01: The organization improves performance. In: Standards for ambulatory care. 2016th ed. Oak Brook, IL: Joint Commission Resources; 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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525	Quality management and improvement. In: Accreditation handbook for ambulatory health care. 2016th ed. Skokie, IL: Accreditation Association for Ambulatory Health Care, Inc.; 2016:46-50.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
526	Quality assessment/quality improvement: Quality improvement. In: Regular standards and checklist for accreditation of ambulatory surgery facilities. Version 14.4 ed. American Association for Accreditation of Ambulatory Surgery Facilities; 2016:64.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
527	Quality assessment/quality improvement: Unanticipated operative sequelae. In: Regular standards and checklist for accreditation of ambulatory surgery facilities. Version 14.4 ed. American Association for Accreditation of Ambulatory Surgery Facilities, Inc.; 2016:66-69.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
528	Salkind EM. A novel approach to improving the safety of patients undergoing lumbar laminectomy.. AANA J. 2013;81(5): 389-393.	Organizational experience	N/A	N/A	N/A	Decreased morbidity and mortality associated with positioning	The checklist itself was easy to use in its intended environment and accomplished the goal of including the many facets of correct positioning necessary to prevent morbidity and mortality.	VC
529	MAUDE—Manufacturer and user facility device experience. . U.S. Food and Drug Administration Web site. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfmaude/search.cfm . Accessed 11/28, 2016.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Guideline for Positioning the Patient
Evidence Table

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/POPULATION	INTERVENTION(S)	CONTROL/COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE