Positioning and the Surgical Robot

How to deal with the special requirements of the surgical robotics experience.

By: Dan Allen, Founding Partner, Medicus Surgical and Nursing CE Portal

One of the most important discussions surrounding patient positioning today revolves around the area of robotic assisted laparoscopy. Having observed many GYN and Urologic robotic procedures I became painfully aware that the unique nature of the surgical robot has created unintended consequences with regards to patient positioning. Since the earliest days of the robot there has been a substantial void between real time positioning requirements, existing patient positioning standards and guidelines and the availability of new generation, robot compatible accessories.

In this article I will identify some of the “unintended positioning related consequences” and shed light on the strengths and limitations of many of the contemporary positioning accessories currently being used for positioning patients during robotic procedures. Primary focus will be on Trendelenburg and upper extremity patient restraints.

Trendelenburg Restraints

Current positioning principals and guidelines apply to traditional laparoscopy. In robotic surgery there exist certain positioning requirements that make a number of the guidelines and recommended Trendelenburg restraint devices inappropriate.

It is a fact, the knowledge of which coming from years of personal observation and conversations with anesthesiologists, nurses and surgeons, that contemporary Trendelenburg restraints permit patients to slide during the course of traditional MIS and open surgical procedures requiring the Trendelenburg position. I have been told that it is not unusual for patients to slide “just a little bit” (equating from one inch to as many as six inches) on the table. The sliding occurs quite slowly and gradually and commonly becomes obvious only at the end of the procedure after removal of drapes. It most often presents as a noticeable reduction of leg flexion when utilizing booted stirrups. The concern for patient risk due to sliding a few inches when in Trendelenburg appears to have been relatively low. Not so for robotic procedures. Sliding during robotic surgery places the patient at serious risk for injury.

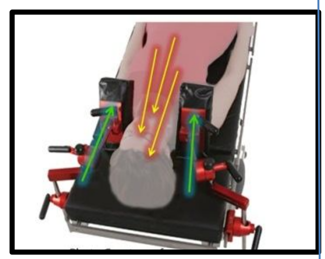
Extreme Trendelenburg and the Effects of Sliding During Robotic Surgery

The effects of patients sliding while in Trendelenburg cannot be ignored as the robot is not programed to detect if a patient is moving or sliding on the table.

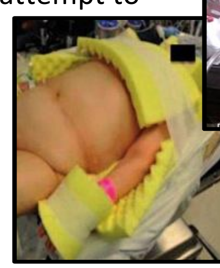
Patients sliding on the table during robotic surgery is becoming recognized globally as a serious patient positioning risk. The robot is incapable of adjusting to **any** variations in the patient's position on the table. When a patient slides, even just one half of an inch, the robotic arms, instruments and trocars maintain their fixed location as programmed. Ultimately they become the primary restraint for the patient. This has been ironically referred to as "the meat hook" restraint technique. Analysis of the literature suggests that patient injuries from sliding on the table during robotic procedures will present as severe and prolonged post op pain, bruising or even necrosis at the primary port sites.

The History of Robotic Trendelenburg Positioners

A number of positioning concepts were adopted or developed by early robotic adopters and passed along by example or by practice to others as robotic surgery gained favor.



- **Shoulder Braces –** These devices are very effective in anchoring the patient on the table. They are also generally avoided. It is well documented in the literature that shoulder braces are causal to brachial plexus injury. Martin, in his text, *Positioning in Anesthesia and Surgery*, describes the combination of gravity and patient weight forcing or "funneling" the patient's mass between the braces. This distorts the clavicle which places direct pressure on the brachial plexus. Martin also states clearly that extra padding does not reduce patient risk or reduce the cause of brachial plexus injury.



- **Tape and Foam** - Early robotic restraint concepts, still used by many hospitals, include Interesting "homemade" designs for patient restraint. In an attempt to fix the patient onto the table these techniques were often created based on theory, conjecture and the availability of large quantities of tape and foam. Several of the techniques restrict respiration by crossing adhesive bands over the chest and under the table, sticking them to the table rails

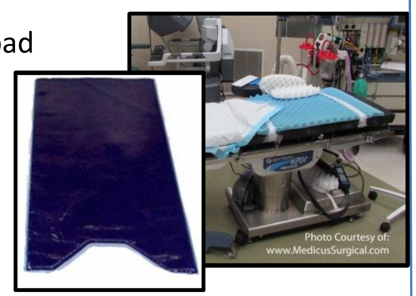
- **Anatomical Concavities** - Restraints utilizing the patient's natural, anatomical concavities were first described in 1956 by the English anesthesiologist, Dr. Langton Hewer. He described his successful experiences utilizing the concavities of the body (nape of the neck, small of the back, behind the heels) each of which contributed to the stabilization of the patient on the table. This technique eliminated the need for straps or bracing. This concept was updated and commercialized for the first time in 2006.

Common Contemporary Trendelenburg Positioners

Many Trendelenburg restraint concepts acceptable for traditional MIS and open procedures have been found not to be complimentary for use for robotic procedures.

- **Devices with Restraint Straps** - All devices utilizing straps to hold them on the table are known to slide.
  Bean bags, restraint vests with chest straps and the sticky colored pads utilize straps, attached to the table rails, to keep them from ultimately sliding off the table. Sliding occurs slowly and gradually during the course of the procedure stopping only after the weight of the patient finally pulls the restraint belts taut on the rail. Surgeons and nurses have reported observing patients sliding as much as 6 inches.

  CAUTION: *Bean bag technology is susceptible to punctures which can cause the loss of all stability. The world's largest surgical table accessory company requires users to utilize shoulder braces along with their bean bag.*



- **Skin Friction Techniques -** Patients lay with direct skin contact on table pad overlays consisting of long pieces of gel or egg-crate foam taped to the table. Sliding on these materials has been reported during robotic procedures and catastrophic sliding has been reported during traditional MIS procedures.

  CAUTION: *Overlays reduce or eliminate the patient benefits of pressure relief OR table mattress.*

- **Skin Shear Techniques –** Several devices use a combination of shear and friction. Patients are in direct physical contact with the bare operating room table mattress with the torso lying skin to skin upon a colored pad with a high coefficient of friction. These devices utilize straps to secure them to the table and patients have been reported to slide during robotic procedures. One device also incorporates the tucking of arms.

Contemporary Trendelenburg Restraints that Anchor Patients and Prevent Sliding.

To keep patients safe during robotic-assisted surgery, patients must be prevented from sliding during the procedure.

- **Shoulder Braces -** Shoulder braces are very effective in keeping patients from sliding. Some hospitals, recognizing the importance of fixing the patient on the table, still use this technology despite the clinical risks and positioning guideline cautions. Reports of neuropathy continue to appear.

  CAUTION: *Using shoulder braces has been reported in all the literature as placing patients at serious risk. They are known to be causal to brachial plexus neuropathy.*

- **Shoulder Braces supporting bean bag technology** – Shoulder braces are strongly suggested for use to keep bean bags from sliding.
  It is thought that the patient risks associated with using this technique may be common to using shoulder braces alone.

- **Anatomical Concavities** – An anatomical cervical head rest pad positioned under the notch of the neck is very effective in keeping the patient from sliding. This technique utilizes the concavity of the anatomy to anchor the patient in position.

Arm Restraint Devices for Robotics

Contrary to AORN guidelines tucking arms has become the standard for performing robotic procedures.

AORN guidelines clearly state; "unless necessary for surgical reasons, the patient's arms should not be tucked at his or her sides when in the supine position. Patient risks associated with tucking includes: interference with physiologic monitoring (e.g., blood pressure monitoring, arterial catheter monitoring) and the inability to resuscitate during an emergency due to unrecognized IV infiltration in the tucked arm. There is also an increased risk for the patient to develop compartment syndrome in the upper extremity."

- Contemporary toboggan devices are effective in cradling the arms for MIS procedures however they have proven to be impractical for use during robotic surgery as they often clash with the robot arms or interfere with the assistant.

- Arm restraint devices are available that were designed specifically for robotic surgery. They meet or exceed AORN guidelines while safely restraining arms and allowing easy access to IV lines. Several do not interfere with the assistant or clash with the robotic arm.

Summary

These suggestions are the result of conversations and interviews with nurses, surgeons and anesthesiologists and my personal experiences observing robotics procedures. In my opinion the ideal robotic positioning “system” should include:

- **Split Leg accessory for lower extremity support**.
  - Anatomically designed multi-positional split leg accessories should replace higher profile stirrups. They can increase operative space for robotic arms and further reduce the potential for peroneal nerve injury.
- **Trendelenburg restraint that anchors the patient in place**
  - The device technology must completely eliminate any risk of patient sliding.
  - It cannot utilize shoulder braces as they encourage skeletal distortion.
  - It must not incorporate crossing chest straps to assure proper respiration.
- **Arm restraints should provide a safe environment for the arm without tucking**
  - Arms should be securely cradled against the patient with very little compression.
  - The restraint should have a low profile to avoid clashing with the robot arms.
  - It should be unobtrusive to surgeons and assistants.
  - It must provide immediate and easy anesthesia access.
  - It should easily accommodate high BMI patients.
- **Table mattress should be the highest quality pressure relief patient surface available**
  - The mattress should fully conform to the patient in order to reduce shear and lower the risk of pressure injury.

Developing clinical standards for patient positioning for robotic surgical procedures is an important goal that needs to be addressed and reached immediately.

It is well past time that we question common theory on positioning patients who are being subjected to extreme postures and unusual circumstances. It is obvious to me that the classic positioning rules and current published AORN standards of care for patient positioning in extreme postures were not designed for the unique environment and the special requirements of the surgical robotics experience.

Authors Disclosure:
Mr. Dan Allen is a published author and speaker recognized as an authority on patient positioning and pressure management in the operating room. He has been involved in the development, pioneering and marketing of innovative surgical table accessory devices since 1978 and may be best known as the inventor of the Allen Stirrup and many other innovative patient positioning devices.
His professional disclosure includes being a founding partner of Medicus Surgical and Nursing CE Portal.