# Prevention of Post-Operative Vision Loss During Surgery

**Activity Number: 8210**

Continuing Nursing and
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# Prevention of Post-Operative Vision Loss During Prone Surgery

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## OVERVIEW

One of the most catastrophic complications from undergoing surgery in the prone position is the development of post-operative vision loss, referred to as post-operative vision loss (POVL). In surveys performed amongst a wide variety of patients, people often state that they would rather die than become blind. Fortunately, with proper medical care, POVL can be avoided.

This educational activity will review the background and history regarding POVL and describe current understanding of how eye injuries occur. It then details the methods and equipment needed to prevent POVL.

## LEARNER OBJECTIVES

After completing this continuing education activity, the participant should be able to:

1. Describe the causes of post-operative vision loss (POVL) during prone surgery.
2. Understand the background and studies regarding POVL.
3. Identify the steps for reducing the incidence of POVL.

## INTENDED AUDIENCE/EDUCATIONAL NEED

This continuing education activity is intended for a perioperative nurse **who is attending the Virtual AORN Global Surgical Conference & Expo 2020** and wants to learn more or needs to gain knowledge and skills in post-operative vision loss.

## TEACHING METHODOLOGIES

This continuing education activity is governed by principles of adult learning. PowerPoint images will be used to augment the speaker's presentations and a supportive study guide with content and references is provided to each participant. Attendees will have an active role in discussion as well as opportunities to ask questions and share experiences.

## ACCREDITATION INFORMATION

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Pfiedler Education is a provider approved by the California Board of Registered Nursing, Provider Number CEP14944, for **2.0 contact hours.**

Obtaining full credit for this offering depends upon attendance, regardless of circumstances, from beginning to end. Licensees must provide their license numbers for record keeping purposes.

**The certificate of course completion issued at the conclusion of this course must be retained in the participant's records for at least four (4) years as proof of attendance.**

***IAHCSMM***

The International Association of Healthcare Central Service Materiel Management has approved this educational offering for **2.0 contact hours** to participants who successfully complete this program.

## EXPIRATION DATE

This nursing activity was planned and produced exclusively for participants **of the Virtual AORN Global Surgical Conference & Expo 2020.** Credit will be awarded only to individuals who complete and submit the registration and evaluation forms by **May 1, 2020 through August 31, 2020.**

## COMMERCIAL SUPPORT

Healthcare organizations engaged in continuing medical, nursing and allied health education have adopted standards to promote balanced and evidence-based content. This course is supported by commercial funds and complies with the intent of these standards. Pfiedler Education gratefully acknowledges educational grants provided by: **Mizuho OSI.**

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## INTRODUCTION

Case reports of blindness after spine surgery surfaced decades ago. In some cases, in which the blindness was unilateral, and the affected eye was very swollen, it was presumed that direct trauma to the eye, from pressing on the head rest, was the cause. In other cases, the blindness was bilateral, and the eyes appeared normal externally. This included instances when Mayfield tongs were used and thus there was no pressure on the face at all. The actual incidence of the complication was unknown but assumed to be very rare.

A survey conducted in 1997 by Dr. Mary Chang from Barnes-Jewish Hospital called this conclusion into question. She surveyed members of the American Association of Neurological Surgeons, asking whether they had experienced any cases of blindness after prone surgery. At the time, the incidence of post-operative vision loss (POVL) was thought to be on the order of 1 in 40,000 cases. She found however that 24 of 290 surgeons reported having patients with POVL after spine surgery, and 2 of those surgeons has had 2 patients experience visual loss. This suggested that the incidence of POVL may be as high as 1 in 1000.[1]

**How common is POVL after surgery in the prone position?**

**The exact incidence of POVL is not known but is estimated to be from 1 in 1,000 to 1 in 40,000 prone surgeries.**

These findings prompted the American Society of Anesthesiologists (ASA) to use its closed claims study methodology to study POVL. In the Closed Claims Study, a committee of the ASA was given access to malpractice cases that were closed, either via settlement or trial, so they may evaluate the care provided by the anesthesia providers. The committee established a POVL Registry in 1999 to specifically look at cases in which POVL prompted the lawsuit. In their first summary of findings published in 2001, they found that 81% of the cases of blindness were caused by ischemic optic neuropathy (ION) and 19% were caused by central retinal artery occlusion (CRAO). In 77% of the cases of ION, the patient's head had been supported by a foam pillow, and in 19% by Mayfield tongs. None of the cases of CRAO occurred in patients supported by Mayfield tongs; rather, 29% occurred when a horseshoe headrest was used, and 43% when a foam pillow was used (this was before contoured foam pillows were introduced). They also found that the incidence of POVL appeared to increase in prone surgeries lasting more than 6 hours.

**What percent of cases of POVL are due to each of the four causes?**

**The number of cases of POVL due to trauma or chemical exposure is unknown. The American Society of Anesthesiologists POVL registry found that ION is the cause of POVL in 81% of cases and CRAO in 19%.**

The POVL Registry continued to collect data and the Anesthesia Patient Safety Foundation (APSF) used this data in a conference on POVL in 2012. The ASA issued a Practice Advisory for POVL Associated with Spine Surgery 2019 before closing the Registry in 2018. Conclusions from the APSF conference and ASA Practice Advisory are discussed below[2].

## CAUSES OF POVL IN PRONE SURGERY

The four causes of post-operative vision loss in patients undergoing surgery in the prone position are:

1. Direct trauma
2. Chemical exposure
3. Central retinal artery occlusion (CRAO)
4. Ischemic optic neuropathy (ION)

Traumatic injuries occur whenever unintentional contact is made with the eye by personnel, supplies or equipment during a surgical procedure. This occurs more commonly when the patient is in the supine position for surgery, as objects may fall onto the face (such as name badges when someone leans over the head of the patient). There may be an increase in incidence of impact injures with the use of robotic instruments. Robotic surgical equipment has large arms that swing about the patient and may contact the eye. Since the surgeon's focus is on the screen in front of him/her, they may not notice when a robotic arm is getting close to the patient's head. Anesthesiologists and certified registered nurse anesthetists (CRNAs) may not be familiar with a particular robotic procedure or piece of equipment, and thus may not be looking out for mechanical arms encroaching on the patient's head. Once a patient is flipped to the prone position, the eyes are relatively protected from external trauma. The dangerous time is during the flip, when an anesthesia provider or any personnel holding the patient's head inadvertently pokes their eyes. This occurs whether a foam head support or Mayfield tongs are used.

**What are the causes of POVL after surgery in the prone position?**

**The four causes of POVL are direct trauma to the eye, chemical exposure to the eye, central retinal artery occlusion and ischemic optic neuropathy.**

To improve the effectiveness of antimicrobial solutions, medical centers have switched to almost the exclusive use of chlorhexidine for skin prep. Sold commonly under the names Hibiclens, Betasept, or ChloraPrep, chlorhexidine is a powerful antimicrobial whose actions continue in the skin even after the excess fluid is wiped off. Unfortunately, chlorhexidine is toxic to the cornea. This is not commonly known, even though the manufacturer's directions state that it should not be placed on or about the eye. If a patient is placed in the prone position for surgery on the neck or head, prep solution may run down and accumulate on the eye. If the eyes were not taped tightly shut (that is, with the upper eyelid and lower eyelid in direct contact), it is possible for this prep solution to contact the cornea. Even in situations where the eyes have been taped shut, the use of

porous tape may permit chlorhexidine to be absorbed into the tape and eventually make its way onto the cornea.

The majority of the blood flow to the retina comes from the retinal artery, an end artery that courses through the optic canal. Any force placed directly on the eye is transmitted into the globe and increases intraocular pressure. When intraocular pressure exceeds the blood pressure in the retinal artery, the retinal cells become ischemic and may quickly die. It does not take a great deal of pressure to damage the retina; one can demonstrate this by pressing one's finger on the upper eyelid. Once one presses hard enough, the vision through that eye will go dark.

Anesthesia providers are aware of this issue and thus take care to prevent direct pressure on the eye. Unfortunately, as fluid is administered during prone surgery, the eyes may swell and come in contact with the padding around them. Also, movement of the head may occur because of surgical repositioning. Such movement may push the eyes towards the support pads. The use of support pads with small eye openings, such as the single-use T-shaped foam supine pillow, or the use of pads that may not provide much room for the eyes, such as the horseshoe headrest, increase the likelihood of direct pressure on the eye. For this reason, the horseshoe headrest has been abandoned and most anesthesia providers use a contoured foam head support that has a large opening for the eyes so that contact with the foam is very unlikely.

Ischemic optic neuropathy (ION) arises when blood flow to the optic nerve is reduced to an unsafe level. This may occur in either the front part of the optic canal, called anterior ION, or in the back part of the optic canal, called posterior ION. The exact pathophysiology of this injury is uncertain. Multiple purported mechanisms have been offered, but the rarity of the injury and our inability to directly measure blood flow to the eye or oxygenation of the retina has prevented finding a definitive cause. The incidence of ION is greater in longer prone surgeries, generally greater than 6 hours. It is thought that hypotension or the use of vasopressors may contribute to reduction of blood flow to the optic nerve, but a statistically strong correlation has not been found. Similarly, anemia is thought to be a predisposing factor, but a close correlation has not been found. There is a higher incidence of ION in patients who receive a large amount of blood and blood products. It is not clear if this is an independent risk factor or is just associated with long surgery.

**How does one prevent ischemic optic neuropathy (ION)?**

**Since the exact mechanism that causes ION is not understood, one cannot state definitively how to prevent it. The recommendations that are based on available data and expert consensus are to correct preexisting medical conditions that are associated with nerve injury (such as anemia, diabetes mellitus or smoking), maintain the patient's normal resting blood pressure while the patient is in the prone position, avoid surgery longer than six hours, and use a contoured foam prone helmet positioner system.**

Some believe that ION is a compartment syndrome of the optic canal. That is, fluid accumulating in the optic canal prevents normal blood flow to the nerve. This mechanism would provide a basis for the concern about level of blood pressure (too low not allowing blood to overcome the pressure from swelling), the level of venous pressure (too high further increasing the pressure in the optic canal), angle of the head (head up reducing venous pressure, which would be advantageous, but also reducing blood pressure to the head, which may be deleterious), and type of fluid used for volume expansion, with some suggesting the use of blood and/or colloid may be preferable as they would minimize tissue swelling compared to the use of crystalloid.

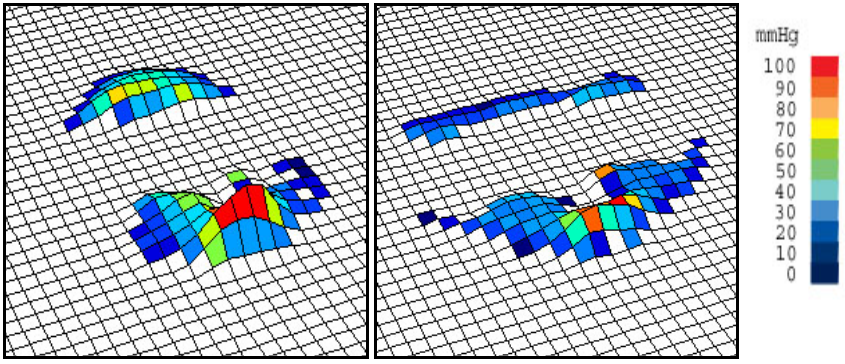
Preoperative medical conditions may also predispose a patient to ION. Anemia increases the likelihood of a need for transfusion, and hypertension may make a patient more sensitive to the effects of low blood pressure (that is, what may be an adequate pressure for a normotensive patient may produce ischemia in a patient with chronic high blood pressure). Patients with diabetes or peripheral vascular disease are prone to ischemic damage throughout the body, and those with carotid stenosis may be even more prone to ischemia above the neck. Tobacco use predisposes patients to ischemic damage and is certainly a factor that can be reduced prior to surgery. Some studies have suggested that the incidence is greater in older patients, while others have not found the incidence of ION to change with age. Male patients are more likely to develop POVL from ION than female patients.

At the current time, there is one prone head support system that has the greatest safety record. The prone positioning system includes a reusable protective helmet that holds a patient specific contoured foam pad. According to data from the manufacturer of this specialty helmet prone positioner system, the exclusive distributor, and the Food and Drug Administration (FDA), there has not been a reported incidence of CRAO or ION in four million applications of the prone helmet positioner system[3]. It makes anatomic sense that a curved foam pad with a large opening for the eyes would not allow contact with the globe and thus prevent pressure on the eye. Why ION has not been reported with the prone helmet positioner system is not clear. Measurements of surface pressure on the face show that a curved foam pad distributes pressure over a wider area and reduces the instances of high surface pressures, and this increased dispersion of pressure may protect the eyes (see Figure 1). Still, ION has been reported even with the use of Mayfield tongs, in which there is no pressure upon the face. Clinical experience shows that facial swelling during prone surgery is less with contoured foam than standard foam. If, as hypothesized, ION is due to compartment syndrome of the optic canal, this decrease in facial swelling indicates that there may also be less swelling in the optic canal when using a contoured foam head support. By wrapping the dependent part of the head in a protective foam, one may be creating a “stocking” effect, similar to compression socks.

**Can ION occur regardless of any precautions taken?**

**Maybe. ION has occurred even when Mayfield tongs are used. To date and after four million applications, the manufacturer and distributor of the contoured head support prone system and the FDA have no reports of POVL when using that system. This does not prove that such a system absolutely prevents POVL but is strong empiric evidence that it is the best system currently available.**

**Figure 1 – Dispersion of Pressure About the Face in the Prone Position[4]**




Flat foam Contoured foam

**Can POVL occur if no pressure or chemicals are placed on the eyes?**

**Yes. Ischemic optic neuropathy causes POVL even if no material comes in contact with the eyes. For example, ION has occurred in patients whose head was supported in Mayfield tongs.**

## PREVENTION OF POVL DURING PRONE SURGERY

***Role Of The Perioperative Registered Nurse (RN)***

To prevent direct trauma to the eyes requires team effort, especially as the patient is flipped from supine to prone. Although the head is controlled by either the anesthesia provider (when foam head supports are used) or the surgeon (when Mayfield tongs are used), the circulating registered nurse should observe the positioning of the patient's head as well as his/her body. In particular, it is wise to note whether anyone's fingers are getting too close to the eyes or if any objects are hanging too close to the head. As part

of his/her final position check, the perioperative RN should confirm that the eyes are visible and not in contact with any foam. It is wise to add this confirmation to the final time out before incision is made.

| Key Points for the Perioperative Registered Nurse (RN) |
|---|
| Patient assessment is a critical responsibility to help prevent injury related to patient positioning. |
| Identify a patient's risk for positioning injury and develop a plan of care for implementing preventive interventions. |
| Implement interventions to prevent direct pressure on the patient's eyes. |
| • Use a face positioner when the patient's head is positioned in the midline. |
| • Position the patient's head in a neutral position, without excessive flexion, extension, or rotation. |
| • Assess and monitor the patient's eyes verifying there is no pressure on the eyes |
| • Assess and monitor the patient's eyes after positioning activities and during the procedure, and implement corrective actions as indicated |
| • Monitor the position of the patient's face confirming the patient's position does not change during the procedure |
| Source: Association of periOperative Registered Nurses. Guideline for positioning the patient. In: *Guideline for Perioperative Practice*. 2020 ed. Denver, CO: AORN, Inc.;2020:630-704. |

**How does the perioperative RN prevent POVL from trauma to the eyes?**

**The eyes are most at risk of trauma when the patient is flipped from the supine to the prone position. A perioperative RN can help prevent trauma to the eye by carefully observing the head during the flip to make sure that no one's fingers, badges or jewelry hang down and contact the eyes.**

***Skin Prep***

A perioperative RN must recognize the danger associated with the use of chlorhexidine near the eyes. As such, chlorhexidine should not be used in skin preps when there is a reasonable likelihood that the prep could drain down into the eyes. Povidone-iodine is an effective alternative that is safe on the eyes. If chlorhexidine must be used, meticulous attention should be paid to preventing the prep solution from reaching the eyes. Asking the anesthesia provider to assist with this is smart, as is asking whether the eyes have been properly taped. It is reasonable to suggest to the anesthesia provider that he/she

use an occlusive dressing to cover the eyes whenever the possibility of prep solution entering the eyes exists.

**How does one prevent chemical damage to the eyes?**

**Chlorhexidine is toxic to the cornea. One can prevent chlorhexidine exposure by using Povidone-iodine prep solution whenever there is a chance that prep solution may drip onto the eyes. If chlorhexidine prep must be used, mopping up prep before it drains onto the face and use of an occlusive dressing to cover the eyes should prevent any seepage of chlorhexidine onto the eyes.**

| Key Points for Perioperative RN |
|---|
| In collaboration with the surgeon and anesthesia professional, select a safe, effective, healthcare organization-approved preoperative antiseptic for the individual patient based on the following<br>• patient assessment,<br>• procedure type, and<br>• review of the manufacturer's instructions for use (IFU) and contraindications. |
| Collective evidence suggests that following the antiseptic manufacturer's (IFU) and applying preoperative patient skin antiseptics in a safe and effective manner may prevent patient harm (eg, inadequate skin antisepsis, fire, chemical injury). |

| Considerations for Skin Antiseptics | |
|---|---|
| **Agent** | **Safe for use on eyes?** |
| Aqueous iodine/iodophors (10%) | For eyes, use 5% ophthalmic solution |
| Chlorhexidine gluconate (CHG) (4%) | No. Can cause corneal damage |
| Alcohol (70%-91.3%) | No. Can cause corneal damage |
| Alcoholic iodine/iodophors | No. Can cause corneal damage |
| CHG-alcohol | No. Can cause corneal damage |

Source: Association of periOperative Registered Nurses. Guideline for patient skin antisepsis. In: *Guideline for Perioperative Practice*. 2020 ed. Denver, CO: AORN, Inc.;2020: 572-597.

***Preoperative Assessment***

As the cause of ION is not certain, recommendations to prevent it are based on the suspected pathophysiology, empiric evidence, and expert consensus. The first step is to optimize the patient's preoperative condition if possible. This includes correcting anemia, normalizing blood pressure, maintaining a normal blood glucose, and a cessation of smoking. Coordination with a patient's primary care physician is helpful, if not critical, to optimize the preoperative medical condition.

***Blood Pressure***

Prior to surgery, the anesthesiologist must accurately determine the patient's resting blood pressure. This may be found in clinic notes, or in a preoperative evaluation

provided by the patient's primary care physician. If a patient shows up with new onset hypertension, it would be wise to delay surgery to bring the blood pressure under control. In some instances, preop hypertension may be due to anxiety or pain. If, in the anesthesiologist's judgment, the preop hypertension is easily treated with analgesics and/or sedatives, then the blood pressure obtained after the patient is comfortable and calm may be taken as the resting blood pressure. Even though a correlation between hypotension and POVL has not been found, current practice calls for much more aggressive maintenance of blood pressure, and certainly the avoidance of hypotensive anesthesia. Physicians and surgeons have varying opinions on this however, so the desired blood pressure range should be discussed prior to commencement of surgery. This acceptable range should be noted during the time out before incision. Treatment of hypotension with alpha agonists is not contraindicated.

***Anemia***

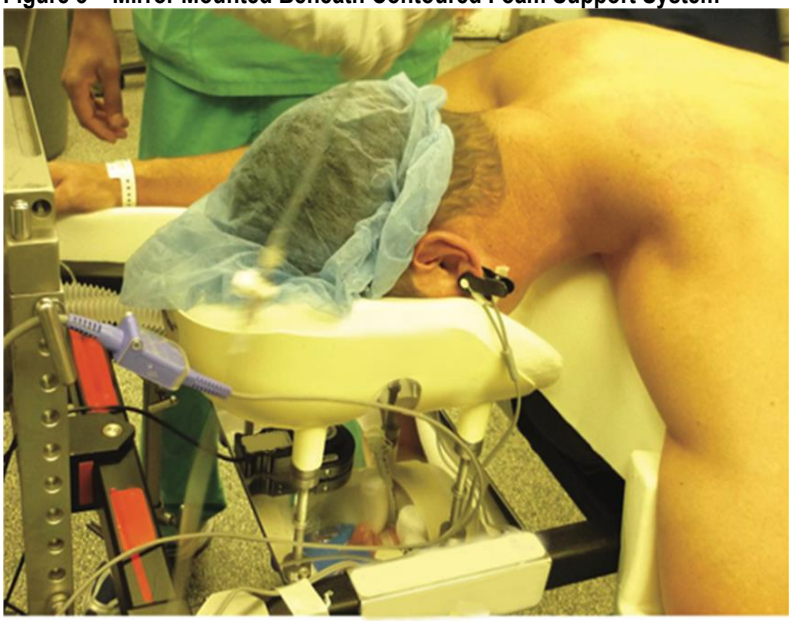
Although anemia and large transfusions are associated with a greater incidence of POVL, it is unclear if any regimen for maintaining adequate hydration and hemoglobin is better than any other. It seems reasonable to keep the hematocrit (Hct) above current recommendations for elective surgery in healthy patients, with many feeling transfusions should be started when the Hct falls below 27. The desired level should also be discussed between the anesthesiologist and surgeon prior to starting surgery. Once a Hct and type of fluid is agreed upon, one must confirm that the required products are immediately available.

***Positioning Device Considerations***

To prevent pressure on the eyes that may lead to central retinal artery occlusion, only head support devices that allow plenty of room for the eyes should be utilized. Horseshoe headrests should never be used in prone cases. If a foam support with a T-shaped hole is used, one should confirm that the eyes are not in contact with the foam once the patient is placed in the final position for surgery. Again, adding this check to the final time out before incision is warranted. Regardless of the support device utilized, eye checks should be performed repeatedly throughout the case to confirm that nothing is touching the globes. Since neurologic injury can occur after only 5 minutes of complete occlusion of the central retinal artery, checks should ideally take place every 5 minutes. If a mirror or camera system is used to see the eyes, such frequent checks are easy to accomplish (see Figure 2 and Figure 3).

**Figure 2 – Use Of A Mirror Or Camera System To Observe The Eyes**

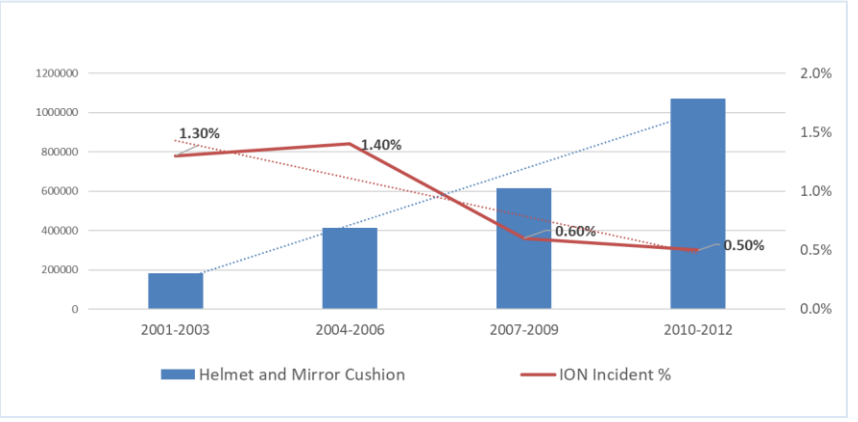
**Figure 3 – Mirror Mounted Beneath Contoured Foam Support System**



ION has been reported with all positioning devices, including Mayfield tongs, but not for contoured head foam supports. Unfortunately, the ASA's POVL registry did not collect data on the type of foam support used, so it is impossible to say whether any of the

cases of ION in the registry were with a contoured foam head support vs a flat support. The FDA requires that all manufacturers submit medical device reports whenever they receive a customer concern or complaint about one of their products. Even after 4 million uses, neither the manufacturer nor the distributor have received notice of POVL with the use of the prone helmet positioner system. If one uses the conservative estimate that POVL in prone surgery occurs in 1/10,000 procedures, one would expect that there would have been 400 cases of POVL when the prone helmet positioner system was used. It seems unlikely that, if such a number of patients was harmed, that none of the patients, physicians or facilities would have informed the manufacturer or distributor of the problem. Similarly, no lawsuit has been brought against the manufacturer or distributor claiming POVL with the use of the prone helmet positioner system[5]. The FDA and legal system do not cover all possible complications associated with the use of any device, and thus such data is not conclusive. Interestingly however, is that the rate of POVL in the last 20 years has fallen in reverse proportion to the use of the prone helmet positioner system (see Figure 4). The decrease may be due to increased awareness of POVL associated with prone surgery and therefore more attention to factors that prevent eye injury. Given that contoured foam supports eliminate the chance of CRAO, many medical centers have switched to using such devices exclusively for prone surgery.

**Figure 4 – Helmet and Mirror Cushion and ION Incident Rate[1]**




The final choice of how to support the head during prone surgery is made by agreement between the anesthesiologist and surgeon. In cases in which the surgical exposure requires a particular rotation of the head or large access to the neck, Mayfield tongs may be required. A new support device just developed may change this however. This new device allows positioning of the head across all axis while using a contoured head support system.

**How does one prevent central retinal artery occlusion (CRAO)?**

**CRAO is prevented if no pressure is allowed on the eye while the patient is in the prone position. This can be assured first by using a head support that will not allow any material to contact the eye, such as a contoured head prone support system or Mayfield tongs, and secondarily by using a method to continually visualize the eyes during surgery, such as a mirror or camera system.**

## SUMMARY

Post-operative vision loss (POVL) is one of most catastrophic complications for patients undergoing surgery in the prone position. POVL may be caused by direct trauma to the eye, chemical exposure to the eye, central retinal artery occlusion (CRAO), or ischemic optic neuropathy (ION). The first three causes of POVL are preventable: one may protect the eyes from trauma by careful observation and coverage of the eyes when the patient is turned from the supine to the prone position; one can prevent chemical exposure to the eye by avoiding the use of chlorhexidine based prep solutions; and one may prevent any pressure on the eye by using a contoured foam support pillow that has a generous opening for the eyes and also allows easy visualization of the eyes from either a mirror or camera. The cause of ION has not been clearly elucidated, but current recommendations to minimize its occurrence are to correct preexisting medical conditions that are associated with nerve injury (such as anemia, diabetes mellitus or smoking), maintain the patient's normal resting blood pressure when the patient is in the prone position, avoiding surgery longer than six hours, and use of a contoured foam prone helmet positioner system. Supporting the latter recommendation are the data from the manufacturer, distributor and FDA which show that no known cases of ION have occurred in the four million uses of the prone helmet positioner system.

**How might a contoured head support prone system prevent POVL?**

**A contoured head support foam disperses pressure about the face more than a flat head support foam and thus makes it less likely that any significant pressure will be placed upon the eyes. Also, there is less facial edema when using a contoured head support foam compared to a flat head support foam. This indicates that there may be less swelling in the optic canal when using a contoured head support foam system, analogous to using compression stockings to prevent lower extremity edema.**

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## NOTES

## NOTES

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