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RESEARCH ARTICLE

An Innovative Prone-Position Head Support for Spine Surgery: An Alternative Aimed at Mitigating Risks while Maintaining Good Exposure and Facilitating Effective Anesthesiological Interventions - A Technical Note

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ABSTRACT
This article aims to describe the development of a head support for prone spinal surgery, which allows the patient's head to be positioned in neutral alignment with the body and enables monitoring of the position of the eyes, mouth, nose, and orotracheal tube, thus avoiding damage due to poor positioning during surgery. A literature review was conducted focusing on complications resulting from head positioning in different supports to develop an option that would reduce the risks of injury. It was developed a support that protects the patient's head and allows easy visualization of the face during surgery, with sufficient space for the anesthesia team to manage the orotracheal tube if necessary. Since its creation, no serious complications have been observed in the use of this support.
Keywords: Spinal column/Surgery; Anesthesia; Safety; Complications; Patient positioning; Prone position.

Introduction

Spinal surgeries performed in the prone position under general anesthesia are widely used when an approach with posterior fixation of the spine is chosen. Putting the patient in a good position is extremely important to allow the surgeon a proper view of the area being treated and to avoid possible complications. The risks of the prone position are related to the position of the head during the operative act. Complications associated with preoperative positioning are well documented and can have potentially catastrophic consequences for the patient. Literature describes hemodynamic changes that can lead to hypoperfusion and thus various ophthalmologic changes as optic nerve ischemia, amaurosis, and vertebral artery occlusion. It also can lead to pressure necrosis of the skin, neurological deficit secondary to spinal compression, compression injury to peripheral nerves, compartment syndrome, airway swelling, and peripheral arterial compression. Although most of these complications are rare, the medical team must be familiar with them so they can develop strategies to limit morbidity in spine surgeries where the patient is prone positioned. Proper positioning of the patient with a head support aimed at preventing the occurrence of such complications and allowing better monitoring of the airway, eyes and pressure points can play an important role in preventing the occurrence of the above complications. To that end, a support for positioning the patient's head in neutral alignment with the body was developed, which allows the anesthesiologist to adequately assess and monitor the eyes, mouth, nose, and orotracheal tube during surgery. (Figures 1, 2 and 3).

Figure 1: Upper view

Figure 1: frontal view

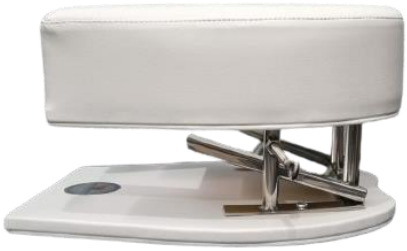

Figure 3: lateral view

Methodology

Aiming to identify pertinent articles addressing complications related to surgical positioning in the prone position during spine surgeries, this study conducted a thorough literature using PubMed, Scielo, and Cochrane databases. Key search terms included "Mayfield," "padded headrest," "horseshoe headrest," "spine," and "prone position." The search considered current and relevant literature. Additionally, reference lists of primary research articles were scrutinized to uncover supplementary contemporary and pertinent information.

Discussion

Spinal surgeries, in general, are lengthy, which leads to higher risks of pressure injuries, blood stasis, ophthalmic changes, and facial edema. In the search of solutions to mitigate these risks during prone positioned surgeries, it was devised a support that allows proper positioning.

On this support, which is based on a horseshoe format, the patient's face can be positioned without causing pressure or ophthalmic injuries and, simultaneously, facilitating the management and observation of the airways by the anesthesia team.

Horseshoe-type supports can be either placed on the table or attached to the same support, as the Mayfield headrest, which is also an option but more invasive and causing scalp and cranial injuries. The ones placed on the table, although allowing for proper positioning, provide little space for managing the endotracheal tube and little to no visualization of the patient's eyes.

The ones attached to the table, with the Mayfield headrest support, offer greater maneuverability of the endotracheal tube, but with difficult visualization of the patient's face. It is also noted that these supports are typically thin, small, and not very adaptable in size.

To overcome these weaknesses, several tests with different horseshoe-shaped designs and their potential use in everyday practice were conducted, resulting on the support shown on Figures 1, 2, and 3. This research was made possible through a

partnership between an orthotics and prosthetics laboratory in the city of Belo Horizonte - MG and the cadaver laboratory of UFMG.

As it can be seen, a padded horseshoe-shaped support was created, with height adjustment to adapt to the anatomy of different patients. The support also includes space for the passage and manipulation of the endotracheal tube and a mirror positioned in the lower region that provides visualization of the patient's face, thus avoiding compression of the patient's eyes. The support is lightweight, small, and easily transportable and assembled by the surgical team.

As an additional safety measure, a cotton helmet is placed on the patient face before positioning them on the support, further reducing the risk of pressure injuries.

This support was developed in 2008, using the authors' own resources, and has since been used as a standard item in surgeries performed by our team.

Support Description

The support consists of two parts: a horseshoe-shaped cushion and a polyethylene fiber base with a removable inclined mirror.

The horseshoe-shaped cushion is made of three parts. The foam, with a density of 28, is cut in the aforementioned shape, 6cm high and 6cm wide. It is supported by a rigid polyethylene piece, 1.5cm thick, also in the aforementioned shape (Figures 1, 2 and 3).

The horseshoe is 29cm long, with an external diameter of 18cm at the base, an external diameter of 25cm at eye level, and a distal external diameter of 20cm. The free span is 23cm long with a maximum internal diameter of 11cm at eye level. The distal part of the cushion has a chamfer that allows the anesthesiologist to check the facial structures. The foam and polyethylene are covered with white surgical napa fabric.

For connection to the polyethylene fiber base, a stainless-steel piece was designed with four solid columns, 6.5cm in length and 0.8cm in diameter, that slide inside four other columns, 6.5cm by 1cm in diameter (hollow), fixed to the base. This height adjustment feature allows the surgeon or anesthesiologist to flex or extend the patient's head for better relaxation of the cervical structures. The distances between the posterior columns are 17.5cm and between the anterior ones 11cm. The distance between the ipsilateral posterior and anterior is 7.5cm, forming a trapezoid.

The polyethylene fiber base, 1.5cm thick, is also covered in napa. It measures 27cm in length by 26cm in width with rounded corners. The stainless-steel piece with the four columns is moved forward on the base, placed at a distance of 2.5cm from the distal edge. This allows the base to slide under the device that supports the abdomen and chest (cushions, buoy, or foam support), increasing stability.

The mirror is trapezoidal, 15cm high; the larger base is 18cm and the smaller base is 14cm. It is placed on a 15cm long rail with a 15-degree incline on the horizontal plane, removable for easy cleaning of the set. The mirror's inclination allows the anesthesiologist to view the eyes, nose, endotracheal tube, and mouth, confirming that they are protected and free from compression during surgery (Figures 1 and 8)

Another feature of the support is that the head is not fixed, thus allowing surgeries to be performed under traction.

This is a long-lasting, non-disposable stainless-steel material. It is washable and allows for antisepsis by chemical means, including the detachable mirror.

Support Use

For the use of support and greater protection, we assemble a "helmet" on the patient before fitting them into the support. We use four rolls of orthopedic cotton of 15cm thickness and two rolls of crepe bandage of 10cm thickness. The cotton rolls are unwound and folded into layers of about 20cm each (Figures 4 and 5). They are positioned on the patient's face, after the anesthetic and intubation process, to protect the forehead, zygomatic prominences, and chin (Figure 6). The cotton strips are then secured with the crepe bandages. The eyes should be left free for checking that they will not be pressed in the prone position of the patient as shown in Figures 7 and 8.

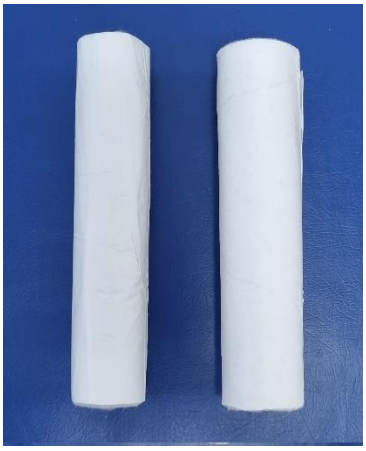

Figure 4: *orthopedic cottons to be used*

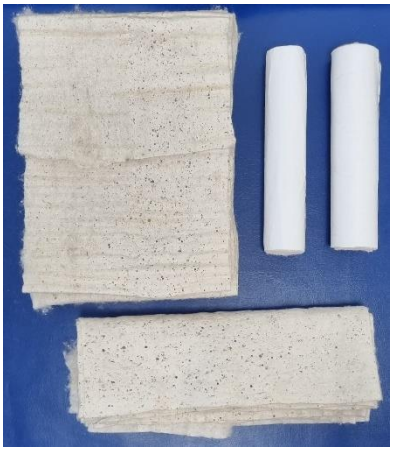

Figure 5: *materials and their preparation before making the helmet on the patient*

Figure 6*: helmet assembly allowing good visualization of the eyes and handling of the endotracheal tube*

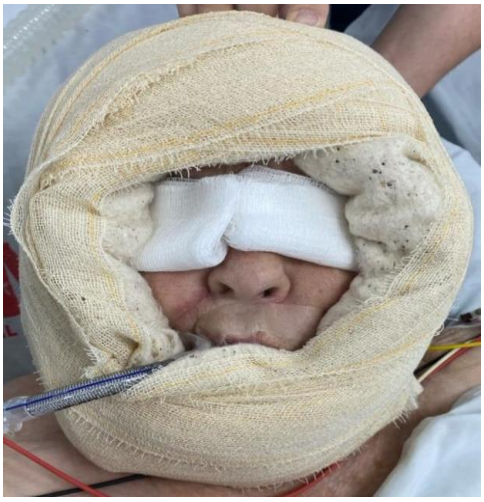

Figure 7: *Patient positioned for spine surgery, notice that the eyes are free, as well as the endotracheal tube*

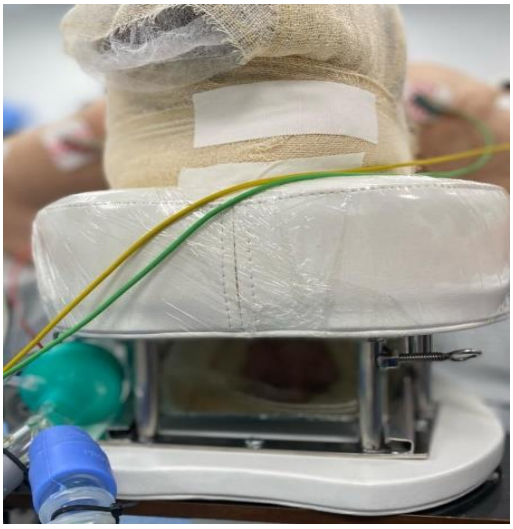

Figure 8: *Patient positioned in prone position for spine surgery, neutral alignment of the head in relation to the body axis is noted. Possibility of viewing the eyes, mouth and nose through the inclined mirror.*

Conclusion

The prone position is known to provide excellent access to the cervical, thoracic and lumbar spine during surgeries that require posterior fixation of the spine. Nonetheless, this positioning entails inherent risks. Meticulous planning by the surgical team is essential, a comprehensive assessment of the risks and benefits associated with patient positioning should be conducted, and strategies implemented to mitigate potential complications. A balance must be found between ideal positioning for the surgical procedure, greater safety during anesthesia and lower risk of complications for the patient.

To this end, a series of aspects such as the protection of pressure areas, the maintenance of perfusion and adequate venous return, eye protection and the safety of ventilatory devices have to be taken into consideration.

Furthermore, it is important that the head support used allows the anesthetic team to perform timely interventions at all stages of the surgery.

The head support developed and discussed in this article serves this purpose, meeting the needs of both the surgical team and the anesthetic team, by increasing safety during the surgical procedure and consequently minimizing complications related to patient positioning.

Conflict of Interest

The authors have no conflicts of interest to declare.

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