Multimodal systemic analgesia using different routes also plays an essential role in controlling the inflammatory process, dealing with the neuropathic component of pain, and thus reducing its severity. The factors other than anesthesia and surgical techniques that influence postoperative pain include the patient's age, sex, comorbidities, pain threshold, and severity of preoperative pain.[1] Besides, the patients' postoperative activity level, the use and duration of tourniquet exsanguinations, preoperative consumption of opioids, opioid-induced hyperalgesia, opioid dependence/resistance/tolerance can also affect the severity of postoperative pain. A thorough assessment of postoperative pain is necessary to determine the actual cause of pain and prompt management. In our experience, we found that the patient develops tourniquet pain over the anterior/posterior aspect of the thigh due to regression of spinal level at 4–6 hours. Many times, patients confuse this with anterior/posterior knee pain. Hence, a thorough postoperative pain assessment is required to determine the cause of pain and rectify mistakes.

To conclude, the ideal RA technique for TKR should be procedure-specific, motor-sparing, opioid-sparing, and should adequately cover both anterior and posterior components of knee pain. Although we have arrows in the form of different RA techniques, we are yet to hit the bull's eye to provide optimal analgesia and minimize the complications.

Conflicts of interest

The authors declare no conflicts of interest.

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Challenges of prototyping, developing, and using video laryngoscopes produced by inhouse manufacturing on 3D printers

Dear Editor,

The limiting factor for routine and widespread use of video laryngoscopes are their cost and availability. The price paid by Brazilian public organizations changed a lot in past months and figures up to 65,000 reais (R$) can be found.[1] Moreover, their availability has declined in the current global scenario. Therefore, pursuing low cost and widely available alternatives has become even more important. A Macintosh style acute angle video laryngoscope made on a 3D printer was developed based on a project available on the airangel.com website. The device is capable of being reproduced in large scale with efficacy, low cost, and availability on a free collaborative platform for the whole population.

During the 3D printing process, some parameters should be set up for the model developed to have expected physical features, among which, the main ones are: type of material, extrusion temperature, model filling, size of printing nozzle, width of layers, number of perimeters, among others. It is worth underscoring that each one of these parameters has a direct impact on the quality, weight, manufacturing time, and consequently on the final cost of the object.

Polylactic Acid (PLA) is a thermoplastic polyester whose end features are that of being biocompatible and biodegradable, it hydrolyzes in vivo and transforms into lactic acid, ideal for clinical use. Thus, use of PLA has already been approved by the National Sanitary Surveillance Agency (ANVISA – Agência Nacional de Vigilância Sanitária).[2]

In order to seek enhanced cost-benefit for the manufacturing process of the device, the method of finite elements was used. The method consists of discretization of a continuous medium into small elements, maintaining the same properties of the original medium. The elements are described by differential equations and solved by mathematical models, so that desired cost results be attained. For this analysis, tension and fatigue simulations of the material using Computer Aided Engineering (CAE)[3] were used.

By looking at image A of Figure 1, we can see that major tensions lie on the object surface, so parameters that influence size of external walls directly influence stiffness and resistance of the device. Thus, for manufacturing the device, it is advisable to use at least 4 perimeters, that is, 4 external lines per layer, as shown in image B of the same figure. Moreover, it is recommended to fill out at least 10%

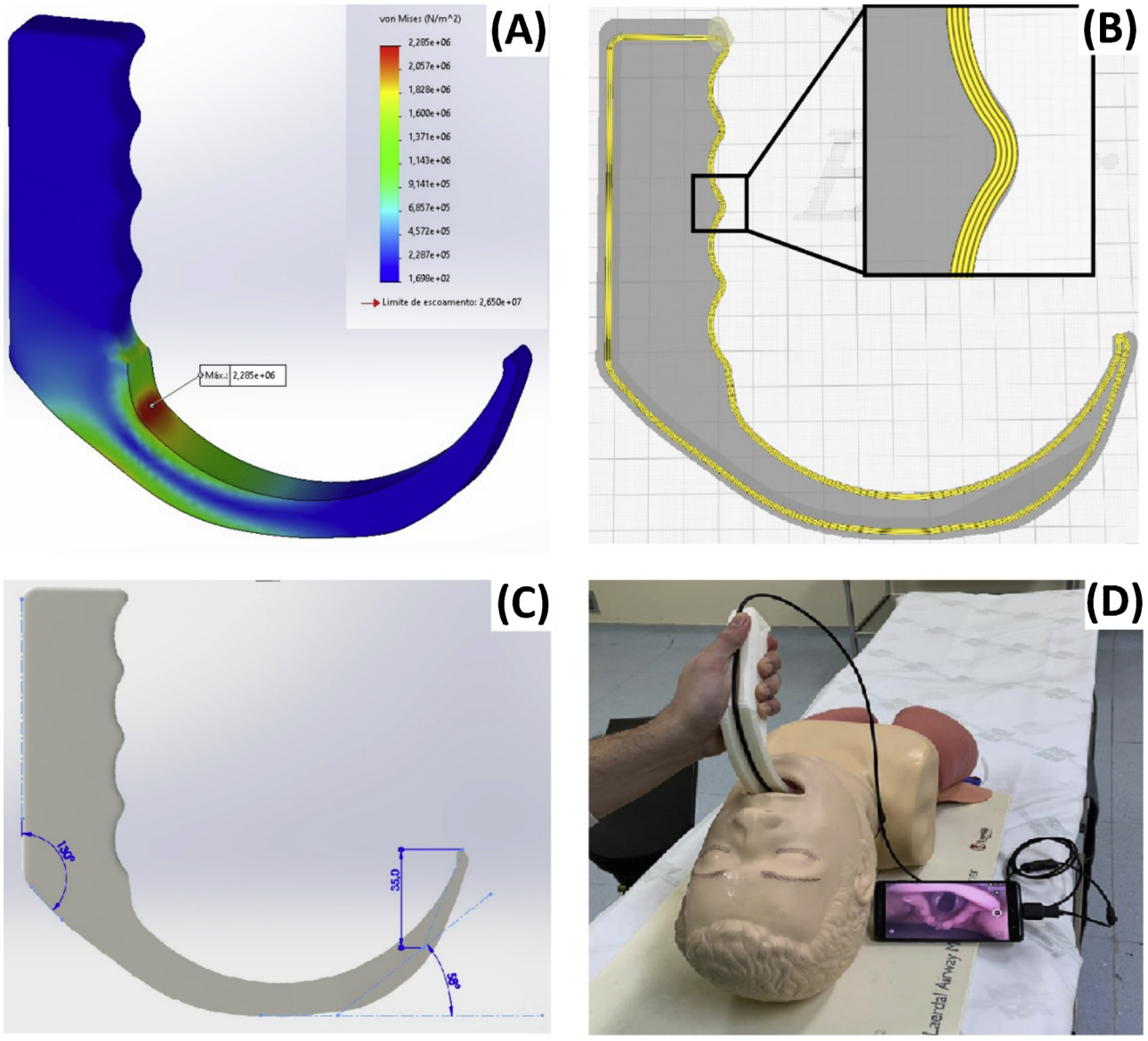

Figure 1 (A) Statistical analysis of tension; (B) Cross-section of printing layers; (C) Main angles and distances; (D) Video laryngoscope test on training dummy airway.

of the model, using a line pattern. It is also worth underscoring, that the possible rupture point of the structure lies on the connection between cable and blade, rendering thus, the device safer in case of any flaw.

A common element to all low-cost video laryngoscope projects is the endoscope camera probe, generally used for fast inspection of difficult access sites. The camera has IP67 certification for water resistance and decontaminants, which has proved to be efficient to visualize airways. Moreover, another advantage of the camera used is the possibility of connection to Android devices, enabling real time visualization of the image through mobile devices in addition to enabling recording, which can be used for educational purposes and medical chart documenting.

Although the model provided by https://pt.airangelblade.org/ is apparently robust and effective, opportunities for improvements were observed as to the format and manufacturing of the device. By adding an acute angle blade prototype (similar to some commercially available models like Glidescope and C-Mac), better visualization of anterior larynx structures and less force necessary to perform laryngoscopy were attained. Such design is characterized by an angle of 130° between the handle and blade of the device, associated with a 58° curvature on the final portion of the blade, and camera positioned at 35 mm of the distal end (Image D in Fig. 1). Moreover, a longer and more ergonomic handle improves laryngoscope grip and the presence of a channel to hold the optic device wire makes camera movements less likely and does not require devices for wire fixation.

Through the parameters found by analyzing finite elements, it was possible to reduce Airangel video laryngoscope printing time from 9 hours and 16 minutes, to 5 hours and 5 minutes, in addition to reducing amount of material used in

51%, despite the 18% larger volume of the model proposed. It is worth underscoring that despite using less material, the model proposed still complies with the safety coefficient of four times the strongest force reported (51.4 N) during laryngoscopy.[4]

A wide range of tests were performed on dummies to develop the most efficient proportions of the blade parts, handle angle and camera positioning. Although of limited applicability, studies on dummies have shown excellent quality of visualization of the glottic cleft and successful intubation in 100% of cases, including difficult airway simulation scenarios as with limited mouth opening, prominent incisive teeth, and impossibility of performing cervical extension.

The low production cost is the major highlight of the video laryngoscope model. Manufacturing the blade by using a non-industrial 3D printer with PLA bought at specialized dealers has an estimated cost of R$ 20. The USB connection videoscope available in the market has its value linked to the diameter of the camera, and the price of 7 mm devices is roughly R$ 45. Totaling a cost of R$ 65, this is a negligible amount, when compared to classic video laryngoscope models available in the market.

A low-cost video laryngoscope can save lives, especially in developing countries or locations where the cost of the device is unaffordable. In the scenario of the COVID-19 pandemic, the benefit can be much expanded. However, there is a concern as to the technical aspects for inhouse development and production of these devices, especially regarding safety such as ruptures, generation of foreign bodies in airways and injury to mucosa. In this way, before using it in medical practice, studies to prove safety and effectiveness of use in humans are warranted, in addition to registration at regulating agencies of medical products, according to Anvisa RDC nº 185/2001. However, there are no norms on self-manufactured medical equipment and as to the legal and ethical implication of use. Given we aim to improve the model presented, we still have not filed for registration at Anvisa. It is worth pointing out that the estimated cost for patent and registration at this government agency is usually high and can prevent a non-profit project. Another potential hindering factor is the requirement for Best Manufacturing Practices Certificate to register medical devices at Anvisa, which is unfavorable to inhouse manufacturing on non-industrial 3D printers.[5]

The Instagram profile @medical3d.com.br and the website www.medical3d.com.br were developed to make the file with the 3D model of the video laryngoscope and step by step manufacturing available. As it is an open and collaborative platform, we believe in the implementation of improvements through the collaboration of the medical community and information acquired as of testing on humans.

Conflicts of interest

The authors declare no have conflicts of interest.

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Reorganization of obstetric anesthesia services during the nationwide COVID-19 lockdown – experience from an Indian tertiary hospital

Dear Editor,

The world is currently facing an unprecedented crisis caused by the severe acute respiratory syndrome coronavirus-2. The World Health Organization declared the novel coronavirus infection (COVID-19) a pandemic on March 11, 2020. The Government of India declared a national-wide lockdown on the 22nd March, 2020 that lasted for 2 months till 22nd May 2020. As a tertiary care hospital, we faced significant challenges during this 2-month lockdown period which we wish to share with regard to the reorganization of obstetric anesthesia services in our hospital.

The clinical characteristics of COVID-19 infection in parturients is consistent with those reported in non-pregnant adults.[1] However, many of the symptoms like fatigue, myal-