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EVALUATION OF ANESTHETIST AND SURGEON COMFORT PROVIDED BY THE 3D PRINTED FACE HOOD DURING SURGERY

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Abstract
Background: Surgeons and anesthetists face ergonomic challenges during surgery due to complex tubing arrangements and interference with critical airway devices such as endotracheal tubes. A 3D printed face hood was developed to improve comfort and reduce disturbances.
Objective: To evaluate the ergonomic benefits, comfort, and practical usability of a novel 3D printed face hood during abdominal and lower limb surgeries under general anesthesia.
Methods: The face hood was placed over the patient's head after positioning in the OR and remained throughout surgery. Surgeons and anesthetists completed questionnaires assessing visibility, cognitive comfort, ergonomics, stability, ease of removal, and procedure compatibility.
Results and Conclusion: Majority found the face hood to improve comfort and ergonomics, with 88% reporting ease in performing suction and drug administration. Most recommended its use for enhancing operating room safety and efficiency.
Keywords: 3D printed face hood, surgeon comfort, anesthetist comfort, airway management, operating room ergonomics, surgical safety

INTRODUCTION

Surgical teams face challenges in maintaining sterility, airway security, and individual comfort during procedures, especially laparoscopic and open abdominal surgeries. Multiple tubing for gases and instruments can crowd the field and interfere with essential equipment like the endotracheal tube, impacting safety and efficiency.
Advancements in additive manufacturing enabled creation of customized protective devices such as 3D printed face hoods. These are designed to minimize interference with airway devices, reduce risk of contamination, and improve ergonomics. This study evaluates the comfort and usability of such a device.

MATERIALS AND METHODS

Study Population
Surgeons and anesthetists involved in abdominal and lower limb surgeries under general anesthesia.
Procedure

METHODOLOGY

This hood was used for all abdominal and lower limb surgeries needing endotracheal intubation where it can be kept in place throughout the procedure till extubation.
After shifting the patient to OR, the protective hood was placed over the patient's head and all the equipments required for intubation were placed above it.
Intubation was performed and assisted by anaesthesiologists and the face hood was kept in place throughout the procedure till extubation.
After that, the face hood was removed and cleaned for reuse using 1% sodium hypochlorite solution.
A total of 21 surgeries were done using this box.
The experience of participants was recorded via a Google Form and one response per participant was restricted. A valid response, within the stipulated time, was received from 25 anaesthesiologists and surgeons who were performing the procedure .
The Google form consisted of 10 questions regarding the ease of performing intubation and using intubation aids, the maneuverability of hands while handling instruments, visibility through the hood, stability of the hood, ease of removal of the hood, cognitive comfort and suggestions for improvement.

A questionnaire given to surgeon and anaesthetist that helps in analysing the level of comfort provided by the novel 3D Printed Face hood

Questionnaire

A comprehensive questionnaire will be administered to both anaesthetists and surgeons post-surgery. The questionnaire will include:

- Quantitative ratings of comfort.
- Qualitative feedback on usability and any issues encountered.
- Specific questions regarding the stability of the ET tube during drug administration.

Data Collection

Data will be collected through direct observation and the completed questionnaires. Observations will focus on real-time issues and adjustments made during surgeries, while the questionnaires will capture detailed feedback from the medical professionals.

Statistical Analysis

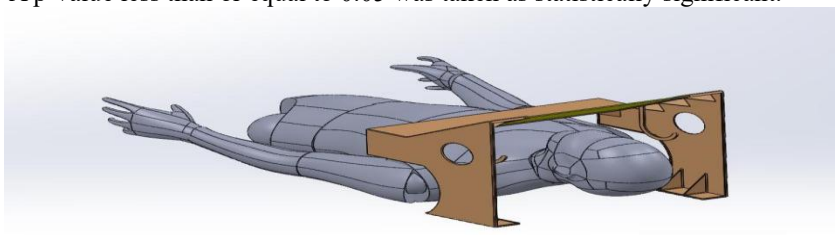
Predictive analysis will be employed to analyze the collected data. This will include:

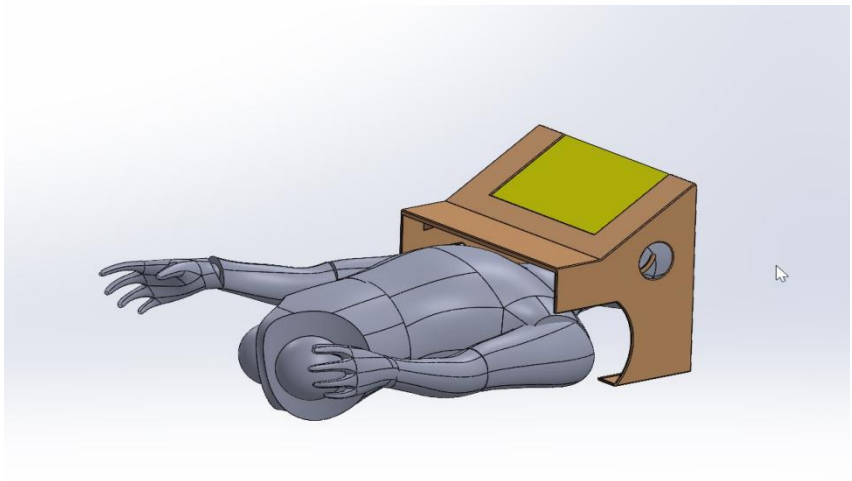
- Descriptive statistics to summarize the comfort levels reported.
- Comparative analysis using statistical tests (e.g., t-tests, ANOVA) to identify significant differences in comfort levels and effectiveness.

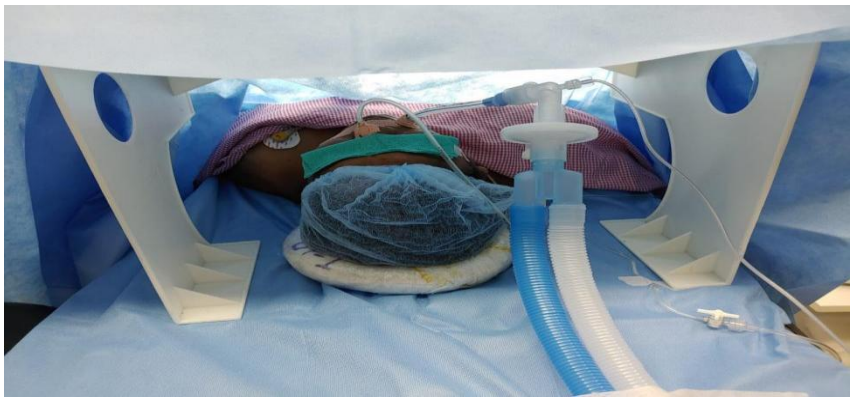
-Data from the questionnaire was compiled and analysed using descriptive statistics.

SPSS (Statistical Package for Social Sciences) software version 23. Categorical and nominal variables were expressed as numbers and percentages and were analysed using the Chi-square or Fischer's exact test.

A p-value less than or equal to 0.05 was taken as statistically significant.







	Response	N	P value
1.Visibility through box	Poor Average Clear	2914	1.000
2.Cognitive comfort	Uncomfortable Equivocal Comfortable	6109	0.128
3. Ergonomic aspect/Discomfort	Difficult Manageable Easy	516	1.000
4.Need to remove box during procedure	During extubation Entire procedure completed with hood	5 20	0.176
5.Ease of removal of box	Difficult Manageable Easy	11113	0.269
6.Stability of hood	stable need for assistance Unstable	1681	1.000

7.Would you recommend the use of the box in terms of efficiency and safety?	yes no	24 1	0.360
8.Ability to perform actions like suctioning and giving drugs	Difficult Easy	3 22	

RESULTS

Data collected from 25 participants (surgeons and anesthetists) following the use of the 3D printed face hood during abdominal and lower limb surgeries revealed:

- Visibility: 56% rated visibility as "Clear," 36% as "Average," and only 8% as "Poor." The hood did not impede visual access significantly.
- Cognitive Comfort: Approximately 36% found the hood comfortable cognitively, 40% equivocal, and 24% uncomfortable suggesting adaptability varied among users.
- Ergonomics: 64% found the hood manageable, while 20% found it difficult, and 16% easy, showing potential for improvement with routine use.
- Removal Need: The hood was removed during extubation in 20% cases; in 80%, it stayed throughout surgery.
- Stability: Rated stable by 64% participants, with only minor assistance needed in a few cases.
- Action Usability: 88% reported ease in performing suctioning and drug administration without disturbance.
- Recommendation: 96% recommended incorporating the hood into practice considering increased safety and efficiency.

DISCUSSION

The introduction of the 3D printed face hood addressed key ergonomic and safety concerns faced by anesthetists and surgeons operating in crowded airway environments.

- The device effectively prevented interference with the endotracheal tube during procedures, reducing potential airway compromise.
- The maintenance of sterility was enhanced by reducing the risk of contaminated instruments falling near the airway.
- While visibility and comfort ratings were generally positive, feedback indicated the need for some acclimatization and possible minor design refinements to optimize cognitive comfort.
- The high acceptance and recommendations endorse the device's integration as a standard adjunct in operating rooms, particularly in minimally invasive surgeries involving multiple tubing and instrumentation.

These findings align with emerging literature on barrier enclosures and protective devices during airway management (e.g., Canelli et al., 2020), affirming their role in enhancing occupational safety without compromising procedural efficiency.

CONCLUSION

The 3D printed face hood is a practical and effective solution to airway workspace challenges during surgery, providing enhanced comfort and safety to anesthetists and surgeons. Its adoption can improve ergonomic conditions and reduce interference with airway devices, supporting its routine use in operative settings.

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