Optimising the ergonomics for endoscopic endonasal skull base surgery: a review

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INTRODUCTION

- Endoscopic skull base surgery (ESBS) is a relatively new, but rapidly growing discipline used in the management of a diverse range of complex skull base pathologies
- Owing to its minimally invasive approach and patient-associated benefits, ESBS has now become the standard care for several skull base pathologies
- Despite advances in ESBS including evolving surgical techniques and use of robotics, endoscopic surgeons have been shown to be vulnerable to developing musculoskeletal symptoms
- Overtime this could lead to repetitive strain injury, work-related upper limb disorders and occupational overuse syndrome
- In the field of ESBS, there is significant paucity of data regarding the impact of the surgeons' posture and positioning on musculoskeletal stresses and the effects on resulting symptoms and injuries. Most of the work done evaluates the ergonomics amongst laparoscopic and/or ENT surgeons but not endoscopic skull base surgeons.
- One study showed that only 9% of the participating endoscopic surgeons considered themselves to be moderately knowledgeable of ergonomic guidelines[1]
- There is a need to continuously enhance surgical techniques/approaches, and ergonomics plays a vital role.

AIMS

- Investigate and highlight the surgical ergonomic principles related to ESBS, and set a template for improvement
- Provide solutions that will minimise the risks associated with developing work related musculoskeletal disorders (WMSDs)

METHODS AND RESULTS

- A comprehensive literature search of EMBASE, CINAHL and PubMed was conducted
- 487 articles were retrieved and 5 met our study criteria
- Inclusion criteria were articles with a primary research on the ergonomic principles associated with endonasal endoscopic skull base surgery
- Recommendations were split into seven (7) domains:
  - **Patient positioning**
  - **Surgeon positioning**
  - **Operating Table Height**
  - **Stool Height**
  - **Seat Position**
  - **Monitor Position**
  - **Operating Adjuncts**

DISCUSSION

- To reduce crowding, surgeon fatigue and muscle strain associated with ESBS, the ***Jefferson approach***, where both the neurosurgeon and otolaryngologist are situated on opposite sides of the patient, has been advocated[2] *(Fig.1)*
- When considering position of surgeon during ESBS, some studies showed that the seated position restricts the mobility of the upper extremity and put more strain on the neck and shoulders
- If adopting the seated position, studies suggested a stool height should be between 39.5 to 50.5 cm and high enough to enable a 135 degree angle between the surgeons back and thighs[3,4]
- Operating table height was shown to be another important ergonomic consideration during ESBS. The optimal table height suggested to reduce WMSDs was between 63.5- 125.7cm and should be 10cm below elbow height[5,6]
- Patient position during ESBS was shown to have a strong impact on WRMD's. The supine position where the head faces directly upwards and in reverse Trendelenburg position, and the conversational position, where the patient is in a semi-sitting position with slight neck flexion and rotation towards the surgeon, has been advised[7] *(Fig.2)*
- Monitor position during ESBS should be placed approximately 100cm from and at 180 degrees and at a depressed angle of between 0-15 degrees[8,9]

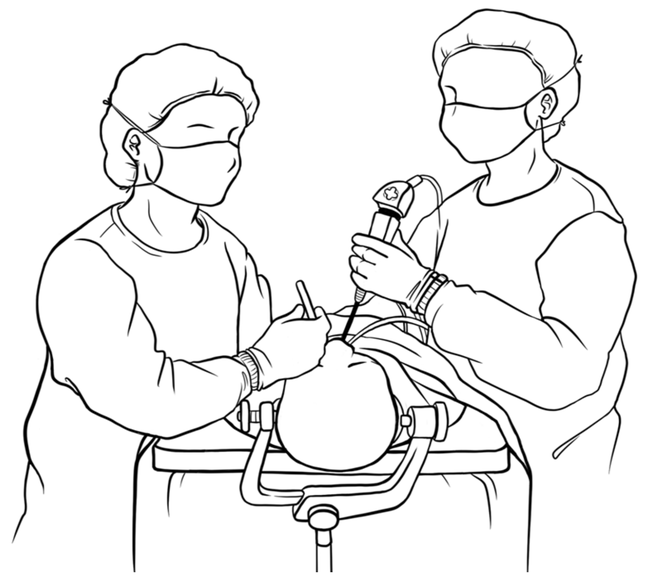

Fig.1 Jefferson position - where the two operating surgeons stand on opposite sides of the patient's head

A B

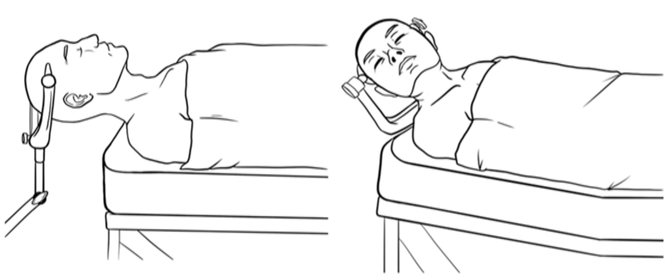

Fig 2 (A) – Supine position, Fig (B) – Conversational position

LIMITATIONS

- There was heterogeneity among the studied groups i.e. level of skill, volume of endoscopic skull base work, combination of endoscopic skull base work with other surgical expertise etc.

CONCLUSIONS

- We recommend adopting some of the principles outlined in order to reduce the risk of developing WMSDs and improve ergonomics in ESBS
- The authors suggest further research into the ergonomics in ESBS is required in order to reduce the WMSDs and to improve understanding of the relevant principles (pertaining to the 7 domains) to ensure intraoperative conditions and postoperative outcomes can be optimised.
- We hope that this review will serve as an antecedent for further related work to be carried out in this expanding field of skull base neurosurgery

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