41398: Systematic review of factors influencing surgical performance: Practical recommendations for microsurgical procedures in neurosurgery

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Introduction

- Microsurgical techniques are employed in neurosurgical procedures which involve fine motor skills requiring excellent hand-eye coordination with micrometer-scale precision.

- These meticulously honed abilities may be hampered or aided by both environmental and behavioral factors via amplification of the human body’s intrinsic physiological tremor or by other mechanisms that potentially influence microsurgery outcomes.

- A few previous reviews have been published on the various aspects of tremor in neurosurgeons; however, these reviews all lack scientifically weighted grading of the reviewed studies.

- The aim of this study was to systematically review the available literature on factors that could alter microsurgical performance and to compile a holistic set of recommendations or indicate areas of insufficient data where such recommendations cannot yet be made.

- In our study, we applied the same approach that is used for development of clinical guidelines.
Protocol
A method for a systematic review of the literature to assess factors affecting microsurgical performance and microsurgical training was developed using the Preferred Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) Statement.

Factors Assessed
We performed a literature review of 8 factors that could affect microsurgical performance in training procedures or actual surgical procedures. These factors were:

1. Listening to music before and during a microsurgical procedure
2. Caffeine consumption before a procedure
3. Beta-blocker use before a procedure
4. Sleep deprivation before a procedure
5. Physical exercise before a procedure
6. Alcohol consumption before a procedure
7. Procedure duration
8. Ergonomic position of the surgeon

Eligibility Criteria
For eligibility in the analysis, the reviewed studies were either randomized controlled trials or cohort studies. The studies were screened by reviewing the abstracts and were then assessed for eligibility and inclusion.

Information Sources and Search Strategy
Searches were conducted using PubMed MeSH; Embase was used when PubMed search produced 3 or fewer relevant articles.

Confidence in Cumulative Evidence
The body of evidence was graded using the amended criteria of the Oxford Centre for Evidence-based Medicine Levels of Evidence.

Linking Evidence to Guidelines
We used a strategy for formulating recommendations similar to that used for therapeutic interventions, breaking down recommendations into standards (high degree of certainty, grade A evidence), guidelines (moderate degree of certainty, grade B evidence), and options (recommendations with unclear certainty based on grades C, D, E, and F evidence).
Results

• The literature search produced 48 studies that met the inclusion criteria, of which only 12 studies specifically addressed the impact of the selected factors on microsurgery compared to general surgery.

• The majority of the studies used surgeons as subjects, and most used laparoscopic surgery simulators to assess the effect of the factors on dexterity and psychomotor skills.

• In addition to laparoscopic simulators, microsurgical and ophthalmological surgery simulators were also used to assess factors impacting physiological tremor or performance. In each of the assessed domains, we looked for not only the link to tremor but also the link to technical performance and possibly patient outcomes.

• None of the domains investigated had strong enough supporting evidence to recommend practice standards; thus, only guidelines and options are noted as recommendations.
Results - Factors Impacting Microsurgery

**MUSIC Recommendations**

*Guidelines*

- Playing non-dichotic, pleasant music of a surgeon’s personal preference during the procedure may have a positive effect and improve performance (grade B).
- Dichotic, unpleasant music and mental loading had a negative impact in most studies and should be avoided during microsurgery (grade B).

*Options*

None.

**CAFFEINE Recommendations**

*Guidelines*

None.

*Options*

- Evidence to support whether or not caffeine ultimately impacts surgical performance is inconclusive, but caffeine use has been shown to increase physiological tremor (grade C).
- Surgeons wishing to decrease tremor may want to avoid the consumption of caffeine. For surgeons who regularly consume caffeine, the effect of caffeine on tremor is lessened, compared to that in individuals who do not regularly consume caffeine (grade D).

**BETA-BLOCKERS Recommendations**

*Guidelines*

None.

*Options*

- Current evidence is insufficient regarding the impact of beta-blocker use on surgical performance, but beta-blockers do reduce physiological tremor (grade D).
- Surgeons experiencing caffeine-related tremor could derive benefit from consuming a beta-blocker, in terms of microsurgical performance (grade F).
Factors Impacting Microsurgery

**PHYSICAL EXERCISE Recommendations**

*Guidelines*
Surgeons should avoid strenuous exercise prior to microsurgery because of an associated increase in the frequency and amplitude of physiological tremor (grade B).

*Options*
None.

**SLEEP DEPRIVATION Recommendations**

*Guidelines*
None.

*Options*
The evidence is mixed in support of the negative impact or the lack of impact of acute sleep deprivation on surgical performance. Surgeons may strive to avoid sleep deprivation to maximize microsurgical performance (grade D).

**ALCOHOL CONSUMPTION Recommendations**

*Guidelines*
Surgeons should avoid over-consumption of alcohol and the “hangover” effect. Over-consumption of alcohol is most likely to decrease performance or make it more difficult to retain baseline surgical skills (grade B).

*Options*
Sleep deprivation reinforces the detrimental effect of alcohol consumption on surgical skills (grade C). The evidence is insufficient to determine whether consumption of alcohol long before microsurgery (with a blood alcohol content [BAC] of zero at the time of surgery) impairs operating performance (grade D).
Factors Impacting Microsurgery

DURATION OF PROCEDURE Recommendations
Guidelines
None.
Options
• The available evidence suggests that physical fatigue develops as the length of a surgical procedure increases and as the course of the day progresses (grade C).
• Although physical fatigue increases physiological tremor, little evidence supports a finding that physical fatigue has a significant influence on microsurgical performance, outcomes, or skills retention.
• Although surgeons usually do not have control over procedure duration, taking short regular pauses during prolonged microsurgical sessions could reduce physical fatigue and lead to a better performance (grade F).

SURGEON’S ERGONOMIC POSITION Recommendations
Guidelines
Devices for hand, wrist, and arm support decrease tremor and fatigue (grade B).
Options
• Devices such as the surgical chair, adjustable operating table, and other body-support devices contribute to a decrease in surgeon fatigue and tremor.
• Use of body-support devices that improve surgeon position may be effective in reducing the risk of occupational fatigue and injury (grade C).
• Ergonomic adjustments to the surgeon’s position as well as instrument modifications positively impact fatigue and tremor. However, whether this benefit to the surgeon also benefits the patient, while logically implied, is still unknown because randomized controlled studies are lacking (grade F).
Discussion

• Using the Oxford Centre for Evidence-based Medicine Levels of Evidence criteria, we were able to produce 7 grade B recommendations, 4 grade C recommendations, 4 grade D, and 3 grade F recommendations regarding 8 factors that may influence microsurgical performance.

• These recommendations may prove helpful not only to young neurosurgeons in training but also to all surgeons in most specialties.

• Factors not assessed in our study but that warrant further consideration as they may be important in learning surgical skills include REM sleep and the time of day that learning occurs prior to sleep.

• Limitations
  – We assumed that results of endoscopy, ophthalmological surgery, microsurgery, and general surgical studies as well as other studies assessing hand tremor might provide useful information and be extrapolated to microneurosurgical performance.
  – However, it is likely that there would be a discrepancy in the degree of performance impairment or increased hand movement that would be considered “significant” as movements are magnified in microsurgery.
Conclusions

• This review provides 18 recommendations regarding 8 factors that affect microsurgical training effectiveness and performance

• All factors evaluated were determined to have some effect on microsurgical performance, with various degrees of evidence

• These recommendations may be used by neurosurgical trainees and practicing neurosurgeons to improve microsurgical performance and acquisition of microsurgical skills

• Additional randomized studies assessing factors that can influence microsurgical performance are needed. Although many studies assessed tremor as a variable, evidence is currently lacking on the association between hand tremor in experienced surgeons and patient outcomes.