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Enhancing surgical performance by adopting expert musicians' practice and performance strategies

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ABSTRACT

Background. Surgery is a performing art—each surgical procedure is a live performance that has immediate and irreversible consequences for both the performer and the audience. Surgeons operate with surgical instruments, whereas musicians perform with musical instruments. Both perform in high-stress, high-risk work environments, where small errors in motor performance or judgment can have immediate negative consequences. While there is abundant literature on musical performance and their impact on outcome, little similar research has been published in the field of surgery. We aimed at identifying expert musicians' practice and performance strategies that may aid surgeons to enhance their surgical performance.

Methods. In the study, 82 relevant English-language articles from 1974 to 2017 matched applicable search terms. Nominal Group Technique was applied to identify 5 key domains that comprise important parallels between surgical and expert musical performance.

Results. The 5 key domains identified were: (1) extensive training and deliberate practice, (2) dexterity and ambidexterity, (3) performance evaluation and competition, (4) performance-related injuries, and (5) performance anxiety. We found focused and mindful training in motor performance, not performing immediately after a hiatus from practice, training to improve the precision and responsiveness of the nondominant hand, continuous and critical self-evaluation, training in injury recognition and prevention, and pharmacologic factors to be of utmost importance.

Conclusion. Critical parallels exist between surgical and expert musical performance that may improve surgical outcomes by adopting musicians' strategies for combating physiological and psychologic performance-related issues. Raising surgeons' awareness for this subject content may improve surgical performance and patient outcomes, as well as help prevent occupational injuries. (Surgery 2017;160:XXX-XXX.)

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Surgeons operate with surgical instruments, whereas musicians perform with musical instruments. Historically, there have been several eminent surgeon-musicians, including Herman Boerhaave (1668–1738), Leopold Auenbrugger (1722–1809), Theodore Billroth (1829–1894), Alexander Borodin (1833–1887), Albert Schweitzer (1875–1965), and Boyd Neel (1905–1981), each of whom made landmark contributions to surgical science and humanity. It seems intuitive that the ability of these surgeon-musicians to play an instrument likely enhanced their motor performance to facilitate their expert surgical performance.

However, while parallels between surgical and expert musical performance exist, there is a dearth of literature on how surgeons could potentially adopt expert musicians' practice and performance strategies to improve surgical performance. We therefore performed a structured analysis of the published literature on musicians' practice and performance strategies that could help surgeons to improve their motor performance in the operating room, improve mental health and prevent musculoskeletal injuries.

Methods

PubMed was searched for English-language articles published between 1974 and 2017 using the search terms “surgical performance,” “surgical skill,” “surgeon hand dominance,” “surgeon dexterity,” “manual ambidexterity,” “pianist dexterity,” “musician deliberate practice,” “competition performance,” “musician musculoskeletal health,” “surgeon musculoskeletal health,” “musician hand injury,” “surgeon hand injury,” “musician performance anxiety,” “surgeon performance anxiety,” “performance stage fright,” “surgical

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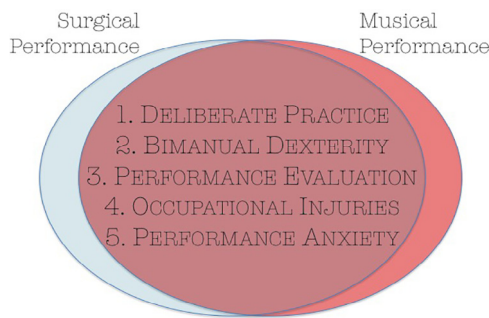


Fig. Parallels between surgical and musical performance.

performance propranolol,” “musicians propranolol,” and other combinations of relevant terms. The reference lists of articles identified in the searches were cross-reviewed by authors to identify additional relevant articles. Then the authors reviewed the identified articles independently to (1) identify relevant articles, (2) extract key parallels between surgical and musical performance, and (3) collaboratively evaluate the information for relevance.

Nominal Group Technique to take each group member's opinion into account was applied. First, group members reviewed the literature independently and provided a list of key domains with their supporting relevant literature. Duplicate musical domains were eliminated by the facilitator. The facilitator encouraged discussion for the naming and identification of domains to find the domain terms that would encompass most of the relevant literature. For example, domains such as “collaboration and team dynamics” and its parallel “chamber music” were discussed, voted to be less relevant and therefore excluded. The 5 domains with the highest ranking were selected as the 5 domains under which the relevant literature was grouped. Prioritizing the recorded domains pertaining to parallels between musical and surgical performance were performed using direct voting. Published articles on surgical performance and musical practice guidelines and performance strategies were compared. The data were synthesized to identify concrete practice and performance guidelines that could aid surgeons in improving surgical performance.

Results

A total of 82 relevant articles were identified. Five parallels were identified between surgical and musical performance (Fig). To achieve optimal performance, both expert surgeons and musicians may benefit from (1) extensive training, deliberate practice, (2) ambidexterity, and continuous performance evaluation. Both are susceptible to (3) performance-related injuries, (4) performance anxiety, and may draw on (5) pharmacologic measures, especially the use of β -blockers, to alleviate symptoms. The extracted information was discussed in a structured review process and the results are presented below. After discussion of the data, each performance item is followed by concrete recommendations on how to use the information from expert musical performance to improve surgical performance.

Movement I: extensive training and deliberate practice

Surgical and musical performance both require extensive training and deliberate practice to achieve and maintain expertise.¹⁻⁵ Deliberate practice is a mindful, structured, repetitive, and reflective process that demands relentless self-critique, and error detection. An estimated minimum of 10 years of intense involvement and 10,000 hours of deliberate practice to achieve mastery in highly

competitive fields such as surgery and classical music is required.^{3,6} For most surgeons, completion of surgical training requires 5 to 10 years—equivalent to $\approx 10,000$ hours—of total-immersion training. Similarly, a graduate-level, professional pianist also will have accumulated $\approx 10,000$ hours of practice, while an amateur one of comparable age will have practiced only 2,000 to 8,000 hours.⁷ A study on surgical residents showed that deliberate practice, compared with standard training alone, led to higher-quality laparoscopic surgical performance as measured by speed, dexterity, and global rating scales.⁸ Recently, educational initiatives have been implemented to accelerate the “training to competence” process and decrease hours spent in surgical training.⁹ Whether this can actually be accomplished successfully is an area of ongoing research.^{10,11} Furthermore, the importance of deliberate practice may extend beyond surgical trainees to staff surgeons in practice: low operative volume institutions have significantly higher 90-day mortality and lower-quality oncologic surgery for patients undergoing laparoscopic pancreaticoduodenectomy.¹² Insufficient “practice time” in performing this complicated procedure is almost certainly a major factor.

Among musicians, it is a well-regarded principle that consistent deliberate practice contributes to performance success, while paucity or interruption of practice has a deleterious effect on performance quality. Various studies have shown that productivity is reduced when the temporal distance between tasks increases.^{13,14} In 188 surgeons who performed 56,315 coronary artery bypass grafting surgeries, each additional day away from the operating room increased the inpatient's mortality rate. Among the subgroup of emergent patients treated by high-volume providers an additional day away raised mortality risk by 0.398 percentage points (11.4% relative effect). For surgeons needing to intervene in patients emergently, as temporal distance increases, the ability to recognize and address life-threatening emergent complications decreases. Absence from the operating room for 3 to 14 days before surgery raised the mortality risk by 11% to 14% (relative effect), and absence for >15 days raised the mortality risk by 22%.¹⁵ While it would be unimaginable for a concert violinist to vacation without practicing on their instrument in the days leading up to an important concert, surgeons may elect to perform challenging operations the day after returning from a trip, resulting in compromised surgical outcomes.

Recommendations for surgeons

Data on deliberate practice suggest that reduction in surgical trainees' work-hours can compromise mastery of surgical motor and patient management tasks.^{10,11} Therefore, to compensate for the decreased hours spent in the operating room, surgical simulation, focused training in motor performance, and earlier specialization to reduce dilution of training may be beneficial. Moreover, surgeons should consider avoiding scheduling high-risk operations immediately after returning from a surgical hiatus lasting for ≥ 3 days.

Movement II: dexterity and ambidexterity

Surgical performance and musical performance both require high levels of dexterity in both the dominant and the nondominant hand. Surgeons routinely need to use their nondominant hand to facilitate surgery—to support anatomic structures or to optimize the angle of dissection. A previous study showed that using the nondominant hand to operate required 1.45 times as long as using the dominant hand,¹⁶ suggesting an asymmetry in dexterity between the dominant and nondominant hands. Other recent studies revealed high bimanual dexterity as a predictor of expert surgical performance,¹⁷ and a trend toward improved navigation and bimanual performance with daily training of the nondominant hand using designated activities, such as playing video games.¹⁸

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