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Education

Creating a Spaced Repetition Model to Supplement Education in Plastic Surgery

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Summary: Plastic surgery encompasses a wide spectrum of material involving comprehensive anatomy, physiology, microbiology, biomaterials, complex surgical techniques, and many nonsurgical interventions. The core disciplines overlap extensively with the foundational knowledge of many other surgical specialties. With the ever-expanding knowledge base required to become a competent plastic surgeon, spaced repetition is a means to optimize learning in plastic surgery and help trainees master new concepts while retaining other facts that are easily forgotten. Platforms for spaced repetition are user-friendly and can be synchronized between devices to streamline progress and make efficient use of the limited free time that exists throughout the workday. Flashcard decks can be imported to these platforms to follow a spaced repetition algorithm. Currently, no publicly available comprehensive deck exists for education in plastic and reconstructive surgery. Creation of flashcard decks covering lectures, textbooks, or old examination questions can reinforce the foundational concepts of our field. Additionally, there is potential to improve resident performance on the Plastic Surgery In-service Training Examination. Once created, this comprehensive flashcard deck can be distributed to plastic surgery residency programs to pave the way for a uniform curriculum. *(Plast Reconstr Surg Glob Open 2022;10:e4317; doi: 10.1097/GOX.0000000000004317; Published online 20 May 2022.)*

CURRENT PARADIGM FOR PLASTIC SURGERY EDUCATION

Classical plastic surgery education relied heavily on textbooks, journal articles, grand rounds presentations, and conferences. Ali et al[1] highlight how the digital era introduced electronic texts, online journals, interactive videos, 3D software, and social media as modern vectors for building a similar foundation. Odom et al[2] report various learning style preferences among plastic surgery residents including aural, verbal, visual, and physical learning styles. Others have called for further reform of plastic surgery education, including the flipped classroom concept for didactic sessions, replacement of the teacher-centered with learner-centered models, promotion of a universally accepted and uniform curriculum, and innovative tools for resident acquisition of technical skills.[3,4] Although these new resources can be useful for surgeons at all levels, they may not efficiently produce a broad understanding of the material required in our rapidly paced training environment.[5]

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MECHANISM OF SPACED REPITITION

Although interval assessments help cement topics, knowledge learned for examinations can soon be forgotten. This is possibly due to methods with which trainees prepare for examinations. Although reading textbooks, watching videos, and listening to lectures cover most curricula in an ordered manner, this information is given "en masse" and can be difficult to review effectively. Spaced repetition can remedy this by promoting active recall at varying time intervals based on trainees' interpretation of their ability to recall facts. Facts are presented at unique intervals to drive knowledge retention. Poorly understood information can be viewed more frequently, enhancing subsequent recognition and recall memory.

SOFTWARE SYSTEMS AVAILABLE FOR SPACED REPITITION

Platforms for spaced repetition include Quizlet, Brainscape, StudyBlue, and Anki, with Anki reportedly being the most popular within medical education.[2] The proportion of new and previously viewed facts is set to

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the trainee's preference. Additionally, the interval at which cards are reviewed is adjustable. Cards can be organized within folders to cover specific chapters of a textbook or presentation. All cards within a given deck can be randomized. This presents an opportunity to study a given subject to enhance core knowledge or to study all subjects to simulate an examination-like experience. Integrated statistics pragmatically analyze one's study habits and highlight knowledge gaps. Various card types can be selected to customize the specific topic being studied (Figs. 1–4). Audio clips can be added to aid those who prefer an aural or verbal learning style. Regardless of learning style preference, spaced repetition software can be adapted to fit individual preferences. Once a set of flashcards has been constructed, it can be shared online to enhance universal knowledge acquisition.

APPLICATIONS OF SPACED REPITITION

Spaced repetition has been used extensively outside of medical education, heightening name-face associations and aiding patients with Alzheimer's disease to remember tasks of daily living.[6] It is used by children to recognize pictures of household objects and broaden their vocabulary. It is also the basis for foreign language applications like Duolingo. In recent years, medical education in the preclinical and clinical years has recognized the value of spaced repetition. Premade flashcard decks exist for the US Medical Licensure Examinations based on high-yield resources such as UWorld, First Aid, Pathoma, and Sketchy Medical. After purchasing a textbook or question bank, copyright laws enable sharing the content to those who are entitled to it, as long as it does not exactly duplicate the text as written in the source.[7] Word-for-word copy-and-paste is neither appropriate nor necessary for creation of flashcards.

Despite seemingly widespread application of spaced repetition, surgical education is still in the infancy of exploring its utility, possibly due to the time required to create useful flashcard decks that follow a spaced repetition algorithm. Kerfoot and Brotschi[8] first highlighted the value of spaced repetition within urological surgery training. Orthopedic surgeons, otolaryngologists, and obstetricians/gynecologists recently showed improved performance on in-service examinations with the integration of spaced repetition learning.[9,10] Still, many other surgical specialties, including plastic surgery, have yet to explore this model. And no formal spaced repetition education models have been produced for mass consumption by all trainees in any of the surgical fields. Plastic surgery trainees would likely benefit from efficient spaced repetition of foundational topics and past in-service examination content.

Takeaways

Question: What is the role of spaced repetition in plastic surgery education?

Findings: Spaced repetition is a learning approach where lessons and facts are reviewed at increasing intervals until knowledge is retained at a sufficient level. This approach to learning has been explored in medical education and various surgical specialties but not within plastic surgery.

Meaning: Creating a standardized spaced repetition model for plastic surgery residents and students might bestow greater clinical knowledge and in-service examination scores.

THE ROLE OF SPACED REPITITION WITHIN PLASTIC SURGERY

Every March, plastic surgery residents across the United States take a comprehensive in-service examination that evaluates knowledge of breast reconstruction, cosmetic surgery, craniomaxillofacial surgery, and hand/extremity surgery. Creating a standardized spaced repetition model for medical students and plastic surgery trainees as an adjunct to textbooks, journal articles, and presentations could bestow greater clinical knowledge and in-service examination scores.

Plastic surgery education presents many opportunities to utilize spaced repetition. Image occlusion can be used to enhance anatomy knowledge or memorize treatment tables (Fig. 2). Omission can be used to discern between technical nuances and recognize rare pathology (Fig. 1). These two types of flashcards can be created from any form of educational medium (slide show, podcast, and textbook) to promote recall of the highest-yield and most challenging facts.

OUR APPROACH

At West Virginia University, we are taking a head start to spaced repetition by creating a comprehensive

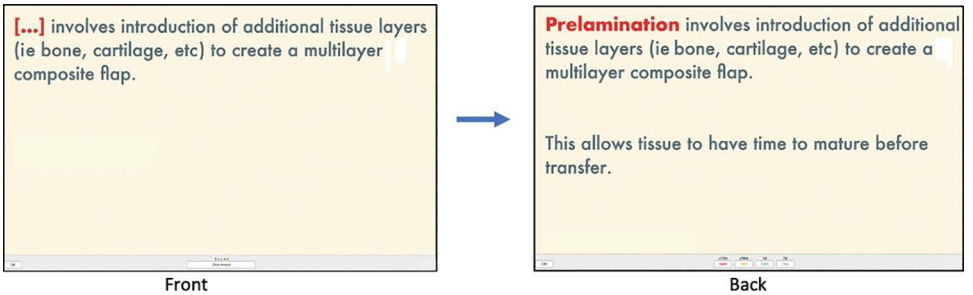

Fig. 1. Example of omission card type (Anki) for general reconstruction.

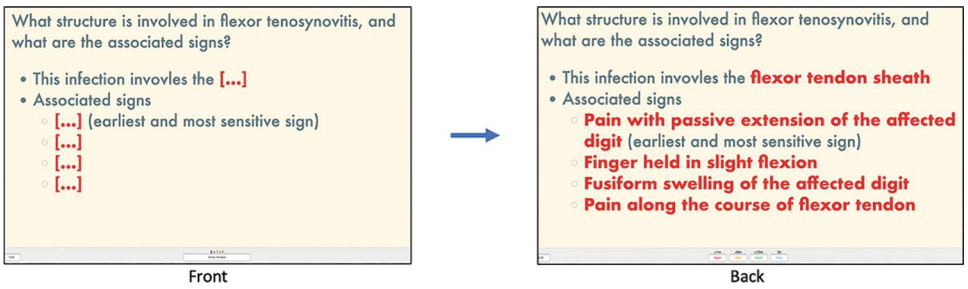

Fig. 2. Example of omission card type (Anki) for hand surgery.

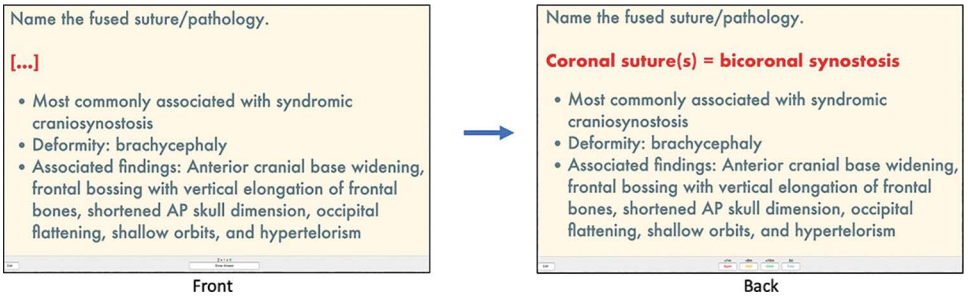

Fig. 3. Example of omission card type (Anki) for craniofacial surgery.

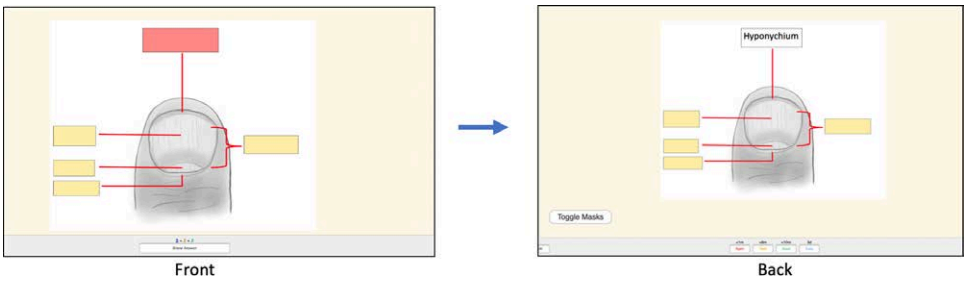

Fig. 4. Example of image occlusion card type (Anki) for hand anatomy. The occluded anatomic landmark of interest is indicated by the red box. Selecting "toggle" unveils the remaining occluded anatomical landmarks, indicated by the yellow boxes.

digital flashcard set drawn from the most valued texts in our field. When combined with a prerecorded lecture, this spaced repetition model allows for a seamless transition to the flipped classroom. Our hope is to create a framework to enhance education in plastic surgery. Although components of this file can be shared via secure-access online cloud-sharing platforms, there is ideally also a role for national educational committees within the American Council of Academic Plastic Surgeons, the American Society of Plastic Surgeons, and the American Society of Aesthetic Plastic Surgeons to create and distribute similar models of spaced repetition learning. The time required to create and maintain a comprehensive flashcard set is worthwhile when considering the likely benefit for the next generation of plastic surgeons. Given the ever-broadening range of topics that must be mastered, it is prudent that models of plastic surgery education focus on long-term knowledge retention.

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REFERENCES

1. Ali K, Colchado D, Davis MJ, et al. Online resources in plastic surgery education: a toolbox for modern trainees and plastic surgeons. *Plast Reconstr Surg Glob Open*. 2020;8:e2894.
2. Odom EB, Janis JE, Gosain A, et al. Education for the future: what the residents want. *Plast Reconstr Surg*. 2017;140:646e–647e.
3. Luce EA. The future of plastic surgery resident education. *Plast Reconstr Surg*. 2016;137:1063–1070.
4. Bancroft GN, Basu CB, Leong M, et al. Outcome-based residency education: teaching and evaluating the core competencies in plastic surgery. *Plast Reconstr Surg*. 2008;121:441e–448e.

5. Khansa I, Janis JE. Maximizing technological resources in plastic surgery resident education. *J Craniofac Surg*. 2015;26:2264–2269.
6. Hawley KS, Cherry KE, Boudreaux EO, et al. A comparison of adjusted spaced retrieval versus a uniform expanded retrieval schedule for learning a name-face association in older adults with probable Alzheimer's disease. *J Clin Exp Neuropsychol*. 2008;30:639–649.
7. Austin S, Brong GR, Vlcek CW. *The Copyright Act of 1976: Guidelines for Educators*. Olympia, WA: Office of the Attorney General, State of Washington; 1978.
8. Kerfoot BP, Brotschi E. Online spaced education to teach urology to medical students: a multi-institutional randomized trial. *Am J Surg*. 2009;197:89–95.
9. Lambers A, Talia AJ. Spaced repetition learning as a tool for orthopedic surgical education: a prospective cohort study on a training examination. *J Surg Educ*. 2021;78:134–139.
10. Kuperstock JE, Horný M, Platt MP. Mobile app technology is associated with improved otolaryngology resident in-service performance. *Laryngoscope*. 2019;129:E15–E20.