Novel use of 'Mental Rehearsal' in learning musculoskeletal ultrasound

Fitzhugh A 1, Hubbard R 1, Ahemd N 1, Gabbott B 2, Sookr P 1

1. Chelsea & Westminster Hospital NHS Foundation Trust, London
2. St George’s Healthcare NHS Foundation Trust, London

**Introduction**
Musculoskeletal sonography has evolved considerably over the past decades. The increased availability of ultrasound has made it a key adjunct in the diagnosis and treatment of a wide range of soft tissue and joint-based pathologies, allowing dynamic evaluation as well as image-guided interventions not afforded by MRI studies. [1]

However, the techniques used are relatively operator dependant, both in terms of image acquisition and interpretation. There is a need to develop visuospatial (hand-eye coordination) and the ability to scan and compare acquired image to a visual standard. [2] The operator also requires refined visuospatial skills, namely the ability to visualise a 3D image from a 2D image. These skills must be executed simultaneously alongside clinical deduction, all whilst manipulating the transducer for image optimisation.

Novices, even those familiar with general ultrasound, consequently find they take a steep learning curve to acquire these skills, often during busy outpatient lists.

**Figure 1:** Mental rehearsal of the ankle exam followed by supervised practice with a colleague

**Aims**
1. Development of mental rehearsal scripts for sonographic evaluation of the shoulder and ankle joints.
2. Trial of these scripts with radiology registrars learning musculoskeletal ultrasound, with collection of qualitative feedback.

**Methodology**
Mental rehearsal scripts for sonographic evaluation of the shoulder and ankle were created using European Society of Musculoskeletal Radiology (ESSR) technical guidelines [3] as well as ESSR Shoulder Examination [4]. These were provided to radiology registrars (Fitzhugh, Hubbard) undertaking rotations in musculoskeletal radiology at Chelsea and Westminster Hospital.

The technique of mental rehearsal was introduced to registrars by senior MSK Fellow (Ahmed). Registrars undertook supervised outpatient ultrasound lists on average once per week. Mental rehearsal was used with Dr Ahmed or an MSK Consultant (Sookr) prior to the relevant examinations, before carrying them out with supervision.

Participants discussed their experience of mental rehearsal and its impact on confidence with these examinations, presented below.

**Results**
Experience with the mental rehearsal technique for shoulder and ankle examination proved generally positive. By the end of the 4-month rotation, registrars reported a subjective improvement in their confidence - not only in memorising the steps involved in examinations, but also in the physical technique (probe orientation and manipulation) needed for image acquisition.

A period of observation as well as physical practice prior to mental rehearsal was felt to be more useful prior to mental rehearsal to provide context within the learning process. In addition, the list-like nature of the mental rehearsal was helpful for more visual learners.

Opinion was that shoulder joint examination was easier to rehearse with the practical examination, whereas the various ligaments and tendons requiring assessment as part of the ankle examination made this more complex for relative novices.

**Discussion**
Mental rehearsal is a well-established technique in many fields, although limited work exists exploring its use and benefits within medicine. Arora S et al have shown that its use improved surgical trainees’ performance in virtual reality cholecystectomy simulation, but we were unable to find comparable literature demonstrating its use in musculoskeletal ultrasound.

Our work shows novices in musculoskeletal ultrasound found mental rehearsal a useful means of improving their confidence and skill, although the relatively large number of anatomical detail (tendon and ligamentous structures) can be somewhat abstract. Hence, mental rehearsal is not a substitute for physical practice when learning to appreciate assessment of these structures as well as genuine pathology and for use of ultrasound dynamically in problem solving.

It is suggested that the existing ESSR technical guidelines could similarly be modified for other ultrasound examinations, enabling further mental rehearsal scripts to be created.

The main limitation of our presentation is that this was a small ‘proof of concept’ study without a quantitative component, which would represent the next logical step for future work. It would also be interesting to see if mental rehearsal could be used to develop improved performance in various joint injection techniques using a comparable quantitative methodology to Arora et al.

An important consideration for others wishing to use mental rehearsal within their department is that the technique is most beneficial not only combined with physical practice, but when also implemented following a period of prior physical performance. [4] It is therefore suggested that trainees have some time to become familiar with the basic musculoskeletal ultrasound skillset and examination content before beginning mental rehearsal in order to maximise the benefits.

It is hoped that this work will introduce other radiologists to the technique of mental rehearsal, and lead to its use in various further novel fashions - both within musculoskeletal ultrasound as well as radiology in general.

**Conclusion**
The authors introduce the mental rehearsal technique, and present qualitative feedback following its use of diagnostic musculoskeletal ultrasound. Radiology registrars subjectively felt improvement in their confidence when conducting shoulder and ankle examinations.

This could be extended to other ultrasound examinations, as well as joint injection techniques.

**References:**