**CONCISE REPORT**

Sonographic training in rheumatology: a self teaching approach

E Filippucci, Z Unlu, A Farina, W Grassi

**Objective:** To evaluate a self teaching approach to be followed by a novice without previous practical experience in musculoskeletal ultrasonography.

**Methods:** The novice was given short general training (two hours) by an experienced sonographer focusing on the approach to the ultrasound equipment, and asked to obtain the best sonographic images of different anatomical areas as similar as possible to the “gold standard” pictures included in the online version of the guidelines for musculoskeletal ultrasonography in rheumatology (free access at http://www.sameint.it/eular/ultrasound). The novice had free access to a CD-ROM version of the online guidelines, using a computer placed beside the ultrasound machine. Additional resources used by the novice during the teaching programme that may have fastened her learning curve included textbooks and atlas of anatomy and musculoskeletal US, and some recent papers on musculoskeletal US.

**Results:** Sonographic training lasted for one month and included 30 scanning sessions (24 hours of active scanning). 243 images were taken of the selected anatomical areas. The mean time required to produce each image was 6 minutes (SD 4.2; range 1–30). At the end of the training, the novice scored ≥6 for each standard scan.

**Conclusion:** A novice can obtain acceptable sonographic images in 24 non-consecutive hours of active scanning after an intensive self teaching programme.

Over the past few years, rheumatologists have become increasingly interested in ultrasonography (US). However, US is the most operator dependent imaging modality and requires experience and expertise. Only a few comments on the learning curve in musculoskeletal US have been made, and most of them state the importance, the difficulty, and the relatively long duration of the training. Moreover, there is no standardised educational model for training in musculoskeletal US.

In a recent paper Balint et al showed that a novice in musculoskeletal US can be trained by an experienced investigator to produce acceptable images of the hip within three hours.

Our study aimed at evaluating a self teaching approach to be followed by a novice without previous practical experience in musculoskeletal US.

**METHODS**

The novice (ZU) had not previously performed an ultrasound examination and her anatomical knowledge was basic. After a short general training (two hours) focusing on the approach to the ultrasound equipment by an experienced sonographer (EF), the novice was asked to obtain the best sonographic images of different anatomical areas as similar as possible to the “gold standard” pictures included in the online version of the guidelines for musculoskeletal ultrasound in rheumatology (freely available on the website of the EULAR Working Group for Musculoskeletal Ultrasound in Rheumatology: http://www.sameint.it/eular/ultrasound).

This version has the basic structure of a web based teaching file and provides sonographic images corresponding to each specific standard scan in a very short time, allowing immediate support for the sonographer while performing an ultrasound examination. The novice had free access to a CD-ROM version of the online guidelines, using a computer placed beside the ultrasound machine. Additional resources used by the novice during the teaching programme that may have fastened her learning curve included textbooks and atlas of anatomy and musculoskeletal US, and some recent papers on musculoskeletal US.

The teaching programme focused on eight main anatomical areas (shoulder, elbow, wrist, hand, hip, knee, ankle, and foot) and 66 standard scans.

Scanning sessions were numbered chronologically and each session included all the standard scans of a specific anatomical area. An auxiliary scan of the shoulder was not included in the teaching programme, because this scan cannot be performed in all patients with shoulder pain.

The novice was free to choose the chronological succession of the anatomical areas to explore. The only instructions were to try to obtain acceptable sonographic images in a specific anatomical area, according to the tutor’s evaluation, before starting to explore another one.

At the end of each scanning session, both novice and tutor scored “blindly” all the images from 0 (the lowest quality) to 10 (the highest quality). The minimum quality score considered acceptable for standard clinical use of US was 6. After discussing the scores with the novice the tutor explained how to improve the quality of the pictures. Time spent by the tutor was recorded. The novice recorded the time spent in producing each image and scored the perceived difficulty in performing each standard scan from 0 (the lowest difficulty) to 10 (the highest difficulty).

Fourteen consecutive inpatients with different rheumatic diseases (seven with rheumatoid arthritis, three with psoriatic arthritis, two with reactive arthritis, and two with osteoarthritis) and five healthy subjects were included in this educational programme. Ultrasound examinations were performed with a Diasus (Dynamic Imaging Ltd, Livingston, Scotland, UK) using two broadband linear probes of 5–10 and 8–16 MHz frequency.

**RESULTS**

Sonographic training lasted for one month and included 30 scanning sessions (24 hours of active scanning). Table 1 lists the details of the teaching programme. The novice decided to
start with the upper limb and then to examine the lower one. A total of 243 images were taken of the selected anatomical areas. The mean time required to produce each image was 6 minutes (SD 4.2; range 1–30).

Table 1 shows the results of both the self assessment and tutor evaluation of the quality of the pictures taken by the novice. The median values of the tutor scores were ≥6 in 8 of the first 15 sessions and in 13 of the last 15 sessions. As the study continued, the scores given by the tutor and the novice for the quality assessment of the pictures, gradually became more similar. Lack of concordance occurred in all the first 15 sessions and in 13 of the last 15 sessions. Table 1 also reports the tutor’s perception of the difficulty level of the scanning sessions. Wrist and shoulder were the most demanding areas.

The total time spent by the tutor in discussing the quality of the sonographic images with the novice was 8 hours and 20 minutes. Over the teaching programme the time spent by the novice was 30 Hip 22 3 4 (4–4) 7 (6–7) 6 (6–7) 3 (3–3) 10
  25 Ankle 22 8 2.8 (2–4) 6 (6–7) 7 (6–7) 2 (2–3) 15
  24 Knee 26 10 4.8 (2–7) 6 (6–7) 5 (6–7) 2 (2–3) 30
  24 Knee 57 10 5.7 (2–11) 6 (5–7) 6 (5–7) 4 (2–7) 15
  23 Knee 23 8 3.8 (3–5) 6 (6–7) 5 (6–7) 3 (2–8) 15
  23 Knee 69 8 5.6 (3–20) 5 (4–6) 6 (5–8) 5 (2–10) 30
  22 Ankle 48 10 4.8 (2–7) 6 (6–7) 5 (6–7) 2 (2–3) 30
  21 Ankle 23 8 2.9 (2–5) 6 (6–7) 5 (6–7) 3 (2–8) 15
  20 Ankle 36 8 4.5 (2–8) 6 (6–7) 5 (6–7) 2 (2–3) 15
  20 Foot 19 7 2.7 (2–3) 6 (6–7) 6 (6–7) 2 (2–3) 15
  19 Ankle 22 8 2.8 (2–4) 6 (6–7) 6 (6–7) 2 (2–3) 15
  19 Ankle 38 8 3.8 (3–5) 6 (6–7) 5 (6–7) 3 (2–8) 15
  18 Ankle 30 8 3.8 (3–5) 6 (6–7) 5 (6–7) 3 (2–8) 15
  18 Shoulder 30 8 3.8 (3–5) 6 (6–7) 5 (6–7) 3 (2–8) 15
  17 Foot 22 7 3.1 (2–4) 6 (6–7) 6 (6–7) 2 (2–3) 15
  17 Shoulder 16 7 3.1 (2–4) 6 (6–7) 6 (6–7) 2 (2–3) 15
  16 Shoulder 22 8 7 (3–10) 6 (5–7) 7 (6–7) 5 (2–10) 30
  15 Shoulder 56 8 7 (3–10) 6 (5–7) 7 (6–7) 5 (2–10) 30
  14 Ankle 69 8 8.6 (3–20) 6 (6–7) 7 (6–7) 5 (2–10) 30
  14 Ankle 97 8 12.1 (7–30) 6 (5–8) 7 (6–7) 5 (2–10) 30
  13 Shoulder 70 10 7 (4–15) 6 (6–7) 7 (6–7) 5 (2–10) 30
  12 Wrist 10 7 6.5 (4–7) 6 (6–7) 6 (6–7) 5 (2–10) 30
  11 Shoulder 89 8 11.1 (7–15) 6 (5–7) 7 (6–7) 5 (2–10) 30
  10 Shoulder 45 8 8.6 (3–20) 6 (6–7) 7 (6–7) 5 (2–10) 30
  9 Elbow 39 6 6.2 (5–7) 6 (5–7) 6 (5–7) 5 (2–10) 30
  9 Elbow 37 6 6.5 (4–10) 6 (6–7) 6 (6–7) 5 (2–10) 30
  8 Wrist 98 10 9.8 (2–15) 6 (6–7) 7 (6–7) 4 (2–10) 30
  8 Wrist 79 10 7.9 (2–15) 6 (6–7) 7 (6–7) 4 (2–10) 30
  7 Wrist 98 10 9.8 (2–15) 6 (6–7) 7 (6–7) 4 (2–10) 30
  7 Elbow 37 6 6.2 (5–8) 6 (6–7) 6 (6–7) 4 (2–10) 30
  6 Wrist 96 10 6.9 (2–15) 6 (6–7) 6 (6–7) 4 (2–10) 30
  6 Hand 158 14 11.3 (3–19) 6 (6–7) 7 (6–7) 4 (2–10) 30
  5 Hand 79 10 7.9 (2–15) 6 (6–7) 7 (6–7) 4 (2–10) 30
  4 Wrist 47 10 4.7 (1–15) 6 (6–7) 7 (6–7) 4 (2–10) 30
  3 Hand 50 14 3.6 (1–5) 6 (6–7) 7 (6–7) 4 (2–10) 30
  2 Wrist 47 10 4.7 (1–15) 6 (6–7) 7 (6–7) 4 (2–10) 30
  1 Hand 50 14 3.6 (1–5) 6 (6–7) 7 (6–7) 4 (2–10) 30

### Table 2: Time spent on active scanning to reach a score of ≥6 for all the standard scans of each anatomical area

<table>
<thead>
<tr>
<th>Anatomical area</th>
<th>Number of sessions</th>
<th>Time total spent scanning for each anatomical area (min)</th>
<th>Mean time spent on scanning for each standard scan (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand</td>
<td>3</td>
<td>3 h 32 min</td>
<td>1 min to 20 min</td>
</tr>
<tr>
<td>Wrist</td>
<td>4</td>
<td>3 h 26 min</td>
<td>20 min to 36 min</td>
</tr>
<tr>
<td>Elbow</td>
<td>3</td>
<td>1 h 8 min</td>
<td>11 min to 20 min</td>
</tr>
<tr>
<td>Shoulder</td>
<td>3</td>
<td>2 h 22 min</td>
<td>17 min to 45 min</td>
</tr>
<tr>
<td>Foot</td>
<td>2</td>
<td>2 h 22 min</td>
<td>4 min to 15 min</td>
</tr>
<tr>
<td>Ankle</td>
<td>3</td>
<td>1 h 35 min</td>
<td>11 min to 30 min</td>
</tr>
<tr>
<td>Knee</td>
<td>2</td>
<td>58 min</td>
<td>5 h 8 min</td>
</tr>
<tr>
<td>Hip</td>
<td>3</td>
<td>36 min</td>
<td>12 min to 22 min</td>
</tr>
</tbody>
</table>
active scanning after an intensive self teaching programme. Hand, wrist, and shoulder were the anatomical areas with the longest learning curve.

At the end of the educational programme the novice could obtain acceptable images. We believe that basic skills in exploring the main acoustic windows is the first step in the complex and endless training in musculoskeletal US. Adequate experience in interpretation of the wide spectrum of sonographic findings requires further training and closer supervision by an expert tutor.

Although further studies are needed to define the most adequate training in musculoskeletal US, and the self teaching programme should be tested against other learning methods, our experience indicates that this kind of approach may reduce the time needed to gain familiarity with the sonographic landmarks of standard scans, allowing a quick and direct comparison between the “gold standard” images and those taken by the novice.

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