Reducing the risk of musculo-skeletal discomfort in screening mammography
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A report from the National Trainers Forum
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Authors
The NHSBSP National Trainers Forum

Enquiries
Enquiries about this report should be addressed to

Sarah Sellars
Tel: 0114 271 1060
Fax: 0114 271 1089
Email: sarah.sellars@cancerscreening.nhs.uk

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NHS Cancer Screening Programmes
Fulwood House
Old Fulwood Road
Sheffield
S10 3TH

Tel: 0114 271 1060
Fax: 0114 271 1089
Website: www.nbss.nhs.uk

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CONTENTS

ACKNOWLEDGMENTS iv

1. INTRODUCTION 1

2. BACKGROUND TO THIS DOCUMENT 2

3. MAIN CONCLUSIONS OF THE WORKING PARTY 3

4. ERGONOMIC RECOMMENDATIONS 4
   4.1 Risk Assessment 4
   4.2 Appointments 4
   4.3 Positioning 5
   4.4 Equipment 5
   4.5 Exercises 6

5. BODY AREAS AT RISK WHEN UNDERTAKING MAMMOGRAPHY 7

6. WHAT SHOULD BE CONSIDERED ALONGSIDE RISK? 8

7. GOOD PRACTICE WITH POSITIONING 9

8. FEATURES THAT MAY HELP TO REDUCE MSD 14
   8.1 Equipment design 14
   8.2 Room design 15

9. CONCLUSIONS 16

REFERENCES 17

Appendix 1 Example Survey 18

Appendix 2a Example Clinic Scheduling 22

Appendix 2b Screen shot from NBSS showing an example clinic 23
ACKNOWLEDGMENTS

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Claire Borrelli
Melanie Button
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Barbara Eckersley
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Sharon Hoffmeister
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Ann Mumby
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Sarah Sellars
Anne Shaw
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Zoe Vegnuti
1. INTRODUCTION

The NHS Breast Screening Programme (NHSBSP) is currently phasing out conventional film–screen mammography in favour of digital mammography. Digital imaging has many advantages over film: it brings post-processing and image enhancement capabilities, improves workflow, and allows more efficient image transfer, archiving, and retrieval.

However, the implementation of this technology has led to some unfortunate consequences. Consultation with the NHSBSP, discussions with individual mammography practitioners, and dialogue with regional training centres all reveal that many mammography practitioners have experienced musculoskeletal discomfort or even injury during the course of their duties in the wake of the transition to digital imaging.

The term ‘musculoskeletal injury’ covers a range of problems affecting the muscles and tendons in the hand, arm, wrist, back, neck, and shoulders. These may be caused by repetitive or awkward movement of the fingers, hands, or arms.¹ These risk factors need to be managed to ensure that the potential advantages of digital imaging are effectively realised, without compromising the health and wellbeing of mammographers.

This is particularly important because the NHSBSP is currently expanding the breast screening age range, a move that will increase the number of women undergoing screening. In order to maintain the throughput required to meet these demands, mammography practitioners will need to perform procedures efficiently, in a minimum amount of time. Since positioning women for mammography may require the practitioner to adopt unusual postures, particularly when pressed for time, the risk of injury is ever-present and may even increase should practitioners begin to work extended days to enhance service capacity.²
2. BACKGROUND TO THIS DOCUMENT

An ergonomic assessment of mammography units was carried out for the NHSBSP in 2007 by Professor Alistair Gale. His report concluded that although digital mammography would bring potentially important design-related innovations to the breast screening process, it would also bring ergonomic challenges.

Overall, direct digital mammography units are more ergonomic in design than analogue units. However, the tasks of positioning the breast and taking the exposure remain the same, and both involve high-risk postures that carry a risk of injury.

After discussing Professor Gale’s report, the NHSBSP National Trainers’ Forum agreed to run a workshop examining the ergonomics of positioning. The aim was to produce a Good Practice Guide for the users of digital mammography units that would provide advice, hints, and tips for reducing the risk of musculo-skeletal injuries.
3. MAIN CONCLUSIONS OF THE WORKING PARTY

The working party set out to evaluate the ergonomics of the new tasks arising from the transition to digital screening, and to assess the demands that these placed on mammographers and their environment. On the one hand, using direct digital equipment alleviates stress points by eliminating the need to handle cassettes, or to process and load film. On the other hand, the main causes of stress remains the need to position women for mammography. Additionally, some new risk factors have been identified, such as the use of workstations for reading images (bringing an increased use of keyboards). For all of these reasons, good practice needs to be seen as a means of preventing potential injuries as well as a way of producing high-quality diagnostic images.

The working party sought to identify the main stress points on a mammographer’s body when positioning women for imaging. It concluded that the nature of this activity entails a repetitive cycle that includes:

- significant bending and twisting of backs, knees, and wrists.
- stretching of upper and lower limbs.
- forceful movements when supporting the breast.
- the application of compression.
- the making of exposures.
- the maintenance of a static working posture for periods when standing or sitting at the reporting workstation.

The working party agreed that the Guide should not be too prescriptive when giving advice, but should set out some general principles on posture. Key points are outlined in pink boxes throughout this document.
4. ERGONOMIC RECOMMENDATIONS

This section briefly outlines the key ergonomic recommendations that emerged from the working party’s consideration of the issues.

4.1 Risk Assessment

Some Trusts already undertake body mapping of individuals and Appendix 1 gives an example of a proforma for this purpose. Whether or not this type of detailed assessment is practiced, ergonomic assessment must form part of a unit’s risk assessment in future.

- Recommendations on ergonomics should be put into risk assessments for staff.

4.2 Appointments

At present, screening centres are striving to increase their workflow to accommodate both the Programme’s expansion and the switch to digital mammography. At such a time, new working practices can be considered. Appendix 2 shows examples of shifts and timings that include statutory breaks to comply with working directives.

- Mammography screening appointments, in general, should not be less than 6 minutes long.
4.3 Positioning

The working party also considered the ways in which the women undergoing screening could help to reduce the mammographer’s discomfort. Providing clear directions when positioning a subject was seen as particularly important, alongside employing common sense where very tall or very short women were to be screened.

- Where practical, mammographers should be encouraged to ask a colleague matched in height to take over an examination.
- Where women attend in wheelchairs, two mammographers should always be present.

4.4 Equipment

The positive and negative features of current and digital units were considered by the working party.

It is recommended that mammographers use a saddle seat, or other suitable stools, for positioning medio-lateral obliques. This should also be covered in training programmes wherever possible, and has been included in the positioning DVD produced by the NHS BSP National Training Centre at King’s College Hospital, London.

- Mammographers’ positioning practice should be observed regularly by an experienced colleague. The colleague should identify behaviour and practices that might lead to ergonomic injuries, and advise on alternative approaches. This could serve as CPD activity.
Mammographers have a responsibility for their own health and safety and for the health and safety of others. They must also maintain good and safe working practices.

4.5 Exercises

Some centres recommend* that mammographers complete exercises during their micro-breaks³ between screening examinations. These might be guided by animated on-screen tutorials.

* These exercises would be provided by physiotherapists and occupational therapists within the trusts.
5. BODY AREAS AT RISK WHEN UNDERTAKING MAMMOGRAPHY

The points made in the following sections apply equally to analogue and digital mammography. The health and safety of all practitioners performing mammograms are critically important, and the Employers’ Liability Act makes it the employer’s responsibility to care for the health and safety of their employees while the latter are at work.4

The areas prone to injury in screening mammography3 are the:

- neck.
- shoulders.
- knees.
- elbows.
- base of thumb and hand.

The risk factors include:

- stretching.
- force.
- the frequency of repeated movements.
- poor posture.
- the relative height of the client/practitioner.
- time pressures.
- client body size and mobility.
- client anxiety.
6. OTHER CONSIDERATIONS

1. The same technical standards should be used for performing digital and analogue mammograms: 97% should be diagnostic and no more than 3% of screened women should be recalled for repeat x-rays.

2. The duration of a screening appointment should be no less than 6 minutes for routine clinics, where there are two mammographers in attendance and one x-ray set. However, some flexibility is necessary, as some appointments have to be tailored to a specific case.

3. A larger-format fixed detector requires the shoulder positioning to be adjusted. Further adjustments are necessary where equipment has changeable paddles.

4. Where possible, paddles should be changed to suit the breast size.

5. Face shields may cause difficulties when clients have neck and shoulder problems, thereby limiting whole breast imaging process.
7. GOOD PRACTICE WITH POSITIONING

- Good communication with the client is empowering: it enables her to move independently rather than being moved.

- Use the whole hand, or as much of the hand as possible, to position the breast, rather than relying on the thumb and forefinger.

![Figure 1](source: National Breast Screening Training Centre, Kings College Hospital)

- Try not to use the same fingers to press the exposure button. Different exposure control designs exist, involving different types of movement (see below). Selecting an appropriate means of control can avoid injury.
Reducing the Risk of Musculo-skeletal Discomfort in Screening Mammography

Figure 2.

Figure 3. Source: Anne Teape, BreastCheck

Figure 4.
• Familiarise yourself with the full range of the equipment and its controls. Most new equipment has controls in more than one position, and the user can select that which is most convenient.
• Before positioning a woman, make sure that the foot pedals are placed correctly so that there is no need to stretch extremities.

Figure 8. Source: NHSBSP National Breast Screening Training Centre, Kings College Hospital

• Consider the seated position for screening, both for client and mammographer. This will require the provision of suitable chairs and flooring. Each mammographer must adjust their seat height and proximity to suit each woman, and each should avoid over-extension of their elbows and shoulders. The wheels on the stool must be selected to give the right level of grip for the type of floor.
• Store additional equipment at waist height to reduce bending and stretching.

• Where possible, set the height of the modality acquisition workstation. Some manufacturers have introduced touch screen technology to reduce the use of keyboards.

• Always have two practitioners available where disabled women or women in wheelchairs are to be screened.

• Always rotate screening mammography with other tasks, such as clinic reception duties, to ensure that practitioners have micro-breaks from repetitive tasks.
8. FEATURES THAT MAY HELP TO REDUCE MSD

8.1 Equipment design

*Automatic tube angling*: this feature causes the tube head to move automatically into the oblique position, reducing the amount of stretching required for each examination, and thus decreasing stress on the upper body. The elimination of this repetitive movement is particularly valuable for lowering fatigue levels during screening clinics.

*Exposure controls*: this allows mammographers to elect to use either of the two desk-mounted exposure controls, so that the left and right hand can be employed in rotation. Although the exposure control buttons are very light to the touch, the preferred method for taking mammography exposures uses the foot pedal, enabling a ‘hands free’ approach.

*Compression*: a number of features can help reduce injury:

a) Some units do not require mammographers to make physical changes to the compression paddle between small and large women, thereby reducing the risk of strain.

b) Where it is not necessary to shift the compression paddle for each oblique view of the smaller breast, demands on the hands and wrists are minimised.

c) Where hand-controlled compression knobs for fine-tuning the level of compression are avoided, the need for repeated twisting of the wrist is reduced.

d) Use of a high-edge paddle pushes the contra-lateral breast back, and supports it away from the field of view. This means that the practitioner does not need to ask (or assist) the client to do this during the oblique projections, reducing the risk of injury.
Acquisition workstation: keyboard use, and the musculo-skeletal injury associated therewith, can be reduced by limiting the number of steps requiring the use of a mouse or keypad through the mammography process, or by employing touchscreen technology.

8.2 Room design

The design of the mammography room can also help to reduce musculo-skeletal strains and improve workflow. The working triangle should be as small as possible, but must include handwashing facilities.

The design of the reading room should also be considered, as many radiographers are now involved in film-reading as well as mammography. The same principles will apply to radiographers involved in extended roles, such as ultrasound.
9. CONCLUSIONS

Mammography is a repetitive task and every effort should be taken to reduce musculo-skeletal strain. This guide sets out some examples of good practice and lays out some recommendations for minimising the risk of injury.

Individuals must take responsibility for their own health and safety, and must ensure that safe practices are used when carrying out their duties.
REFERENCES


Appendix 1  Example Survey†

Breast Screening Unit
Musculoskeletal Comfort Survey

This survey has been distributed to all staff members in the Breast Screening Unit as part of a Musculo-Skeletal Risk Assessment of the department. The information collected from this survey is confidential, and will only be viewed by members of the Back Care Team. The information collected will be collated and presented in report format to ensure anonymity.

Please complete the survey, seal it in the provided envelope, and return it to………. Should you have any questions, ……. can be contacted by email or on extension xxxxx.

<table>
<thead>
<tr>
<th>PART A: General information about your job</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which work area(s) do you use the most?</td>
</tr>
<tr>
<td>(If rotational, tick appropriate areas and indicate by side how many months the placement lasts for)</td>
</tr>
<tr>
<td>Ultrasound</td>
</tr>
<tr>
<td>Prone biopsy room</td>
</tr>
<tr>
<td>Static Mammo room</td>
</tr>
</tbody>
</table>

What equipment/machine do you use most frequently? (You can list more than one, if applicable)

<table>
<thead>
<tr>
<th>PART B: Musculoskeletal comfort assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: For the purposes of this survey, pain or musculoskeletal discomfort are defined as any aches, strains, stiffness, numbness, tingling, or burning sensations.</td>
</tr>
</tbody>
</table>

Have you experienced any musculoskeletal discomfort in the past year that you would attribute to your work in the department? (please circle response)  

| Yes | No |

† Updated from a questionnaire provided by the Occupational Health Department. University Hospital Birmingham, NHS Foundation Trust
If you circled **NO**, please **go to PART C**.

If you circled **YES**, please **complete the following questions**.

Please mark on the diagram the area of your body that experiences the **most** musculoskeletal discomfort.

<table>
<thead>
<tr>
<th>Aching</th>
<th>Change of colour</th>
<th>Swelling</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Burning</th>
<th>Numbness</th>
<th>Stiffness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cramping</th>
<th>Pain</th>
<th>Tingling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other (*please specify*)

Please answer the following questions for the body area you identified above

Please indicate the frequency that you experience the discomfort.  (*tick one box*)

<table>
<thead>
<tr>
<th>Seldom</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0-5% of your time at work)</td>
<td>(36-65% of your time at work)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occasionally</th>
<th>Constantly</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6-35% of your time at work)</td>
<td>(66-100% of your time at work)</td>
</tr>
</tbody>
</table>

Please rate your **worst** musculoskeletal discomfort on the following scale, where 0 = no pain and 10 = unbearable pain.  (*Please circle the appropriate number*)

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unbearable pain</td>
</tr>
</tbody>
</table>

**Breast Screening Unit Musculoskeletal Comfort Survey**
Has the discomfort interfered with your ability to do your job? *(please circle response)*

| Yes | No |
--- | --- |

If YES, please indicate how your ability to do your job has been affected. *(e.g. sick leave, restricted duties, etc.)*

Are there any specific tasks and/or equipment you think contribute to your discomfort? *(please circle your response)*

| Yes | No |
--- | --- |

If YES, please specify which tasks and/or pieces of equipment you think have caused your discomfort. *(tick all that apply)*

- Positioning the breast:
  - Cranio-caudal view
  - Lateral view
  - Oblique view
- Adjusting the C arm
- Operating the foot pedals
- Operating the buttons
- Assisting with patient movement
- Other;

If you have **any other body area(s)** that experience **discomfort related to work**, please indicate on the diagram

---

**PART C: Summary**

Any additional comments are welcome!
**PART D: Information about you**

<table>
<thead>
<tr>
<th>What is your job title?</th>
<th>How many hours do you work per week?</th>
</tr>
</thead>
<tbody>
<tr>
<td>How long have you worked as a radiographer or Assistant Practitioner?</td>
<td>How long have you worked in this department?</td>
</tr>
<tr>
<td>How tall are you?</td>
<td></td>
</tr>
<tr>
<td>Are you right handed or left handed? <em>(Please circle one)</em></td>
<td>Right</td>
</tr>
<tr>
<td>Please tick the box which includes your age at last birthday</td>
<td>21 – 25</td>
</tr>
<tr>
<td></td>
<td>26 – 30</td>
</tr>
<tr>
<td></td>
<td>31 – 35</td>
</tr>
</tbody>
</table>

*Thank you very much for taking the time to complete this survey. The findings will contribute to the Musculoskeletal risk assessment for the department.*

**Please place this survey in the provided envelope and return it to:**
## Appendix 2a  Example Clinic Scheduling‡

<table>
<thead>
<tr>
<th>Work patterns on mobiles</th>
<th>Screening hours</th>
<th>Staff allocation</th>
<th>Breaks or stoppages</th>
<th>Numbers invited per day</th>
<th>Appointment interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift 1</td>
<td>7.45 am – 12.45 pm</td>
<td>2</td>
<td>Shift 1 will complete the required QC on the equipment before starting the clinic. Both shifts have 15 minute staff changeover and 15 minutes stopped appointments, mid am and mid pm</td>
<td>47</td>
<td>6 minutes</td>
</tr>
<tr>
<td>Shift 2</td>
<td>1.00pm – 6.00 pm</td>
<td>2</td>
<td></td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>(Plus half day at base)</td>
<td></td>
<td></td>
<td></td>
<td>Total: 84</td>
<td></td>
</tr>
</tbody>
</table>

| Standard day             | 9.10 am – 4.30 pm | 2 | Lunch: 45 minutes and 2 x 10 minute stops, one am and one pm | 62 | 6 minutes |

<table>
<thead>
<tr>
<th>Work patterns on static hospital site</th>
<th>Screening hours</th>
<th>Staff allocation</th>
<th>Breaks or stoppages</th>
<th>Numbers invited per day</th>
<th>Appointment interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>One shift, one mammography set</td>
<td>9.10 am - 4.35 pm</td>
<td>2</td>
<td>Lunch: 60 minutes 2 stopped slots am and 2 pm</td>
<td>60</td>
<td>6 minutes</td>
</tr>
</tbody>
</table>

‡ These times should be negotiated based on DNA rates and equipment type. For example some equipment has a longer refresh time between each exposure, so timings would need to be adjusted.
Appendix 2b  Screen shot from NBSS showing an example clinic

Figure 10. Example clinic timings