Patient-assisted compression improves image quality, patient experience

By Dr. R Iordache

The benefits of screening mammography have been confirmed in hundreds of studies [1-3]. However, at least a third of women over 40 do not consistently undergo recommended screenings [4]. There are numerous reasons for this, but one of the most common is fear and anxiety related to the pain of compression [5-10]. Indeed, a review of a total of 7 studies involving 5,741 women found that up to 46% avoided exams because of a previous painful experience [11]. Another study found that nearly a fourth of 109 women attending a screening clinic took pain or anti-anxiety medication before the exam [12].

Yet breast compression is an integral part of the exam, required to improve image quality and reduce the amount of absorbed radiation [13].

Several options are available to improve the patient experience and reduce pain and anxiety during breast screening. These include providing more information about the exam before screening; using breast cushions or pressure-standardized mammography; improving the interaction with the technologist; reducing the overall amount of compression; and giving the patient more control over the compression itself [6, 12, 14-18].

Despite these options, a 2008 Cochrane review of 7 randomized clinical trials involving 1,671 women concluded at the time that “there are very few proven interventions” to reduce pain and discomfort of screening mammography, especially procedures that can be easily introduced into the screening workflow, and it called for more research on such options [14].

PATIENT-ASSISTED COMPRESSION

Control is a particularly significant factor in one’s anticipation of and reaction to a painful event, with studies finding that increased control and self-efficacy can reduce the perception of pain [19, 20]. Even giving women verbal control over the amount of compression during a mammogram, such as reminding them that they can tell the technologist if the pressure is too intense, can reduce the perception of pain [21]. More recently, the first patient-assisted compression (PAC) device, in which the patient has physical control over the intensity of the compression, has been commercially released.

The first published study of PAC appeared in 1993, when researchers from Duke University Medical School assessed the effect of PAC on screening mammography and patient satisfaction in 109 women who received standard two-view imaging. The technologist performed compression in one breast and the patient in the other, with women randomized as to which breast was imaged first. Patients used a handheld button to control the compression [12].

Thirty-one percent of patients reported significantly less pain with PAC (P<0.03) regardless of who compressed the breast first, while 56.9% reported no difference between the 2 approaches. Overall, 96% reported satisfaction with the procedure and a willingness to repeat the experience. Image quality was similar regardless of who performed the compression as long as the technologist performed the first compression, suggesting, according to the researchers, that there was a learning curve.

Another study conducted over a 6-month period in 2009 assessed the effect of PAC on the mammography experience and image quality in 139 patients compared to previous technologist-compression (TC) exams. The investigators observed a slight decrease in breast thickness for the cranio-caudal (CC) and mediolateral oblique (MLO) views and a slight increase for the right MLO view. There was also a mild increase of compression strength in the self-compression group.

Figure 1. Hand-held by the patient, the Patient-Assisted Compression device is smaller than a typical TV remote control device.

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for all views except the right MLO. A discrete decrease of the motion blur score was found for all incidences using the self-compression technique compared to the conventional technique [22].

The investigators also reported that 83% of the patients were extremely satisfied with the PAC experience, noting that they appreciated the ability to control their compression and actively participate in the exam. Fifteen percent of patients had more negative comments, however, saying that the procedure took longer, was too complicated, and/or that patients had more negative comments, however, saying that they preferred technologist-provided compression.

**FIRST APPROVED PATIENT-ASSISTED COMPRESSION DEVICE**

In 2017, regulatory authorities in several countries, including the European Union and the United States, approved the industry's first PAC device. About the size of a computer mouse, the wireless device features a "plus" button to increase compression and a "minus" button to decrease it [Figure 1].

A single-blind, prospective, randomized study was conducted to compare image quality in two-view (CC and MLO) breast images acquired using PAC versus TC compression in 30 consenting women presenting for screening exams with digital mammography. Each participant had one breast imaged with both PAC and TC compression and the other breast with TC only, per standard of care. Two readers blinded to the patient history and compression mode evaluated the images. They rated all image quality as acceptable, with all PAC images deemed of equal or better quality than the TC images. A single PA acquisition was determined to require a repeat scan due to positioning versus four repeats needed among the TC acquisitions [23].

A larger study evaluating the efficacy of the device and its impact on patient experience in 100 women (median age 59) during mammography was recently published in the European Journal of Cancer [24]. Sixty-six patients had post-surgery or post-treatment examinations and 34 patients who were considered at intermediate risk of breast cancer had screening mammograms; all exams consist of bilateral 2D or 3D+2D mammography. Prior to the procedure, the technologist provided a simple yet detailed explanation about the procedure and the device, including the importance of compression in relation to breast thickness, radiation dose, and image quality. Such explanations took less than a minute for 90% of the women [24].

The technologist performed the compression for the first breast (randomly choosing left or right) in CC, then the technologist ensured patient positioning and initiated minimal compression of 3 decanewtons (daN) to immobilize the breast before inviting the patient to use the PAC device to finalize the CC compression in the other breast. The same procedure was used for MLO views. There was no specific compression force required by the technologist, just that the breast be immobilized and flattened as much as possible given the patient's comfort. The patient could compress up to 20 daN, with 2 decompressions of 1 daN possible under the technologist's control and surveillance.

The technologist could intervene if it appeared the patient was using insufficient compression.

It was found that compression was significantly higher with Patient-Assisted Compression (PAC) than Technologist Compression (TC) for both views (P<0.0001), with an average breast thickness under compression significantly different only for CC (-1.90 mm, P=0.02) and the mean glandular dose significantly different only for CC view (-0.03 mGy, P=0.02). These findings are similar to those observed in a routine clinical practice at a large Midwest imaging center in the US [25]. Of the 1,814 patients who used the PAC device in that study, 63% achieved higher compression than the technologist-provided compression the previous year [25].

A radiologist blinded as to which breast was self-compressed evaluated the cases in the trial carried out by the group of Balleyguier[24]. The image quality obtained with PAC was rated superior to that of TC in 10% of cases, equivalent in 85%, and inferior in 5%. In three of the five cases judged to be inferior, suboptimal positioning prior to compression appeared to be at fault because the device was not handed to the contralateral arm. These exams were conducted early in the study and the protocol was changed to ensure appropriate positioning.

Adding PAC to the exam had little impact on workflow, with 84% of cases requiring similar or less time than those typically completed at the authors' institution.

In a post-procedure questionnaire, 17% of women reported discomfort during the procedure and 13% reported pain, with no significant difference between the self- or technologist-compressed breast. These results were particularly striking given that two-thirds of the study population had a history of breast cancer, which can lead to even more painful mammogram [26].

As the authors noted: "The fact that the majority of our study population . . . found the procedure painless may indicate that they perceive the pain differently because of the way the mammography examination is performed with the self-compression device."

Figure 2. In one study [24] of the effect of Patient-Assisted Compression, the technologist performed the compression for one breast, then initiated minimal compression (3daN) on the other breast to immobilize it, before inviting the patient to complete the compression using the PAC device.
REFERENCES

Figure 3. By pressing on the “plus” button of the PAC device, the patient can increase the compression on her breast; pressing the “minus” button reduces the compression.

In addition, 90% of patients reported that they found the device useful and 74% agreed that the device made it more likely they would return for their next mammogram. Anecdotally, the women reported less apprehension about compression and a greater ability to manage their own stress and pain by actively participating in the exam. This result is similar to that found in a patient satisfaction study conducted with 160 patients in 2 sites in Europe who underwent mammography with the same PAC device. In that survey, 79% of patients reported that it improved the comfort of their exam and 54% said it led to less anxiety [27].

CONCLUSION
A significant percentage of women do not adhere to national guidelines for screening mammography. Fear of the results, pain, and anxiety are among the primary reasons for such non-compliance. The majority of the pain results from the compression, which is required to reduce dosage absorption and improve image quality.

Table 1. Comparison of Patient-Assisted Compression (PAC) and Technologist Compression (TC) [24]. The figures in red indicate statistically significant differences. Abbreviations: daN decaNewtons; CC cranio-caudal view; MLO medio-lateral oblique view; AGD average glandular dose in milligray (mGy).

<table>
<thead>
<tr>
<th>Compression (daN)</th>
<th>PAC*</th>
<th>TC*</th>
<th>Difference* (PAC-TC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/8.5</td>
<td>8/8</td>
<td>2/1.5*</td>
<td></td>
</tr>
<tr>
<td>5/3.2</td>
<td>5/3.2</td>
<td>-0.2*</td>
<td></td>
</tr>
<tr>
<td>AGD (mgGy)/CCMLO</td>
<td>1.35/1.35</td>
<td>1.36/1.45</td>
<td>0.01*</td>
</tr>
</tbody>
</table>

*statistically significant differences

Providing a handheld, wireless device that allows women to control compression intensity, however, can significantly reduce the pain and anxiety associated with mammography with no impact on image quality. The minimal impact on workflow (one minute or less to explain the procedure) may, according to the researchers, actually provide a benefit, because it offers an opportunity to improve patient/staff dialogue and the overall mammography experience.

It remains to be seen, however, whether such a device can also improve screening compliance.