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Breast compression techniques in screening mammography – a Maltese evaluation project

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Highlights:

- A flexible approach is required for a successful breast compression technique
- Explanation and requesting client feedback are essential to obtain cooperation
- A proper breast compression technique positively influences client turnout
- The findings have the potential to enrich new mammographers' training phase

Abstract:

Introduction: In screening mammography, the radiographer should be responsible for providing mammograms of high diagnostic value, possibly without subjecting clients to a painful experience. This skill is demonstrated via the technique of breast compression and is explored in this study by analysing insights about methods and underlying principles in regards to this procedure.

Methods: One-to-one semi-structured interviews were conducted with radiographers who perform screening mammography in Malta. For data analysis, a descriptive phenomenological approach following a simplified version of Hycner's (1985) method was adopted. **Results:** Five general themes were extracted from the data; meeting the client, preparing the client, the mammography procedure, pain from compression and client turnout. It was determined that the participants alter their breast compression technique according to the client rather than following a rigid step-by-step process and that explanation and requesting client feedback are essential to obtain cooperation. Additionally, mammography positioning and compression application are tailored in a way that encourage compliance, however not at the expense of degrading image quality. Ultimately, it is also believed that a proper breast compression technique positively influences client turnout.

Conclusion: The results of this study demonstrate that radiographers should be flexible in their approach in order to carry out a successful breast compression technique. However, it has also been shown that such effectiveness in practice is gained from experience rather than initial training. If exposed to this study's findings, new mammographers would be able to form a robust core of knowledge before embarking on the challenging specialisation of mammography.

Keywords: breast compression, screening mammography, descriptive phenomenology, interview

Introduction and background

According to the Malta National Cancer Registry, carcinoma of the breast is the most commonly occurring cause of female cancer mortality in Malta.¹ Breast screening has the potential to effectively reduce breast cancer mortality²⁻⁴ by at least 40%.⁵ In Malta, the breast screening programme was established in 2009 and it currently invites women aged 50-66 years for free breast screening every 3 years. It operates 2 state-owned direct digital mammography units, which are fully quality assured in-line with the European Guidelines for Quality Assurance in Breast Cancer Screening and Diagnosis.⁶

During screening, the radiographer acquires cranio-caudal (CC) and medio-lateral oblique (MLO) projections of each breast, where the breast is positioned on the image receptor at 0° and 50° respectively and compressed with a compression paddle.⁷ Compression uniformly thins out the natural varying thickness of the breast from chest-wall to nipple and creates a contact area with the paddle, which varies according to the breast's size and elasticity.⁸ This reduction in thickness leads to less breast tissue overlap, less image motion blur and a decrease in breast radiation dose, the latter meaning less scattered radiation and hence higher image contrast.^{8,9} Insufficient compression may therefore result in low image quality with a detriment on lesion detection and misdiagnosis.¹⁰

When Rosenkratz et al. (2016)¹¹ reviewed 464 tweets from women talking about mammography, breast compression was found to be the most commonly discussed topic. 50% of breast screening clients suffer moderate to severe pain from compression and while many of them may accept the pain as a normal part of the procedure, 8% delay or do not go for their appointment¹² and also discourage others from accepting the invite.¹³ Some radiographers tend to set their own compression force tolerance levels without paying enough attention to the breast type and this may negatively affect the client and may also give them more radiation dose than necessary.¹⁴⁻¹⁶ A positive experience as well as highly diagnostic mammograms are more likely if the breast compression technique is adapted to the client through communication, proper positioning, machine adjustment and careful manoeuvring of compression paddle application.^{1,10,12,17,18}

The objective of this study is to evaluate the way breast compression techniques in screening mammography are performed and to establish what determines the chosen methods. Quantitative research may be able to provide significant findings from a mechanical

view; however, qualitative methods may perform superiorly in terms of offering a more in-depth and insightful report.¹⁰ Furthermore, qualitative studies which evaluate the way radiographers practise are extremely scarce.¹⁹ Data provided directly by radiographers will contribute a different perspective on breast screening for the first time in the local scenario and may also have the potential to shape practice and even policy and future development.

The aims of this evaluation project are:

- to obtain descriptions of how radiographers in breast screening carry out their breast compression techniques and what motivates their choice of methods,
- to establish whether these radiographers are willing to reach a compromise between sufficient compression force and the client's tolerance to pain,
- to evaluate whether they recognize the impact they may have on client turnout,
- to determine whether there is any significant variation in technique amongst them.

Methodology

The methodology that was adopted for this study is descriptive phenomenology. This was founded by Edmund Husserl (1859-1938) and is characterised by findings that truly represent the study group's descriptions of their personal experiences. Descriptive phenomenology differs from interpretive phenomenology by not including the researcher's insights about the phenomenon,²⁰ its main aim being to describe and not to explain²¹ and to understand the essence of a concept without generating a theory.²²

Method

Ethical approval to commence data collection was granted by the higher education institute. Since descriptive phenomenology necessitates participants' spontaneity,²² will and capability to be able to give a detailed account of their lived experiences,²⁰ methods with minimum structure that obtain maximum depth should be used.²¹ Whilst participant observation and focus meetings are good examples of such data collection tools,²¹ interviews are generally considered the main method for gaining in-depth insight into a phenomenon.²³ The face-to-face interview was chosen for this study as it is the most likely to provide

authentic and individual information, while allowing observation of facial expressions, gestures and other non-verbal cues.²⁰ Purposive sampling was applied to recruit the 9 radiographers who perform duties at one breast screening unit. More diverse accounts may have been acquired if symptomatic mammographers, or screening mammographers from other sites had participated, leading to increased transferability. However, a homogenous sample allows an ideographic and a detailed examination of a lived experience. Information sheets and consent forms were distributed personally by the researcher to the eligible participants, providing the reason behind the invitation and the topics that could have been discussed during the one-to-one interview,²⁴ while guaranteeing anonymity and confidentiality and the freedom to withdraw from the study at any stage. The consent form also specifically asked the potential participants for permission to be recorded during the interview.²⁵

A maximum of 2 interviews per day were allocated throughout a month²⁶ and set up in concordance to the participants' duties in a private office in a quiet part of the screening establishment.^{25,27} An interview guide was used, which was compiled by extracting questions from the aims of the study. It consisted of specific and open-ended questions, so as to prevent the participants from deviating from the main purpose of the study and to encourage in-depth answers, rather than a simple "Yes" or "No". This guide also helped to keep track of the topics covered, while maintaining structure in responses so as to facilitate comparison among the participants' answers.

Since the researcher is also a radiographer with experience in mammography, it was ensured that a bracketed approach was adopted throughout all the interviews. This was done by accepting the answers provided by the participants as is and by only probing or asking follow-up questions if responses were vague or too brief. A field diary was used to record participants' non-verbal cues, as well as any further comments given after the recording had stopped. Non-verbal cues could also trigger probing.

A simplified 5-step version of Hycner's (1985) method was followed in order to analyse the data in a systematic phenomenological descriptive manner.²⁸ Firstly, the researcher listened carefully to each interview for multiple times, performed manual verbatim transcription and read the transcripts repeatedly, taking into consideration the para-linguistic cues. This process helped the researcher to become familiar with the words and to get a sense

of the whole interview, also known as gestalt.²⁸ The second step consisted of scrutinising the transcripts and extracting the words, phrases, non-verbal or para-linguistic cues, which expressed a distinctive meaning, noticeably distinguished from one another; this produced Hycner's units of general meaning (UGMs). In the following step, the UGMs which responded to the phenomenon under evaluation were then selected and presented as Hycner's units of relevant meaning (URMs). It was then determined whether any of the URMs naturally clustered together to form a common theme. This procedure necessitated a to-and-fro process from the transcripts to the URMs to the clusters of URMs. In the fourth step, the interviews were summarised whilst merging in the extracted themes to provide context; this also provided gestalt.²⁹ Each summary was emailed to the respective participant for member-checking. In the final phase, themes that were common to most or all of the participants were grouped to produce general themes and a composite summary was written in order to place these themes into context and hence, to determine the phenomenon's meaning.²⁸

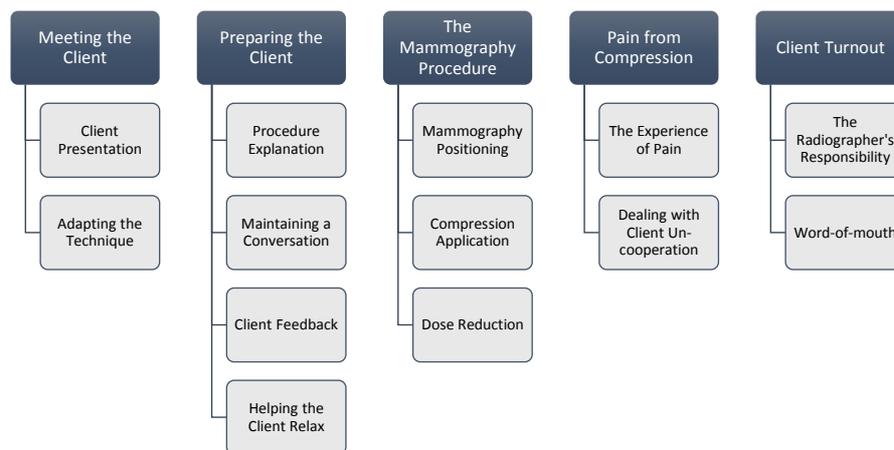
Methodological or data triangulation was not possible within the confines of this study. However, validation of the data was achieved via member checking, inter-rater agreement and bracketing. Reflexivity, which was originally implemented to separate the researcher's opinions from those of the participants', actually portrayed that the 'insider' experience was an asset because the participants' narratives could be easily followed and understood, including the mammography-specific terminology.^{30,31} Finally, the supervisor's continuous assistance during the research process, mainly via discussions regarding the methodology, data collection, data analysis and findings, helped the researcher with the identification of any possible sources of bias.^{32,33} These methods increased the robustness of the study and avoided reaching premature conclusions, which could have led to misinterpretations and a decrease in trustworthiness of the findings.

Consent for the study was obtained from all the eligible radiographers, making this an absolute favourable outcome.^{29,34} The participants were all female with an age-range of 29-57, the majority being in their early thirties. Their mammography-specific experience varied from 5 months to 12 years, with a mean experience of 6 years. Even though most of the participants had their mammography training in other hospitals, they were all retrained when they initiated their duties at the screening unit. Each interview lasted 30 min on average.

Results

As illustrated in Table 1, 13 themes were extracted from the URMs, which were further clustered into 5 general themes, demonstrating the factors which influence and are affected by the breast compression technique in a sequential manner. Overlapping of some of these themes, such as adapting the technique and compression application, was inevitable due to the nature of the interview questions which all revolved around compression application.

Table 1 – General Themes and Sub-themes



Discussion

Findings of this study show that the participants do not strictly abide by the objective measure of compression force but rather use the numerical scale as a reference point to ensure that the compression applied is within the claimed acceptable range of 60N-160N. 100N is their target compression force, which appears to be something they were taught in their training phase. It was stated that soft breasts require much more compression to achieve minimum breast thickness reduction than dense breasts, with the latter generally starting to resist the compression paddle at less than 100N. Additionally, the participants declared that clients with soft breasts tend to be more tolerant to compression but that there is no clear-cut relationship between breast type and compression force and that it may only depend on the client's pain threshold. Contrarily, in the sequential studies by Mercer et al.,¹⁴⁻¹⁶ it is reported that radiographers tend to set their own compression thresholds.

The participants claimed that their techniques have been mostly shaped by experience throughout their mammography career, rather than by their initial training. Nevertheless,

there appeared to be no obvious connection between years of practising mammography and technique proficiency since no significant variation was detected in their mode of practice. On the other hand, the techniques described in the study by Murphy et al. (2015)¹⁰ varied substantially.

In the following section, the general themes are developed in the context of relevant literature, while making use of some excerpts from the participants' interviews to further illustrate their experiences and beliefs.

Meeting the client

Clients' appearance, flexibility, attitude, body language and clinical history are the main factors, which determine the participants' breast compression technique. One participant talked about the challenge of stature difference between client and radiographer, “... *for me it's a bit difficult because ... you need more strength to pull and I need to go on ... tiptoes ...*”, while another participant declared, “*If [the breasts are] really small and she's really thin, you take into consideration that you need to pull more ...*”. This first stage of the mammography procedure is highlighted in the literature review by Davey (2007)¹³ and also in the study by Nightingale et al. (2015),¹⁸ where it is stated that such factors establish the radiographer's breast compression technique.

Adapting the technique

The participants believe that when the breast compression technique is adapted to the client through the use of an appropriate compression paddle size and by adjusting the image receptor's height and angulation,³⁵ proper compression distribution is achieved and consequently, client comfort and image quality are likely to increase. Mercer et al. (2015)⁷ explain that a correct level of the image receptor during the CC increases client comfort because a compression balance from the receptor and the compression paddle is achieved, leading to a balanced distribution of compression force from above and below the breast. A high receptor level for the MLO may be painful due to lengthwise tension of the breast and pectoral muscle, which would require more compression to hold the breast forward.³⁶ One participant highlights the importance of adaptation in the following statement:

“[You should be] ... careful and really work with the breast that's in front of you rather than doing the exact same thing on every client ... and try and make it as

painless as possible.”

Preparing the client

The participants regard procedure explanation as an effective tool to reduce anxiety, increase awareness and provide empowerment, “*Awareness of what is happening is always a benefit for the client as she feels that she's in control ...*”. Similarly, Nightingale et al. (2015)¹⁸ report that the success of the mammography examination depends on both cooperation and empowerment. One participant emphasizes on the importance of educating the client about the correct facts of mammography due to the negative influence of social media - an issue highlighted in the study by Rosenkratz et al. (2016),¹¹ “... *there's a ton of misinformation about mammography ... on Facebook, saying that it causes cancer ... So ... you have to take the time and explain ...*”. It is also reported that introducing oneself, keeping a calm approach and displaying non-verbal behaviour such as having a smile on your face is likely to increase trust; this is bound to improve the practitioner-client relationship.³⁷ The importance of explanation and communication in mammography is also emphasised in several other studies.^{1,10,12,38} However, in concordance to the findings by Murphy et al. (2015),¹⁰ it is believed that the 6-10 min allocated per client are not enough time to offer reassurance and full procedure explanations. Furthermore, some participants admitted that the client's attitude and their own mood may affect how willing they would be to offer explanations, while others declared that they tend to reserve explanations to only those clients who would be nervous.

The mammography procedure

Mercer et al. (2015)⁷ report that the way the breast is positioned under the paddle determines how pressure is received in various areas of the breast and therefore affects whether the client endures pain during compression. For the CC, the participants described how they adjust the image receptor at the level of the inframammary fold and pull the breast forward and centrally with the nipple in profile, with the aim of placing all the breast tissue on the breast support, possibly with the inclusion of the pectoralis major. This is done while smoothing out skin folds and the inframammary fold. This technique ensures minimum breast thickness reduction upon compression³⁹ and results in uniform breast thickness and less pain through minimised pressure and reduction of skin dragging.³⁶ One participant discussed her unique method of positioning the client:

“I find that I get a better mammogram if I lean them a bit to the lateral. And that allows me to pull that medial aspect of the ... breast a bit more forward on the CC. And I find I get a bit more muscle ... If you're at the right height, I find that maybe that my leaning just slightly laterally gives you maybe a little bit more compression because you're more working with the angle of the breast.”

The participants rotate the image receptor to 45° for the MLO, and adjust it in the range of 40°-35° for short and obese women with big breasts and to 50°-55° for tall and thin women with small breasts. Brnic & Hebrang (2001)⁹ performed the MLO projection at 60°; this resulted in more adequate compression and a 25% reduction in absorbed glandular dose when compared to the standard 45°. These advantages were more obvious in small and drooping breasts than in large and dense breasts, which coincide with the participants' conviction that small breasts are more adequately compressed with a steep angulation and vice-versa. Compression during the MLO projection is also believed to be improved by the following technique, as described by one participant:

“I like to tell [clients] during the MLO ... to breathe in and out, so that the compression paddle can ... go ... exactly with the chest wall. That's, I think, a technique that I got 'cause I saw a radiographer doing it.”

The consequence of incorrect MLO positioning is portrayed by Dustler et al. (2012),⁴⁰ who conclude that although radiographers are taught to include the pectoral muscle, excessive pressure on the juxtathoracic region should be avoided as this may result in insufficient pressure on the breast tissue itself. This issue was also brought forward in this study:

“... [if] you've got a lot of latissimus dorsi muscle ... then you're not gonna get as good a compression at the bottom of the breast. So, I tend to try and reach from the axilla and make sure I'm only getting pectoralis major and minor and move the other more posterior stuff away.”

Similar to the finding by Murphy et al. (2015),¹⁰ the participants of this study claim to rely on automatic exposures, which offers reassurance that they are not giving high radiation doses. However, unlike in the study by Murphy et al. (2015),¹⁰ they also list reduction in dose as one of the main advantages of compression and believe that this is especially effective

with 100N or more. This advantage is also mentioned in other studies.^{8,9,14}

Pain from compression

As discussed previously, the way the image receptor is adjusted and the method used to position the breast, influences whether the client endures a painful experience upon compression. The participants also explained how after positioning the breast, they first apply compression with the foot pedal and generally complete it with the hand dial¹⁰ because it gives them more control as it makes the paddle go down slower. This and the fact that it is more silent, are believed to make the compression feel gentler. In addition, if breast thickness reduction is prioritised, rather than the numerical scale indicating the level of compression,^{15,39} and the appearance and feel of the breast are taken note of, the compression technique is likely to improve.¹⁸ The participants described the breast as becoming taut and blotchy upon optimum compression. Nevertheless, Poulos & McLean (2004)³⁹ could observe that sometimes, the breast would become taut and blotchy as soon as the compression paddle would simply touch the breast.

Clients' facial expressions and verbal feedback are also deemed important to help reduce pain from compression.¹⁸ The participants stated that feedback has the potential to empower the client and hence to improve the mammography experience, but that care should be taken so that image quality is not degraded as a consequence, *“Usually, you don't get to the compression level that you would like but you can compromise, kind of in between.”* When clients are unwilling to comply with an acceptable level of compression, the participants claimed that they refuse to take bad quality mammograms as they feel that they are responsible for their clients. In addition, one participant shared that clients cannot be pressured to be compressed more than they can endure, *‘After I would have explained all the benefits of compression and [the client] still refuses to do it, I don't see why I have to go against her say ‘cause it's her body after all ... ’* Likewise, Murphy et al. (2015)¹⁰ concluded that many participants considered it wrong to either insist on increasing compression or to stop compression at the expense of producing a mammogram of low diagnostic value.

Notwithstanding the importance of sufficient compression, the participants of this study declared that clients should however not be subjected to excessive compression forces as this does not mean that better image quality will be achieved,^{41,42} *“I try to compress as much as I can but not more than the [client] can take.”* Furthermore, pain can be minimised

when compression is stopped after the breast has already reached its minimum thickness.⁴¹ In fact, a compression force threshold may exist, beyond which there are no added advantages, both in terms of image quality and client care.¹⁰ Moreover, it has been reported that a reduction from 120N to 90N is not likely to affect image quality but is effective in reducing pain.⁴³

Client turnout

Van Goethem et al. (2003)³⁸ indicate that there is the risk that radiographers who have been practising mammography for less than a year would lack confidence, while those who have been in the field for more than 3 years would become indifferent. However, similar to the findings by Mercer et al. (2013a),¹⁶ these observations were not detected in this study. One participant emphasized the necessity of communication in order to improve client turnout:

'... if we explain ... and speak to them, inform them ... and even ask them if everything is OK, if they need to ask any questions ... they will feel more comfortable to come again next time.'

The participants claimed to be well-trained and professional and stated that most client feedback is positive. High client satisfaction at the local screening programme has been attested in a previous study, where 99.2% of the study population declared that they would be back for their next mammogram.¹ Nonetheless, the participants admitted that albeit the effort to create a positive experience, some clients are still bound to be dissatisfied. A negative experience may discourage clients from attending their screening appointment, either through direct experience or word- of-mouth.¹³ The participants are aware that clients share their mammography experience, whether good or bad, with family and friends and that word-of-mouth is very influential on client turnout, especially in the small country of Malta. One participant discussed how she tries to convince dissatisfied clients not to negatively influence other women:

"I explain like, 'Listen, not everybody's the same ... it's normal to feel pain but it's not the norm that you feel this much pain' ... So, as such she gets the hint ... [that she shouldn't] go around and tell people, 'Don't do it' ... 'cause everyone's different ..."

Conclusion

This study showcases the participants' ability to use their skill to combine what they have learnt along their years of mammography practice with what they are presented each time a new client enters the mammography room. The string of events that culminate to minimum breast thickness reduction as described by them is highlighted by the importance of observation, communication and empathy and is likely to result in correct compression application, minimised breast radiation dose, enhanced breast cancer diagnosis, client satisfaction and possibly an improved turnout to the breast screening programme. It is however important to note, that albeit the similar methods that the participants use, the subjective nature of the breast compression technique makes standardization of practice difficult to achieve, which may result in variation of compression application to the same client over successive appointments, possibly leading to variation in client satisfaction and image quality, which may in turn negatively affect client turnout and breast cancer diagnosis respectively.

Although a descriptive phenomenological study does not usually provide results fit to be generalised, these findings can still enrich the limited source of evidence-based literature within this professional field, helping mammographers, radiographers who wish to specialise in this area or anyone with an interest in mammography, appreciate the intricate and sensitive process of the breast compression technique. Furthermore, these results can be compiled and used by clinical mentors to teach radiographers who are about to start their specialisation in mammography, while mammographers could use it to guide their own practice.

Conflict of interest statement

None.

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