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Is there a difference in reading time when normal and abnormal DBT cases are examined by DBT experienced radiologists? [Poster]

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IS THERE A DIFFERENCE IN READING TIME WHEN NORMAL AND ABNORMAL DBT CASES ARE EXAMINED BY DBT EXPERIENCED RADIOLOGISTS?

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Abstract

One of the main challenges of implementing digital breast tomosynthesis (DBT) into the UK screening programme is the known increased time to read DBT than digital mammography (2D) cases. We investigated in detail the nature of reading normal and abnormal DBT images by a group of experienced DBT radiologists to determine if there were image inspection time differences. In this study, seven Italian radiologists, with 2-7 years of DBT screening experience, read two sets of 20 DBT test cases comprising normal, benign and malignant appearances. As well as their reporting decisions about each case, their visual search behaviour, mouse usage and response pad control were all recorded. All participants read the cases as an initial 2D overview followed by DBT views. Excluding any reporting time, they spent an average of 1:05s on each case, comprising 14s reading the initial 2D overview and then 51s examining the DBT view, (p=0.001). There was no significant difference in overall reading time between normal (1:03s) and abnormal cases (1:07s, p=0.53) and little difference in reading time for the 2D overview for either normal (15s) or abnormal cases (13s, p=0.1335). Additionally there was no significant difference in time for normal (48s) and abnormal cases (54s, p=0.3411) when these were examined as DBT images. It is concluded that when case reporting time is excluded then a similar image inspection time is found, irrespective of whether a case is normal or abnormal. The image inspection times here are faster than previously have been reported by very experienced DBT readers.

Introduction

Digital Breast Tomosynthesis has been proven to be superior to 2D mammography in many aspects. However, it is still under investigation whether it is cost-effective to implement DBT into breast screening programmes. It was reported by previous studies that the DBT reading time is normally twice as long as reading traditional 2D mammography (Skaane, et al., 2013). Whilst DBT screening has been implemented in Italy for over 7 years and proven to be feasible (Bernardi, et al., 2017). The Italian radiologists have taken part in the breast screening programme and managed to cope with the workload and deliver reliable diagnostic accuracy at the same time. Examining the visual search behaviour from experienced DBT screening radiologists may reveal insight into the most effective DBT interpreting strategy and help DBT trainees improve their skills. In this study, seven experienced DBT radiologists from the Italian screening programme were invited to take part in an observer performance study while their visual search behaviour data were collected and analysed to explore the potential optimized DBT interpretation pattern.

Method

Two sets of 20 digital breast tomosynthesis cases comprising normal, benign and malignant appearances were collected as the test case set. All the cases have prior images and consist of both 2D or C-view together with DBT images. The case set were pre-loaded to the Hologic DBT Selenia workstation and shuffled in random order. The Smart Eye remote eye tracker was configured underneath the DBT workstation to record participants' eye movements and a scene camera was fixed on top of the monitor to track participants' hand movements during the experiment (Figure 1). Before participants started examining the cases, they were briefed with an information sheet telling them to view a set of twenty DBT cases and the task was detecting the abnormal lesions and report the details of any features. Then the participant was instructed to calibrate the eye tracking system through a 4-point calibration process.

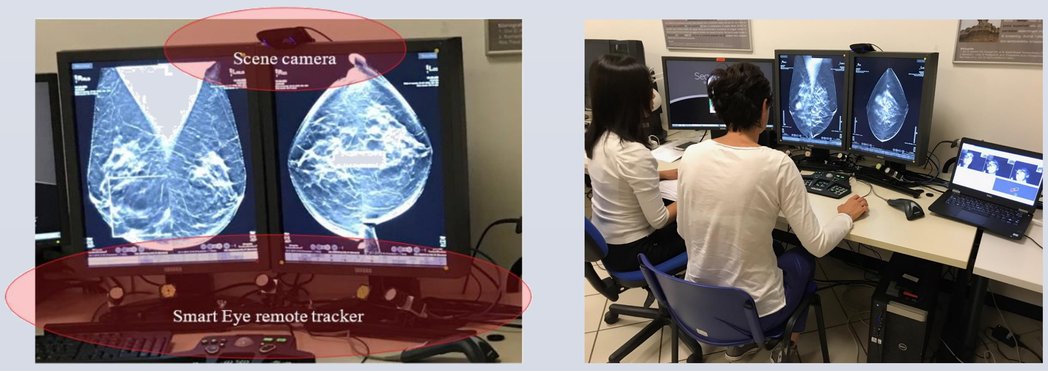
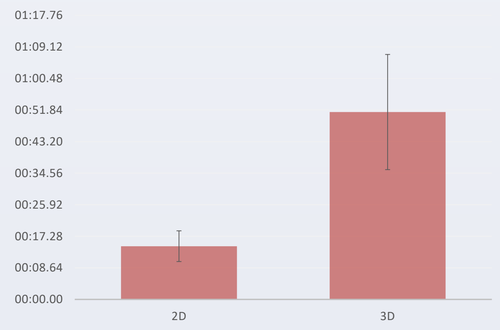


Figure 1. Left: Set up of eye tracking devices on the dual screen mammography workstation. Right: Participant is reading a DBT case while her eye movement data were collected.

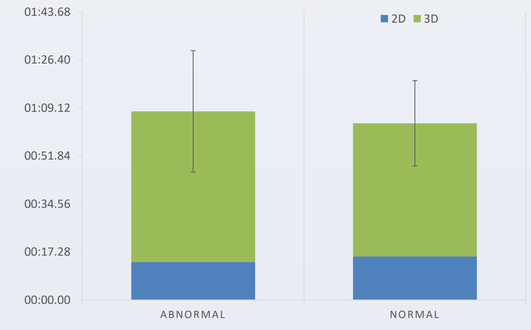
The workflow of the DBT reading procedure is pre-set as the same as what has been used in the Italian screening programme which would allow participants to read the 2D/C-view first with prior images then go through each side of the breasts with the DBT view. Two training cases were also provided to help the participants grow familiar with the experimental set up. During the examining process, participants were told to examine as they usually did during the screening tasks and when they made any decision, they needed to report the results verbally, and one of our experimental assistants would record their decision by marking the relevant answer on a reporting sheet. The participants needed to give a rating based on 5-point confidence level: Normal, Benign, Indeterminate, Suspicious and Highly suspicious. The location of the lesion was reported and type of feature was specified (Well defined mass, Ill Defined mass, Spiculate mass, Architectural Distortion, Asymmetry, Suspicious Calcification, Benign Calcification or Other features). At the same time, the video contents on the screens of the Hologic DBT workstation were captured and saved into a portable hard drive. The reading time was calculated by visually examining the playback of the captured video.

Results

Results show that excluding any reporting time, an average of 65 seconds of reading time was spent on each case across 7 participants. On average, they spent 14 seconds reading the initial 2D overview and then 51 seconds examining the DBT view (Figure 2.a). The reading time was significantly longer for examining DBT than 2D view (p=0.001). When comparing reading time between normal and abnormal cases, participants spent slightly less time reading a normal case (63s) than abnormal case (67s) as shown on Figure 2.b. However, the result is not significant (p=0.53). Additionally little difference was spotted in reading time for the 2D overview between normal (15s) and abnormal cases (13s, p=0.1335) also for the DBT view (normal: 48s; abnormal: 54s, p=0.3411).



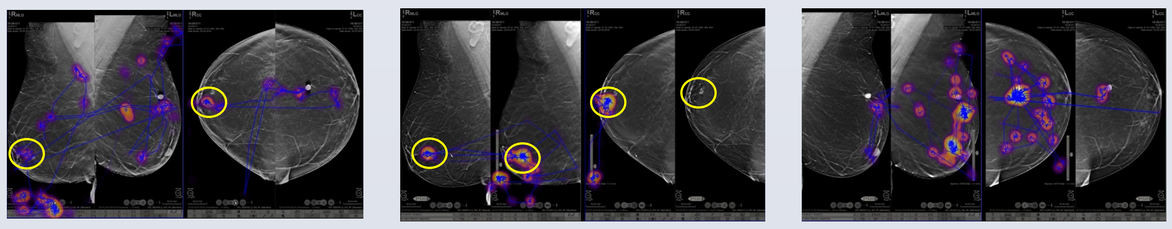
(a) 2D vs 3D



(b) Abnormal vs Normal

Figure 2. Comparison of reading time between 2D and 3D view, abnormal and normal cases

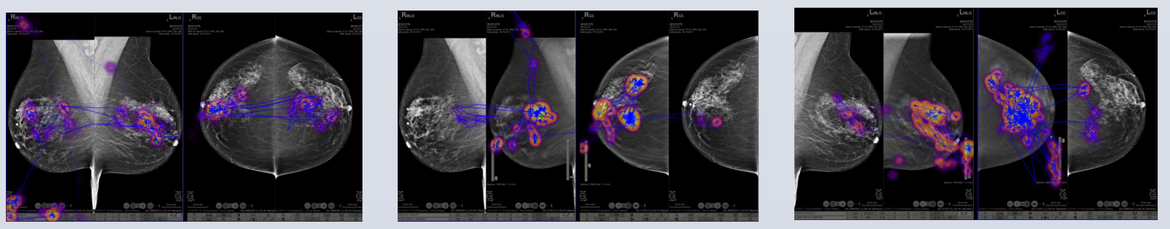
The participants read the cases as an initial 2D overview followed by DBT views. The working flow of the DBT examination consists of comprehensive hanging layout of each side of the breasts with the following order: 2D-MLO/DBT-MLO/DBT-CC/2D-CC. Figure 3 shows a sample case with a pathology proven malignant lesion on the right side of the breast which is marked by yellow circles on different views. The participant's eye movements are overlaid with blue lines depicting the participant's gaze trail and the heatmap with brighter areas represents longer visual attention. It can be seen that this participant tended to perform an overall scanning over the 2D overview and managed to located the lesion area (Figure 3.a) . Then switched to the DBT view to examine the details of the lesion on the right side of the breast (Figure 3.b). Moreover, on the left breast, which does not have a malignant lesion, the participant also visually examined large areas to see if any suspicious abnormality exists (Figure 3.c).



(a) 2D overview (b) DBT right breast (c) DBT left breast

Figure 3. visualization of eye tracking data overlying on a sample case with pathology known lesion on the right side of the breast (marked by yellow circle)

Figure 4 shows a sample normal case which one of the participants also spent more than one minute examining. It can be seen that despite no known abnormality existing on this normal case, the participant also carefully examined large areas of the breasts but finally decided not to recall this case.



(a) 2D overview (b) DBT right breast (c) DBT left breast

Figure 4. visualization of eye tracking data overlying on a normal case

Conclusion

How to reduce the examining time is the key challenge to implement DBT into a breast screening programme. It was hoped that faster reading speed on normal images which take up the majority of the screening cases would be shown by the experienced DBT readers. However, the results in this study did not show much significance. Examination of visual search behaviour from experienced DBT screening radiologist may reveal an insight of how experts read DBT cases. This may help DBT trainees to learn a more effective reading strategy. More experiments and analyses are currently ongoing to investigate this problem.

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