Could surface imaging in breast cancer radiotherapy detect early lymphoedema? : The Calibrate Study [Abstract only]

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Title: Could surface imaging in breast cancer radiotherapy detect early lymphoedema? : The Calibrate Study

Abstract (350 words max):

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Introduction

Breast/trunk lymphoedema is a chronic, progressive medical condition that can occur following treatment for breast cancer[1]. Early detection and intervention are crucial for managing lymphoedema effectively. Yet, no gold standard exists to objectively measure breast/trunk lymphoedema[1]. Within clinical trials recording of breast/trunk lymphoedema is reduced to a single physician reported 4-point subjective scale[2].

Aim: To evaluate system capability of a commercially available 3D surface scanning system for detecting small surface area changes.

Methods

Stage 1: a phantom study using silicone and cotton breast forms with sizes equivalent to UK B, C, E and G-cup breasts, and varying skin tones to test system capability across different ethnicities. Testing using a CIVCO C-Qual™ breastboard allowed simulation of the standard clinical positioning. A synthetic silicone pad to simulate lymphoedema (Figure 1) was placed superiorly, inferiorly and laterally to the breast. Two images were taken using the VisionRT-AlignRT® system:

1. Without the fake lymphoedema pad (baseline),
2. With the lymphoedema pad placed superiorly,
3. With the pad placed inferiorly and
4. With the pad placed laterally.

Surface area was calculated using MeshMixer (Autodesk Inc, USA)) and assessed for reliability by 3 raters, all blinded. SPSS version 26 was used to assess inter and intra-rater reliability using intraclass correlation (ICC).

Stage 2: a healthy volunteer study (n=30) using the same imaging process with volunteers of varying breast/chest sizes. Surface images were captured (n=240) and assessed for inter and intra-rater reliability.

Results:

Phantom study: inter-rater (ICC = 0.9993 95% CI 0.986 to 0.997) and intra-rater reliability (ICC was 0.999, 0.999 and 0.994 for rater 1, 2 and 3 respectively, 95% confidence intervals for all 3 raters was between 0.98 to 1) were excellent.

Healthy Volunteers: Across chest size 42-44inches (males), 30-40inches (females), breast cup A-H and across 3 skin tones, inter-rater and intra-rater reliability was excellent (ICC= 0.995 inter-rater 95% CI 0.985-0.998, intra-rater ICC=0.998 95% CI 0.997-0.999).

Conclusion:

The study findings suggest the VisionRT-AlignRT® surface-guided equipment detected small changes in surface area across a range of breast cup/chest sizes, across different skin tones

providing potential for a non-invasive objective measure for early diagnosis and early onward referral for lymphoedema management.

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Figure 1 Example phantom breasts and fake tissue used to simulate lymphoedema on surface scans.

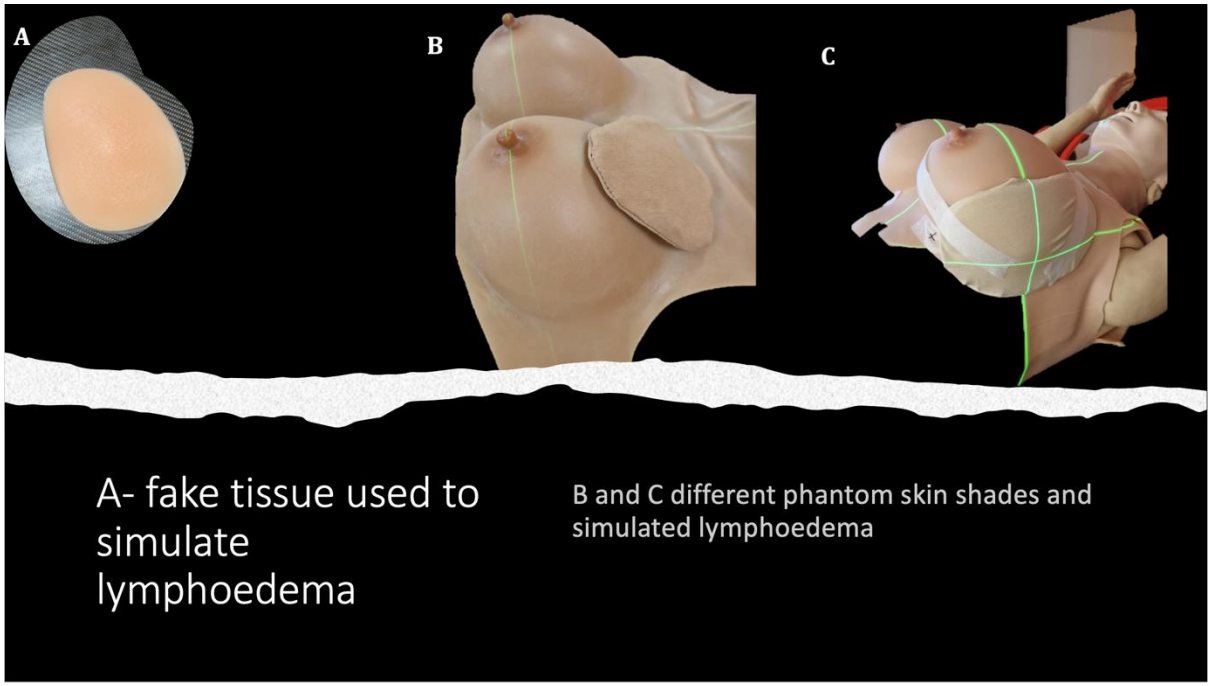
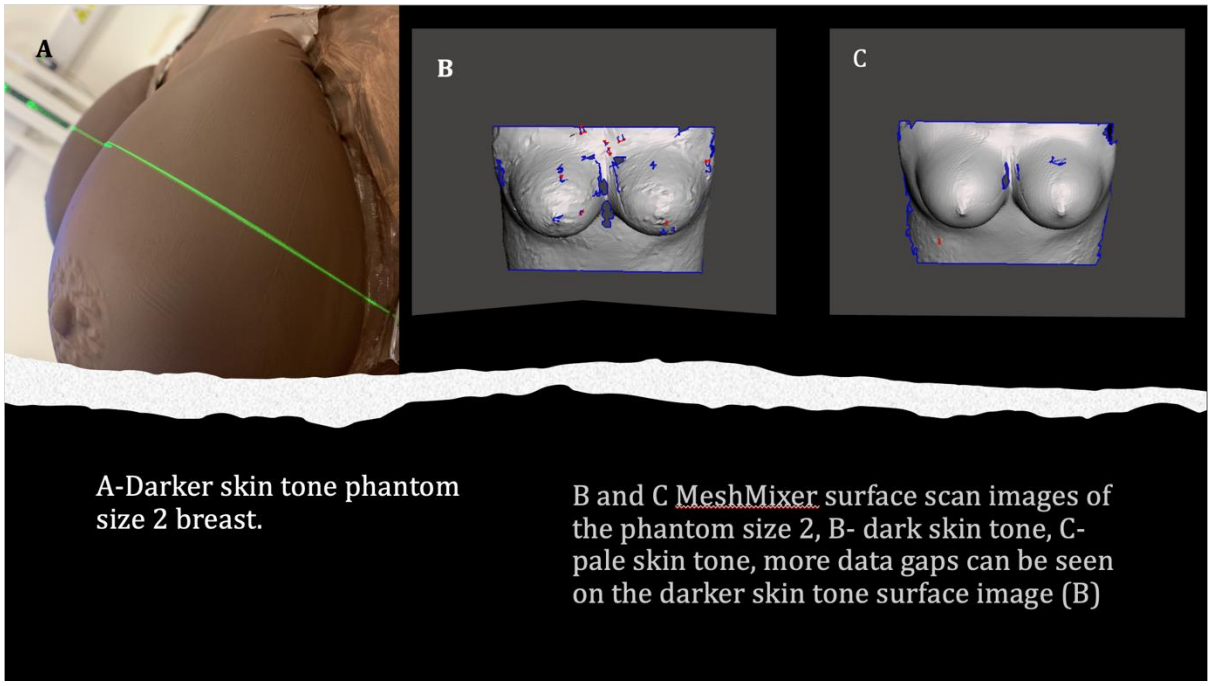


Figure 2. Example of surface images in MeshMixer for breast size 2 in pale and darker skin tones.



References

1. Verbelen H, Gebruers N, Beyers T, De Monie A-C, Tjalma W. Breast edema in breast cancer patients following breast-conserving surgery and radiotherapy: a systematic review. Breast Cancer Research and Treatment. 2014;147(3):463-71.
2. Brunt AM, Haviland JS, Sydenham M, Agrawal RK, Algurafi H, Alhasso A, et al. Ten-Year Results of FAST: A Randomized Controlled Trial of 5-Fraction Whole-Breast Radiotherapy for Early Breast Cancer. J Clin Oncol. 2020;38(28):3261-72.