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Original Article

Improving the Accuracy of a Photographic Assessment System for Breast Cosmesis

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ABSTRACT:
Aims: To determine how the accuracy of a photographic system for cosmetic assessment of the breast after conserving treatment can be maximised.
Materials and methods: Photographs of 40 women undergoing breast-conserving treatment for breast cancer were taken. Upward and lateral retraction was measured using a digitiser to enter the locations of reference marks on the photographs into a computer programme. In the readings produced, reduction in three potential sources of variation was considered by determining how few repeated photographs or measures were necessary to achieve an estimate within ± 2 mm of a mean value obtained from a large series. These included variation between assessments of the same photograph, between different photographs of the same patient and between different observers. We also sought to determine whether the attachment of white nipple markers (WNM) at the time of photography would reduce variation.
Results: A minimum of five readings was required from each photograph in order to obtain a result that was stable (defined as within 1 mm of that achieved by 20 readings). Using similar criteria, we found that at least four photographs of each patient were required, and that each should be assessed by at least four observers. The addition of WNM reduced the standard deviations by 36–45%.
Conclusion: The use of WNM, which is simple, quick and cheap, is effective in reducing variation and can be recommended for use in clinical trials where overhead costs need to be contained. Christie, D. *et al*. (2005). *Clinical Oncology* **17,** 27–31

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Introduction

There remains strong demand for breast-conserving styles of treatment from women with early breast cancer, ductal carcinoma *in situ* and even patients with more locally advanced disease. It is well established that limited surgery followed by radiotherapy to the breast produces the same survival rates as a mastectomy. Many patients still choose to have mastectomy and some of these subsequently elect to undergo breast reconstruction; however, rates of breast-conserving treatment might be expected to slowly increase as radiotherapy services become more widely available.

Measurement of the effects of treatment on the appearance and shape of the breast (the cosmetic outcome) is particularly relevant in clinical trials that attempt to identify optimal techniques for breast conservation. These include the large-scale fractionation trials run in the UK by Yarnold *et al.* [1], and in Canada by Whelan *et al.* [2]. Many potential factors that could influence patient, spouse and observer perceptions of the cosmetic outcome have been identified, and a variety of subjective and objective methods of assessment have been advocated. Harris *et al.* [3] were the first to address it in detail. They proposed a qualitative four-point ordinal scale in which cosmetic outcome was classified subjectively as excellent, good, fair or poor. Many studies have used that scale, and several problems have been identified. First, most patients and observers always rate their cosmetic outcome as either excellent or good, skewing the results towards one end of the scale and limiting the chance of identifying the factors that significantly affect the cosmetic outcome. Few factors have been consistently identified using it. Second, the concordance of results between observers tends to be poor [4]. To address these problems, it is necessary to determine those effects of treatment that have the greatest influence on the cosmetic outcome, and find ways of measuring them objectively and quantitatively.

In a previous Australasian study [5], the effects of the combination of simultaneous chemotherapy and radiotherapy on the cosmetic outcome were analysed and shown to be acceptable. A further analysis of that data compared various methods of assessment, and listed 46 factors that could potentially affect the cosmetic outcome [6].

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A quantitative photographic assessment based on the methods developed by Pezner *et al.* [7] and van Limbergen *et al.* [8] proved to be reliable and useful as live assessment for those factors which had the greatest influence upon the doctor's and the patient's overall assessment of cosmetic outcome, particularly breast retraction.

Thereafter, a new system was developed, with the aim of facilitating the assessment of cosmetic outcome in future multi-centre studies of breast-cancer treatment. The system was conceived, designed, constructed, funded and produced for distribution by members of the Trans-Tasman Radiation Oncology Group. It enables breast retraction on the treated side to be measured quantitatively compared with the untreated side. The measurement is done by a computer using photographs of the patient taken using a standardised method. It consists of a digitising tablet, a measurement programme and a perspex device held by the patient at the time of the photograph to demonstrate alignment and provide reference markings.

The system contains several potential sources of error. These include (1) intra-observer variation in the performance of measurements on the photographic image. Factors affecting this variation would relate to the inherent uncertainties present in the process of taking the reading and the machinery itself (i.e. the resolution of the photograph, the accuracy of the digitising device and the measuring software). Potential sources of variation between such readings would include the steadiness of the readers' hand and the clarity of the photo; (2) further intra-observer variations may be due to differences in photographic technique. Factors potentially affecting this source of variation would include subtle differences in patient position, perhaps due to respiration and differences in photographic set-up, including lighting and camera position; (3) inter-observer variation in the performance of measurements where more than one assessor is called upon to perform measurements. Factors affecting this would include differences in technique between observers, such as different opinions about the position of the nipple on the photograph, different abilities to use the digitising equipment and differences in the ambient conditions if the readers perform the readings at different times.

The aim of the present study was to determine how many photographs and measurements are necessary to produce estimates that are as near to the actual (true) displacements as can be achieved. It also sought to discover whether a simple refinement of the system, the use of adhesive white nipple markers (WNM) at the time of photography, could reduce numbers of observations required to minimise error. The effect of WNM can be seen in Fig. 1.

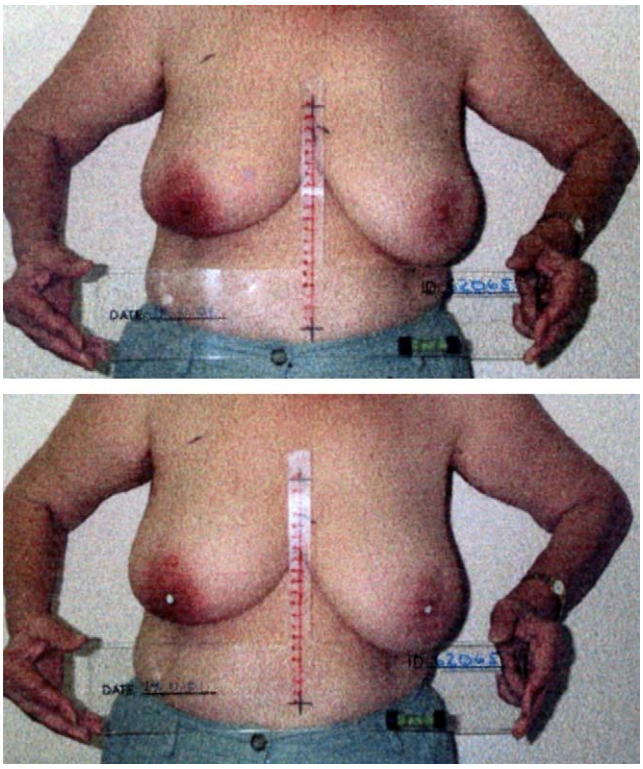

Fig. 1 – Photographs of patient 1 showing the perspex device used as a reference for measurement, and the difference in contrast obtained by applying white nipple markers.

Materials and Methods

Patients

The study included 40 women who had undergone unilateral breast-conserving treatment and consecutively attended the East Coast Cancer Centre on the day of recruitment. The patients were either presenting for radiotherapy, at different stages through radiotherapy treatment, or participating in follow-up after treatment. Each patient was offered the chance to participate and was given the information sheet. The John Flynn Hospital Ethics Committee approved the study. All patients gave written informed consent. Patients were excluded if they were under 18 years of age, unwilling to give written informed consent, had received previous or synchronous contralateral breast treatment or if the nipple was not preserved at the time of surgery.

Photographic Technique

When written consent was obtained, each patient was photographed unclothed from the waist up as follows: each photograph was taken using conditions described in a previous article [6], except that they were holding a perspex scaling device and the photographs were taken using a digital camera. The device incorporated reference marks to assess size, a spirit level and a space for the patient code number to be written on it. As previously, the patients were asked to stand as straight as possible, feet together and backed against a wall. The photo was taken in a private room with a nurse and with good ambient lighting. The photo included the chest and parts of the neck, arms and upper abdomen. The camera was a Kodak DX3500™ digital camera with an image resolution of 2.2 mega-pixels. An assessor entered the positions of specific reference