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Cochrane Database of Systematic Reviews 2018, Issue 12. Art. No.: CD013189.
DOI: 10.1002/14651858.CD013189.

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[Diagnostic Test Accuracy Review]

Optical coherence tomography for diagnosing skin cancer in adults

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Editorial group: Cochrane Skin Group.
Publication status and date: Edited (no change to conclusions), published in Issue 12, 2018.

Citation: Ferrante di Ruffano L, Dinnes J, Deeks JJ, Chuchu N, Bayliss SE, Davenport C, Takwoingi Y, Godfrey K, O'Sullivan C, Matin RN, Tehrani H, Williams HC, Cochrane Skin Cancer Diagnostic Test Accuracy Group. Optical coherence tomography for diagnosing skin cancer in adults. *Cochrane Database of Systematic Reviews* 2018, Issue 12. Art. No.: CD013189. DOI: 10.1002/14651858.CD013189.

ABSTRACT

Background

Early accurate detection of all skin cancer types is essential to guide appropriate management and to improve morbidity and survival. Melanoma and squamous cell carcinoma (SCC) are high-risk skin cancers, which have the potential to metastasise and ultimately lead to death, whereas basal cell carcinoma (BCC) is usually localised, with potential to infiltrate and damage surrounding tissue. Anxiety around missing early cases needs to be balanced against inappropriate referral and unnecessary excision of benign lesions. Optical coherence tomography (OCT) is a microscopic imaging technique, which magnifies the surface of a skin lesion using near-infrared light. Used in conjunction with clinical or dermoscopic examination of suspected skin cancer, or both, OCT may offer additional diagnostic information compared to other technologies.

Objectives

To determine the diagnostic accuracy of OCT for the detection of cutaneous invasive melanoma and atypical intraepidermal melanocytic variants, basal cell carcinoma (BCC), or cutaneous squamous cell carcinoma (cSCC) in adults.

Search methods

We undertook a comprehensive search of the following databases from inception up to August 2016: Cochrane Central Register of Controlled Trials; MEDLINE; Embase; CINAHL; CPCI; Zetoc; Science Citation Index; US National Institutes of Health Ongoing Trials Register; NIHR Clinical Research Network Portfolio Database; and the World Health Organization International Clinical Trials Registry Platform. We studied reference lists and published systematic review articles.

Selection criteria

We included studies of any design evaluating OCT in adults with lesions suspicious for invasive melanoma and atypical intraepidermal melanocytic variants, BCC or cSCC, compared with a reference standard of histological confirmation or clinical follow-up.

Data collection and analysis

Two review authors independently extracted data using a standardised data extraction and quality assessment form (based on QUADAS-2). Our unit of analysis was lesions. Where possible, we estimated summary sensitivities and specificities using the bivariate hierarchical model.

Main results

We included five studies with 529 cutaneous lesions (282 malignant lesions) providing nine datasets for OCT, two for visual inspection alone, and two for visual inspection plus dermoscopy. Studies were of moderate to unclear quality, using data-driven thresholds for test positivity and giving poor accounts of reference standard interpretation and blinding. Studies may not have been representative of populations eligible for OCT in practice, for example due to high disease prevalence in study populations, and may not have reflected how OCT is used in practice, for example by using previously acquired OCT images.

It was not possible to make summary statements regarding accuracy of detection of melanoma or of cSCC because of the paucity of studies, small sample sizes, and for melanoma differences in the OCT technologies used (high-definition versus conventional resolution OCT), and differences in the degree of testing performed prior to OCT (i.e. visual inspection alone or visual inspection plus dermoscopy).

Pooled data from two studies using conventional swept-source OCT alongside visual inspection and dermoscopy for the detection of BCC estimated the sensitivity of OCT as 95% (95% confidence interval (CI) 91% to 97%) and specificity of 77% (95% CI 69% to 83%).

When applied to a hypothetical population of 1000 lesions at the mean observed BCC prevalence of 60%, OCT would miss 31 BCCs (91 fewer than would be missed by visual inspection alone and 53 fewer than would be missed by visual inspection plus dermoscopy), and OCT would lead to 93 false-positive results for BCC (a reduction in unnecessary excisions of 159 compared to using visual inspection alone and of 87 compared to visual inspection plus dermoscopy).

Authors' conclusions

Insufficient data are available on the use of OCT for the detection of melanoma or cSCC. Initial data suggest conventional OCT may have a role for the diagnosis of BCC in clinically challenging lesions, with our meta-analysis showing a higher sensitivity and higher specificity when compared to visual inspection plus dermoscopy. However, the small number of studies and varying methodological quality means implications to guide practice cannot currently be drawn.

Appropriately designed prospective comparative studies are required, given the paucity of data comparing OCT with dermoscopy and other similar diagnostic aids such as reflectance confocal microscopy.

PLAIN LANGUAGE SUMMARY

What is the diagnostic accuracy of optical coherence tomography (OCT), an imaging test, for the detection of skin cancer in adults?

Why is improving the diagnosis of skin cancer important?

There are several different types of skin cancer. Melanoma is one of the most dangerous forms, and it is important that it is recognised early so that it can be removed. If it is not recognised (also known as a false-negative test result), treatment can be delayed, and this risks the melanoma spreading to other organs in the body, which may lead to eventual death. Cutaneous squamous cell carcinoma (cSCC) and basal cell carcinoma (BCC) are usually localised (i.e. limited to a certain part of the body) skin cancers, although cSCC can spread to other parts of the body and BCC can cause disfigurement if not recognised early. Diagnosing a skin cancer when it is not actually present (a false-positive result) may result in unnecessary surgery and other investigations and can cause stress and anxiety to the patient. Making the correct diagnosis is important, and mistaking one skin cancer for another can lead to the wrong treatment being used or lead to a delay in effective treatment.

What is the aim of the review?

The aim of this Cochrane Review was to find out how accurate optical coherence tomography (OCT) is for diagnosing skin cancer. Researchers in Cochrane included five studies to answer this question. Two studies were concerned with the diagnosis of melanoma and three with the diagnosis of BCC.

What was studied in the review?

A number of tools are available to skin cancer specialists which allow a more detailed examination of the skin compared to examination by the naked eye alone. Currently, a dermoscope is used by most skin cancer specialists, which magnifies the skin lesion (a mole or area of skin with an unusual appearance in comparison with the surrounding skin) using a bright light source. OCT magnifies the surface of a skin lesion to the level of that seen using a microscope using near-infrared light. It is quick to perform but is more expensive compared to dermoscopy and requires specialist training. Review authors examined how useful OCT is to help diagnose skin cancers when used after visual inspection or visual inspection plus dermoscopy.

What are the main results of the review?

The review included five studies: two studies with 97 participants with 133 skin lesions suspected of being melanoma, and three studies with 305 participants with 396 lesions suspected of being BCC of which one (50 lesions) also analysed cSCCs (nine lesions).

The studies investigating the accuracy of OCT for diagnosing melanoma were small and too different from each other to allow a reliable estimate of the accuracy of OCT for melanoma to be made. Similarly, only one small, low-quality study investigated the accuracy of OCT for diagnosing cSCC.

For identifying BCC, two studies showed the effects of skin specialists using OCT after visual inspection alone, or visual inspection with dermoscopic examination. These two studies indicated that in theory, if OCT were to be used in a group of 1000 people with skin lesions that were particularly difficult to diagnose, of whom 600 (60%) actually had BCC, then:

- an estimated 662 people would have an OCT result confirming that a BCC was present and of these 93 (14%) would not actually have had a BCC (false-positive result);

- of the 338 people with an OCT result indicating that no BCC was present, 31 (9%) would actually have a BCC (false-negative result).

Compared to making a diagnosis of BCC using visual inspection plus dermoscopy, the addition of OCT in this group would reduce the number of false-positive results by 87 (thus reducing unnecessary surgical procedures) and would miss 53 fewer BCCs.

How reliable are the results of the studies of this review?

In all included studies, the diagnosis of skin cancer was made by lesion biopsy (OCT/dermoscopy positive) (a biopsy involves taking a sample of body cells and examining them under a microscope), and the absence of skin cancer was confirmed by biopsy (OCT/dermoscopy negative)*. This is likely to have been a reliable method for deciding whether people really had skin cancer. However, the small number of studies included in this review, and variability between them, reduced the reliability of findings. Included studies also had important limitations, in particular study participants were from more restricted groups than would be eligible for an OCT scan in practice (e.g. all studies included people with skin lesions that had already been selected for surgical removal), while the way in which OCT was used may not reflect real-life situations.

Who do the results of this review apply to?

Studies were conducted in Europe and the US only. Average age (reported in only two studies) was 46 years for melanoma and 63 years for BCC. The percentage of people with a final diagnosis of melanoma was 23% and 27% (in two studies), ranged from 58% to 61% for BCC (three studies), and was 18% for cSCC (one study). For the diagnosis of BCC, the results apply to people with 'pink' and non-pigmented skin lesions that the clinician considers particularly difficult to diagnose by the naked eye alone.

What are the implications of this review?

Not enough research has been done on using OCT in detecting skin cancers. The results of this review suggest that OCT might help to diagnose BCC when it is difficult to distinguish it from benign skin lesions, but it is not yet clear whether it can adequately distinguish between BCC, cSCC, and melanoma skin cancers. More studies are needed comparing OCT to dermoscopy and to other microscopic techniques (such as reflectance confocal microscopy) in well-described groups of people with suspicious skin lesions.

How up-to-date is this review?

The review authors searched for and used studies published up to August 2016.

*In these studies biopsy or clinical follow-up were the standard comparisons.