More time and cost efficient Mohs Surgery: Optical Coherence Tomography (OCT)

OCT scanning for margin definition of basal cell carcinoma before Mohs micrographic surgery: clinical benefits, cost savings and time efficiencies arising from the use of Optical Coherence Tomography (OCT).

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ABSTRACT

Mohs Micrographic Surgery (MMS) is the preferred therapeutic treatment for high-risk basal cell carcinoma (BCC). Optical Coherence Tomography (OCT) is a non-invasive imaging technique that enables the diagnosis of BCC. It was decided to use OCT to determine the margins of BCCs prior to MMS. This may lead to a significant reduction in the number of surgical excisions. This in turn could have a range of potential upsides for both patients and dermatology clinics.
INTRODUCTION

BCC is a very common cancer and the most common cutaneous malignancy in Caucasians. The aim of a correct treatment of BCC relies on its complete excision with maximum preservation of the functional capacity of the area Surgically treated, along with cosmetic acceptance. MMS is responsible for the highest cure rate of skin cancers, and is the preferred therapeutic management for BCCs that have a high risk of recurrence or are located at delicate areas of the face.\textsuperscript{2,3}

The procedure of MMS involves numerous, repeated, surgical stages. The first stage involves the excision and intraoperative microscopic confirmation of the complete margins of the tumour using pathology. Additional surgical stages are repeated, often several times over, with further excisions taken and analysed each time, until no tumour is detected along the margin.

OCT is already used to diagnose BCCs.\textsuperscript{4} It can, however, also be used to accurately mark and define the lateral margin of BCCs so as to provide imaging substantially equivalent to a histological evaluation of the tissue, before the MMS surgical procedure is started. MMS is usually a slow and costly process because of the time and resources taken in histological processing between each MMS surgical stage.\textsuperscript{5}

If OCT can be proven to significantly reduce the number of surgical stages then hospitals will be able to treat patients more efficiently using MMS. The reason OCT can reduce the number of stages is because the tumour borders can be exactly mapped, prior to the first excision.

Fig 2: Prof. Dr. med. Julia Welzel scanning a patient with OCT to define the tumour margins prior to surgery.

This is contrasting to the current practice, where the surgeon has no idea of the tumour extent and simply adds a 2 mm margin around the clinically, or dermoscopically, visible lesion. Being able to scan the tumour borders with OCT, not only increases the chance that all the tumour is removed within one stage, but may also allow a smaller excision to be made, potentially leading to a smaller scar and better cosmetic result. Smaller excisions are possible with OCT scanning because the surgeon can excise tissue right up to the scanned border of the tumour, rather than having to leave room for human error which is necessary when the operation is performed in a conventional, ‘blind’ manner.

Fig 1: Tissue sectioning: one of the numerous time consuming steps in the histological processing of the tissue.
THE STUDY

The purpose of the study was to quantify how many stages of MMS could be reduced by using OCT image guided margin mapping. Augsburg General Hospital’s IRB approved the 2015 preliminary study. 10 patients were assessed to determine the margins of BCCs with OCT, prior to MMS, with the goal of reducing the number of surgical stages. A further 2018 study, comprising of two cohorts each of 50 patients is fully expected to confirm the main results of the 2015 trial.

OCT Scanning Device: All lesions in the 2015 trial were image mapped using the VivoSight Dx OCT scanner from Michelson Diagnostics GmbH.

Fig 3: Scanning of the subsurface margins of the Basal Cell Carcinoma using OCT.

Fig 4: Hidden margins of skin cancer successfully mapped and marked on skin using OCT. The patient is now ready for surgery.

Fig 5: Prof. Dr. med. Julia Welzel illustrates in the OCT scan, the signal shadow caused by the ink, marking the lateral tumour border.
**CLINICAL FINDINGS:**

The results of this preliminary study showed:

- In 8 out of 10 BCCs the macroscopic/dermoscopic margins using OCT mapping were correct.
- This resulted in a complete first step excision and saved any further steps of MMS excision.
- 2 of the 10 BCCs were excised incompletely within a first excision, even after the use of OCT mapping, due to the greater depth and the infiltrative nature of the tumours.

Preliminary results at Augsburg General Hospital suggested that use of OCT assisted MMS can lead to:

- An estimated reduction in the average number of MMS excision stages from 1.7 to 1.2 stages.\(^6\) (this is similar to observations by other dermatologists - see reference section) \(^7\)\(^8\)\(^9\)\(^10\)\(^11\)
- A reduction in the average size of the MMS surgical repair site.
- An improved MMS technique by reducing the time to define the lateral margins of BCCs - the whole OCT mapping procedure per patient took just 15-20 minutes.

![Image 30x138 to 227x250](Image30x138to227x250)

**Fig 6: Mid-closure of wound, of patient scanned with OCT. This patient only required 1 stage of MMS.**

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**POTENTIAL BENEFITS: COST & TIME SAVINGS, INCREASED PATIENT THROUGHPUT, BETTER PATIENT SCHEDULING**

The economic benefit arising from a reduction of the average number of excision stages from 1.7 to 1.2 MMS stages could be significant to a typical German hospital such as Augsburg. We have a busy MMS department, treating approximately 1,000 patients per annum:

**Increased Patient Throughput and Reimbursement Income:**

A realistic estimate is that OCT could allow a further 3 MMS patients to be treated per week, generating additional reimbursement income of approximately €6,000 per week (based on €2,000 per patient), which is 150 more patients and €300,000 more income per annum - an increase of 15%. Our current waiting lists are 6 weeks for MMS, and this might also be reduced by 15%.

**OCT on FIRST contact with patient, not just prior to MMS:**

OCT could not only be used prior to MMS, but also on first contact with the patient. In this way, BCCs with very clearly demarcated margins could be identified. With these BCCs a decision could then be made as to whether to remove it via MMS, or whether a simple surgical excision procedure or even a topical treatment would suffice.

**Confidence in Patient Scheduling:**

As well as reducing the number of stages, OCT could allow better prediction of how many stages of MMS each patient will require. Cases where some patients have many ‘unexpected’ stages could be reduced. This could allow better patient scheduling within the clinic.
CONCLUSIONS

We are already performing OCT assisted MMS and are continuing with larger clinical evaluations for the 2018 year. We fully expect that the results of the current clinical evaluation will produce similar results to the 2015 trial reported here, i.e that the number of MMS stages can be reduced from 1.7 to 1.2 via the use of OCT guided surgery.

Our initial results have been published in Skin Research & Technology We are a very busy Dermatology department within the hospital and we expect that the use of OCT assisted MMS will result in:

- **PATIENT BENEFITS:** Improved patient outcomes resulting from fewer excision stages; a smaller surgical repair area on the patient and fewer overnight hospital stays.
- **HOSPITAL COST SAVINGS:** potentially substantial cost savings for the hospital arising from less bed occupancy days
- **DERMATOLOGY WAITING LISTS/PATIENT THROUGHPUT:** the opportunity to increase the capacity of the dermatology department and treat more patients, whether by MMS or freeing up of resources for other procedures.
- **A decision to purchase a 2nd VivoSight Dx scanner given the current waiting times for over 6 weeks for MMS.**

Fig 7: OCT scan of a nodular BCC.

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In summary, I believe the clinical use of OCT to be a powerful tool to make Mohs surgery faster and more cost effective. Using OCT provides an immediate opportunity to bring the MMS treatment to more patients whilst having the potential to save bed-day costs. I recommend that all dermatology clinics and practices offering MMS should think about adopting OCT into their daily routine.

REFERENCES


