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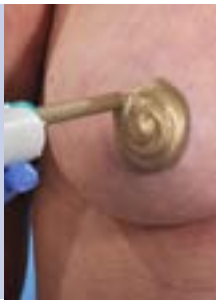





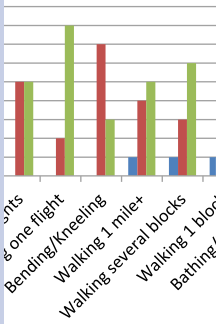






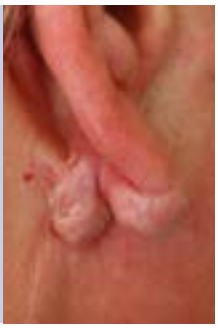



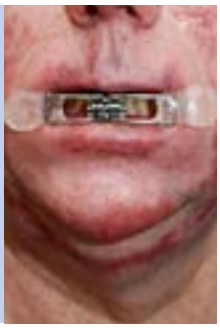



# Note from the Editor

Welcome to the Summer edition of the IMPT journal.

I'm very pleased to say we have some more first time authors, with some interesting articles for you in this publication. In fact half of this edition hails from bonnie Scotland - very fitting with our 28th IMPT Scientific Conference this year being held in Glasgow. Hope you've secured your place; it looks to be another magnificent occasion, not only the lecture programme but also the social events.

Whether you're sharing little nuggets or new found tips and tricks, don't be shy, jot your ideas down and the editorial board will help get you that publication you've always wanted. If you're unsure if it's a case study or technical note, again we're here to help. I'm sure our first time authors will agree the process isn't as bad as they thought it might be!

Research doesn't have to be unique or ground breaking it's about sharing how you've overcome difficulties in a certain case or maybe an audit you've performed. Everything can inform and change our practices for the better. You too could get involved; become part of the team shaping our future by being on Council. If you want to hear more of what the IMPT Council get up to, how decisions are debated or decided, then ask to be co-opted onto Council, come experience it first-hand, I did!

Lastly, I would like to wholeheartedly thank all the authors and contributors to the IMPT Journal for their time and energy in collating another great piece of work.

**Dr Emma Worrell**
IMPT Journal Editor 2017

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**EMS Design & Print**
Medway House
18-22 Cantelupe Road
East Grinstead
RH19 3BJ
01342 323700
emsdesignandprint.co.uk

## Advertising Sales

**Jim Dimond** MIMPT
Consultant Maxillofacial Prosthetist
Maxillofacial Prosthetics Dept
University Hospitals Coventry & Warwickshire
Clifford Bridge Road
Coventry CV2 2DX
james.dimond@uhcw.nhs.uk

**Edward Malton** MIMPT
Principal Maxillofacial Prosthetist / OMFS Laboratory Manager
Luton & Dunstable University Hospital
Lewsey Road, Luton
Bedfordshire LU4 0DZ
edward.malton@ldh.nhs.uk

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All correspondence relating to membership of the IMPT should be sent via post or email to:

**Mark Cutler** MBE, FIMPT
Head of Maxillofacial Prosthetics Dept
Queen Victoria Hospital NHS Trust
Maxillofacial Prosthetics Dept
Holtye Road, East Grinstead
West Sussex RH19 3DZ
mark.cutler@qvh.nhs.uk
registrar@impt.co.uk

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# Custom-made nipple prosthesis

C J Turner MSc BSc MIMFT

Corresponding author: Ms Catherine Turner

Maxillofacial prosthetics Dept., The Queen Elizabeth University Hospital Glasgow, 1345 Govan Road, Glasgow, G51 4TF

email address: catherine.turner3@ggc.scot.nhs.uk

## Abstract

This paper aims to explore the treatment options available to patients requiring nipple reconstruction. It also presents a case study of 53 year old female referred for a custom made nipple prosthesis following a mastectomy in 2008 due to ductal carcinoma in situ. Subsequent breast reconstruction in 2009, was followed by nipple tattooing which became infected, resulting in scaring. She attended clinic to receive a prosthesis to give her a nipple profile under clothing.

## Introduction

### Incidence and aetiology

Ductal Carcinoma in situ (DCIS) is responsible for 25% of all tumours diagnosed within mammographic screening programs.[1] It encompasses a wide spectrum of lesions from low grade to invasive high grade neoplasms. Incidence rates of DCIS of the breast have increased dramatically since 1983 which can be linked with the adoption of modern mammographic screening.[2] Before the routine procedure of mammographic screening, the majority of DCIS were diagnosed through excisional biopsy after surgical removal of a suspicious mass.[3]

Early detection is beneficial, with long term prognosis being generally good. A study in 2000 by Ernster et al., indicated that the mortality rate for DCIS patients after 10 years was less than 2% after excision or mastectomy.[4] Treatment depends on size and grade, but often requires a combination of conservative or ablative surgery (lumpectomy/mastectomy), radiotherapy and chemotherapy.[2] The primary goal of surgical intervention is to isolate the neoplasm and achieve sufficient control of the disease. However, with the long term prognosis for patients looking more promising, secondary aims such as aesthetic cosmetic outcomes and high patient satisfaction are emerging.[5]

There is some debate over immediate or delayed surgical reconstruction. Immediate reconstruction has been shown to provide higher patient satisfaction and improved psychological wellbeing.[6,7] The delayed two stage reconstruction however, is preferred in cases undertaking post-mastectomy radiotherapy, to avoid radiotherapy related complications and difficulties planning radiation delivery.[8]

### Surgical reconstruction of nipple tissue

Over the years there have been numerous surgical reconstruction techniques which have been utilized in rehabilitating the mastectomy patient. In addition to implant reconstruction or autologous reconstruction of breast, there are also various options for nipple areola reconstruction (NAC). These include reconstruction with grafts and local flaps regularly undertaken as staged procedures, which are often in combination with intradermal tattoo.[9] A further option would be nipple sparing mastectomy, where the nipple tissue is conserved and used within the breast reconstruction.[10]

Nipple sparing mastectomy is regarded as controversial due to its risk of oncological reoccurrences and complication rates such as nipple necrosis.[5] However, in a systematic reviews of the literature by Mallon et al., in 2013, and Headon et al., 2016 it was indicated in both studies, that with carefully selected patients presenting a tumour free margin of 2mm around the nipple, a nipple sparing mastectomy can be an appropriate surgical option.[11,5] Radiotherapy post reconstruction, although an important aspect of managing breast cancer, can increase the long term complications associated with reconstructed breast and nipple tissues. Complications can include increased incidence of fat necrosis, capsular contraction of implants and nipple necrosis.[12] Literature shows that the re-creation of the nipple areola has a significant correlation with overall patient satisfaction and acceptance of body image after mastectomy.[13]

### Dermal tattooing

Intradermal nipple-areola tattooing is now a widely utilised procedure in breast reconstruction. Nipple-areola tattooing is undertaken with iron oxide and titanium dioxide pigments and multiple touch-ups can sometimes be required to obtain an appropriate colour match.[14] Colour charts and skin toned pigments are used to match, the opposing side. However, due to inevitable fading the selected pigments are often a shade darker than the final desired result.[15]

## Clinical report

### Medical history

The patient in this case underwent mastectomy in 2008

when a lump was found at mammogram screening. After her post-surgical radiotherapy treatment was completed in 2009 she underwent breast reconstruction with a silicone implant. Due to the time delay between breast removal and reconstruction the implants were placed as a two-stage procedure. The initial stage involved placement of a tissue expander, which was slowly filled with saline during periodic visits until the desired size was obtained. Once the tissue is stretched and sufficiently 'relaxed' the expander is removed and replaced with a stock medical grade silicone implant.

In 2011, unhappy with the appearance of her reconstructed breast she was referred for intradermal nipple tattooing. Although she showed no reaction to the skin test, within a few days the tattoo was infected and demonstrated delayed healing. Intradermal nipple infections are relatively rare with an occurrence of only 3% of patients.[14]

### Case appearance

The patient presented in clinic with a left breast reconstruction showing purple discolouration present in the nipple region due to previous nipple tattoo infection, *figure 1*. The patient indicated she wanted more projection, so she would feel more confident wearing certain clothing and therefore opted for prosthetic nipple rehabilitation. The scarred tissue made colour matching for the areola margin more challenging. To get a good aesthetic outcome the prosthetic margin should blend into the surrounding tissue relatively seamlessly. However to get a good match to the opposing side, it has to match the opposing remaining areola. To obtain enough concentrated colour to disguise the scar, the prosthesis would need to be slightly thicker than normal.

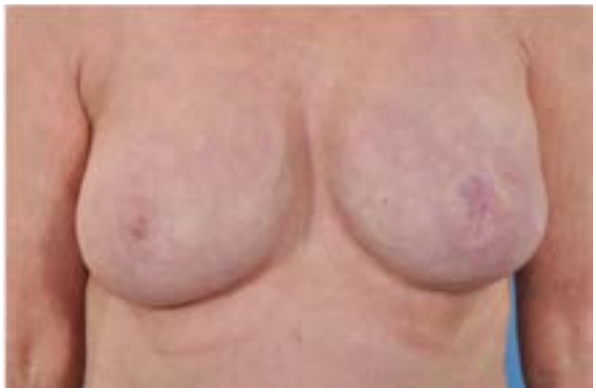

*Figure 1 Case presentation*

## Principles of treatment planning

### Why a nipple prosthesis?

Although they are not readily on display, many women have found that simple nipple prosthesis can be of great psychological and cosmetic advantage to them. They act as a prosthesis which the woman can wear all day and gives the illusion of a nipple profile/projection under clothing. Nipple prostheses can be required for both bilateral and unilateral cases. For unilateral cases an impression is taken from the opposing nipple. For bilateral cases a mould is ideally taken prior to surgery, if this is not possible the patient can choose a certain shape, colour or projection from a selection of 'donor nipples' available.

Currently there are three main ways of holding the nipple prosthesis in place; adhesives, tacky gel or more simply via a vacuum. Although all methods are easy to use the adhesive option does tend to reduce the longevity of the prosthesis margins due to the physical wear which is caused during frequent removal and application.

### Advantages

There are several advantages of producing custom made nipples. Firstly it provides an aesthetically superior result in comparison to stock prosthesis, secondly, it is a nonsurgical reconstruction option and therefore minimally invasive. This can be reassuring for a patient that has already undertaken multiple surgeries and spent prolonged periods of time in hospital. It also provides an option which has a relatively short process of treatment, is not permanent and the placement/shape/projection can all be altered. Medical adhesives also demonstrate an effective method of attachment lasting on average 8 hours without dislodgement.[16]

### Disadvantages

Disadvantages include that the prosthesis is not part of the patient's own body, it requires daily application, adhesion can be compromised by perspiration and can be messy and tiresome. Nipple prostheses may also need frequent replacements due to degradation of the thin/delicate margins and there is a possibility to have an adverse/allergic skin reaction relating to adhesive application.[17]

## Current treatment

Fabrication can start at the initial clinical assessment where nipple prosthesis are introduced, the treatment options explained and some examples can be shown and consent can be taken. Next, a colour match can be undertaken to achieve a series of colour swatches relating to the base and the areola. An important aspect to consider is that if the patient is undertaking chemotherapy this may cause a temporary darkening of the nipple.

### Impression taking

The impression procedure should always be explained to the patient before commencing. The material of choice for this case is medium bodied silicone applied using a silicone impression gun, *figure 2*. This makes it easier to control and produces good surface detail. The high tear strength and dimensional stability of silicone

is also beneficial as the prosthesis is made directly into the impression, so increased longevity of the impression means future nipples can be made without the impression stage needing to be repeated or the patient needing to be present. The impression is started at the top and worked around the periphery. By extending the impression 5mm from the periphery of the nipple, helps to be able to produce fine margins in the prosthesis during fabrication. Once set, the extension of the nipple can be marked onto the impression and the superior aspect can be indicated to help with orientation.

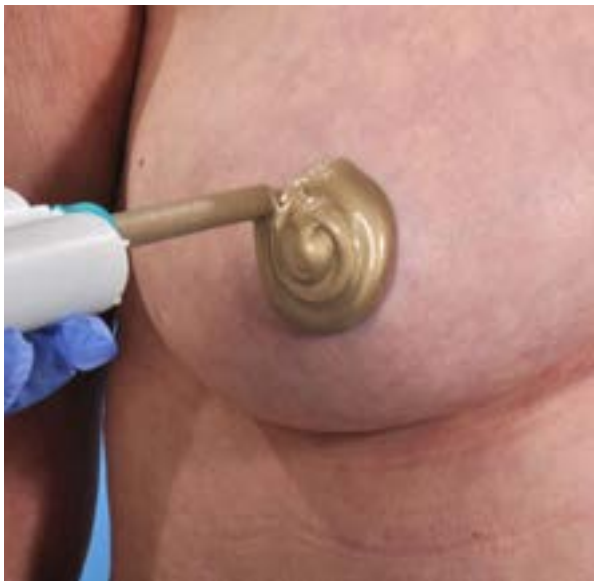

*Figure 2 Impression taking*

## Fabrication of nipple prosthesis

There are several methods of fabrication for a nipple prosthesis. The simplest and least time consuming technique is pack directly into the back of the silicone impression. Utilising this method allows nipples to be fabricated and fitted within a morning appointment which is more convenient for the patient.

*Figure 3 Packing into the silicone impression*

To ensure the silicone impression does not bond to the silicone prosthesis it will need to be post cured for at least one hour at 100°C. The fitting surface of the silicone impression should also be given a light coat of petroleum jelly to act as a separator. Colour matching can be quite challenging for a nipple patient, as the tissues can be particularly sensitive to changes in ambient temperature.

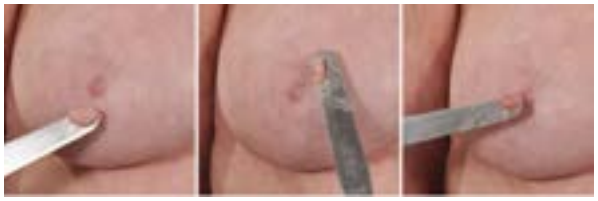

*Figure 4 Colour matching*

The silicone used in this case was Teksil (Technovent, UK) due to its fast curing time. Catalyst (9:1) was added and mixed thoroughly. The air was spatulated out of the silicone before commencement of colour matching. The swatches were individually mixed and checked against the patient's skin. The colours can then be placed into position using a thin tipped brush for accuracy, *figures 3 & 4*. With a little soap on the surface as a lubricant the silicone can be smoothed out at the periphery to produce a thin uniform edge and to make the back of the prosthesis slightly concaved in profile to help with vacuum adhesion. Once smoothed, the soap can be gently washed off with cold water. To cure the silicone, leave the impressions in a pressure pot of boiling water for 25 minutes, as shown in *figure 5*.

*Figure 5 Curing the silicone*

Another method of adhesion is using self-adhesive gel backed nipples. For the gel backing, M512 silicone (Technovent, UK) is mixed to the same colour as the base and nipple shade, thickened with a thixo agent and catalysed with the soft catalyst, but by using 10% less than the recommended ratio, this allows for the 'tackiness' which helps the nipple to be self-retentive. This is then added to the inside of the nipple area ensuring that a smooth contour is created. At this point it is cured in a pressure pot, and allowed at least one hour for a complete cure.

### Finishing procedure

Once cured the nipple can be removed from the pressure pot and gently eased from the silicone mould using gentle pressure. This should be completed with care, to avoid tearing of the delicate and thin edges. Once out of the mould, the nipple prosthesis usually requires very little finishing. Sharp scissors can be used for any irregularities although maintaining the thin feathered edges should be paramount.

### Fitting and evaluation

The fitting involves demonstrating to the patient how to apply a thin layer of water based adhesive to the centre of the prosthesis. It should be explained to avoid using adhesive on the margin as this will help to preserve them. Instead a thin layer of edge adhesive or Vaseline® can be used in these areas to remove air and to help provide a seal. A good seal not only increases the margin aesthetics, but also helps to create a vacuum which assists with adhesion. The final prosthesis is shown in *figure 6 & 7*.

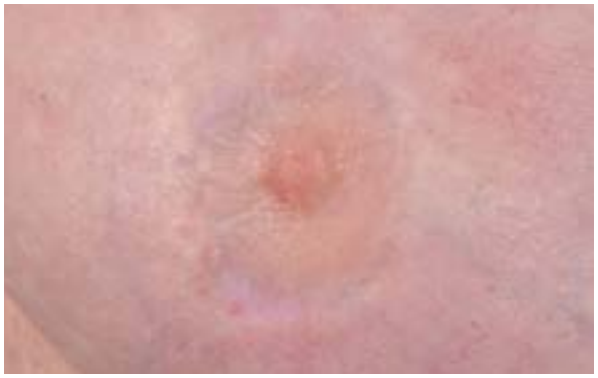

*Figure 6 Fitting of the prosthesis*

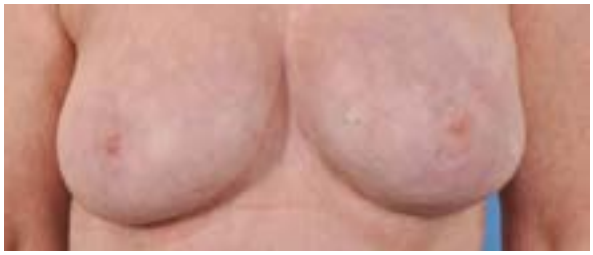

*Figure 7 Finished result*

## Conclusion

Although a relatively simple and discrete prosthesis, this prosthetic rehabilitation was of huge importance to the patient in this case. It demonstrates how different patients with varying extents of defects can be affected in entirely different ways. To one patient a very small scar could cause huge distress whereas someone else with a much larger defect can have a more positive attitude to their situation. The degree of distress can often be linked to the individual's perception of beauty which can be influenced by evolutionary, cultural and social pressures.[18] Although some dissatisfaction with one's appearance is normal, especially when a sudden change has been brought about, excessive unhappiness might be a sign of an underlying psychological issue.

In order to provide a prosthesis which has a high level of patient satisfaction, managing their expectations needs to be addressed throughout patient treatment.

I would like to express my thanks to Heidi Silk who provided me with the insight, training and expertise which has greatly helped when treating patients in this field.

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# Ghana Prosthetic Eye Clinic

D. Carpenter AIMPT

Corresponding author: Mr David Carpenter
Chief Ocularist, Ocular Prosthetics Department, Moorfields Eye Hospital, 162 City Road, London EC1V 2PD
email address: david.carpenter@moorfields.nhs.uk

## Abstract

Africa is considered to be a region with a great need for eye care development. This paper describes the predicament of West African eye patients and the need behind setting up a new eye treatment centre in Ghana. The trials, tribulations and challenges faced by this small team throughout the development of a new ocular prosthetic service are described. Some patient examples from working in this thought-provoking location highlight the unique challenges faced when working in the developing world.

## Introduction

The World Health Organisation (WHO) estimate that 90% of blind people live in developing countries, yet 80% of those affected suffer needlessly, because their blindness is treatable and/or preventable, e.g. cataracts. Without doubt, the restoration of sight and blindness prevention strategies are among the most cost-effective health care interventions in the developing world. Africa is considered the region of the world with the greatest need for human resource development for eye care. WHO estimates that West Africa has some 2.6 million people who are blind.[1] Sightsavers is an international organisation working with partners in developing countries to eliminate avoidable blindness and promote equality of opportunity for disabled people.[2] There are currently an estimated 630 ophthalmologists across West Africa serving a population of nearly 300 million. Sightsavers vision is of a world where no one is blind from avoidable causes and where visually impaired people participate equally in society. Blindness is an important cause and effect of poverty and working with the poor and marginalised communities in developing countries forges alliances and partnerships to ensure a positive and long-term impact on people's lives.

Currently there are no regional opportunities for professional growth or training in specific aspects of eye care e.g. lid surgery, cataract surgery, ocular prosthetics etc, which has resulted in a vast shortage of eye care provision across the whole of West Africa. Medical training as a means of empowering local health care in the developing world is one of the most constructive ways in which established health systems in the western world can assist.

## Eye centre and surgical faculty

Moorfields Eye Hospital has a long history of involvement in research and training in Africa. The teaching, training and seamless care through professional team working and strong innovative partnerships are part of Moorfields mission statement.[3] The hospital, working alongside Lions Club International and key partners within the region, achieved a significant milestone in September 2015 with the completion of a new stand-alone eye centre and surgical training facility in Ghana's largest teaching hospital and primary tertiary referral centre in Accra *(figure 1)*.

*Figure 1 Eye centre and surgical facility, Korle Bu Teaching Hospital*

The specialist eye care centre provides a resource for the diagnosis, management and treatment of all eye diseases. This training facility enabled specialists from across West Africa to train in a safe and high volume surgery unit, helping to eliminate preventable blindness from cataract, glaucoma, diabetic retinopathy and many other eye diseases.

Over the last few years, Moorfields' staff have been working with Korle Bu's ophthalmology department providing support and training to deliver a specialised eye care programme in Accra. The extensive Moorfields' staff enlisted to help included nurses, medical staff, human resources, pharmacy, technical, managerial, and optometry staff.

As part of this initiative, Mrs Evelyn Kyereh, a qualified ophthalmic nurse at Korle Bu, came to Moorfields Eye Hospital, to observe the ocular prosthetic department and its practices. This period gave some additional practical training within the ocular prosthetic field. During this time, the ocular prosthetic team established strong links with Evelyn,

enabling a better understanding of the actual physical challenges faced in trying to provide this unique service in Ghana. There was no provision for any kind of ocular prosthetic rehabilitation in West Africa.

However Evelyn took it upon herself to travel to India, to be trained as an ocularist, prior to the setting up and patient treatment, as an additional role to her ophthalmic nurse duties.

## Ocular prosthetic clinic set up

In October 2015, a team of 16 Moorfields' staff travelled to the newly opened centre to work with their counterpart Ghanaian colleagues, to design patient flow pathways across the various departments and to prepare the unit for patients. On arrival, negotiations started around which rooms would be the best for the ocular prosthetics clinic. Once designated, the basic equipment and consumables that Evelyn had sourced were moved to the rooms. For melting wax an old frying pan on an electric plate was used, 'bucket curing' was essentially the acrylic cured in a metal bucket full of water *(figure 2)* and a rudimentary polishing lathe *(figure 3)*. An alcohol flame torch was the primary heat source for heating up wax knifes (*figure 4)*.

*Figure 2 Acrylic curing bath & wax heater*

*Figure 3 Polishing lathe*

*Figure 4 Alcohol flame torch*

Once the equipment was set up, the newly designated ocular prosthetic clinic was ready to start seeing patients and all on the first day, while everyone else in the eye centre was still busy trying to unpack and set up the cacophony of equipment.

## Indwelling ocular prosthesis

With some trepidation, working in a hot climate, with basic tools and sundries as 'equipment' the first patient entered the ocular clinic. First-hand experience of the issues and problems of working within the developing world became apparent. After initial assessment an impression was taken of the patient's socket. The impression material was delivered through an old syringe and eye impression trays, *(figure 5)*, which had been re-used numerous times. The impression material used was Alginate, but even when 'set' remained sticky to the touch, on the patient's skin and the prosthetist's hands.

*Figure 5 Impression equipment*

In the this hospital, no single use devices or decontamination procedures exist. A two-part plaster mould was fabricated from the impression. A wax shape was cast into the plaster mould. The laboratory wax came from candle wax chopped up into small pieces and melted down *(figure 2)*. Surprisingly the candle wax was easy to manipulate, carve and smooth, with the added bonus of being white to match a scleral shade. The wax shape was then tried in and adapted for the patient's socket. Pigments, iris discs and cornea units had been bought from Moorfields Hospital and therefore the iris colour could be painted to match the patient. Iris colouring bought more challenges as the ambient temperature within the room evaporated the monomer and dried up the molypoly syrup within a couple of minutes. The only way to work whilst painting the iris was to decant small quantities from the bottles kept in the fridge, work quickly mixing the colours and painting the iris, then replenish once the liquids evaporated and repeat. Once the iris unit was painted, it was inserted into the wax pattern, replaced into the eye socket, until in the correct gaze position.

The patient appointment was then finished and a fit appointment was arranged for the next day.

## Laboratory work

The iris unit and wax pattern was invested, as a two-part plaster mould and white scleral heat cure acrylic mixed packed into the mould in the usual manner. The flask was placed into the curing bath (the metal bucket of water) and brought to near boiling for approximately an hour to allow the acrylic to cure. The flask was then removed and cooled under running cold water. Once cured the acrylic pattern was removed from

the plaster mould. The anterior surface, the eventual clear lens portion of the eye, was trimmed down to allow for characterisation. Staining was applied to the scleral acrylic, some veining added and the iris was over painted, to give depth to the iris colour. Once dry, which doesn't take long in the Ghanaian heat, the acrylic pattern was replaced and clear heat cure acrylic packed into the mould and cured for an hour. The acrylic was then trimmed and polished in the usual manner. The patient returned the following day and the finished prosthesis was supplied, as shown in *figure 6*, accompanied by David Carpenter and Evelyn Kyereh.

*Figure 6 Patient with prosthesis in clinic.*

Over the next 4 days, six patients had ocular prostheses provided, one of which was a 3-year-old child born with a microphthalmic, underdeveloped eye.

The challenging work continued, especially when requested to construct an orbital prostheses to replace the whole orbital area, not just an indwelling ocular prosthesis, without the ideal materials, equipment and under a time constraint.

## Patient presentation

One patient travelled 14-hours by bus, having borrowed the ticket money from friends and family. The patient reported a history of injury to the cornea, in combination with a fungal infection and no access to any medical treatment in northern Ghana's rural community had resulted in the loss of the eye. Surgery removed the eye however the fungal infection had spread, exposing the sinus cavity. At the time of surgery there was no availability of orbital implants, conformers or any ocular prosthesis, resulting in the complete contraction of both upper and lower fornices *(figure 7)*. The fungal infection had infiltrated the sinus cavity posteriorly *(figure 8)*, resulting in constant sticky discharge exuding into the eye socket. Further surgery to improve the functionality of the socket or close the sinus defect was not readily available and unaffordable for a rural villager.

*Figure 7 Contracted socket on presentation*

*Figure 8 Exposed sinus cavity*

On assessment, the treatment required was evident, not simply an indwelling artificial eye but an orbital prosthesis. After an epic journey to the clinic, creative thinking was required due to the distance the patient had travelled, the limitation in materials, equipment and the encroaching departure of the Moorfields' team.

An orbital facial prosthesis was required. Usually silicone would be the material of choice, however it would deteriorate quickly in this environment due to the heat, the leaking sinus, and no facility for adhesive retention or ability to mount to the patient's existing spectacle frames. The final design was to be an all acrylic orbital prosthesis, utilising the sinus cavity defect for some mechanical retention.

## Orbital prosthesis

Firstly, some Vaseline® gauze was placed into the posterior section of the sinus defect and the impression taken in Alginate. The impression was cast in plaster of paris® to create a working model *(figure 9)*.

*Figure 9 Plaster working model*

Traditional techniques for orbital prosthesis construction would be too time-consuming, fabricating a separate ocular component, positioning in wax, sculpting the eyelids and surrounding structures. Primarily a sheet of wax formed a base plate on the model. A custom-made painted iris unit was positioned

on some blue-tack® and correctly positioned on the patient. White candle wax was then built up around the blue-tack® to form the scleral portion of the ocular component. Once the eye was accurately aligned the lids and facial contours could be sculpted. The final stage of the wax pattern was to form the wax mechanical retention into the sinus defect.

The wax orbital prosthesis was invested and fabricated in white heat cure acrylic. Once cured an even contoured layer was removed from the whole anterior surface to allow for characterisation. The ocular section was characterised by staining and veining, whereas the facial component was painted to match the patient's skin colour. The orbital prosthesis was replaced into the mould and a thin layer of clear heat cure acrylic sealed all the characterisation into the prosthesis. Excess acrylic was removed on finishing and the eye component polished. The facial skin areas were very lightly abraded with sandpaper to achieve a satin rather than glossy finish. Some locally sourced false eyelashes were attached to the finished prosthesis *(figures 10 & 11)*.

*Figure 10 Fit surface showing mechanical retention*

*Figure 11 Finished prosthesis in flask*

*Figure 12 Finished orbital prosthesis*

*Figure 13 Patient prosthesis and glasses*

The patient was very happy with his new orbital prosthesis; the mechanical retention worked well and under some challenging circumstances a pleasing, functional result was achieved *(figures 12 & 13)*.

Great stigma is still attached to physical deformity in Ghana and the whole of West Africa. Patients who suffer the loss of an eye or have a blind phthisical eye are often shunned. This patient felt positive about his future with his new orbital prosthesis. He hoped to be able to finally get married, previously no-one would have considered him suitable with his disfigurement and he hoped this would change how people saw him.

Currently this is the only clinic in West Africa offering this service, facial rehabilitation and the opportunity to restore patients' dignity.

On returning the purchase of some safer laboratory equipment was a priority. A wax bath to replace the frying pan, an induction heater to replace the alcohol flame torch and an electric water boiler, with a regulated thermostat, to replace the metal bucket, will no doubt make Korle Bu's ocular prosthetic clinic a safer place to work.

First-hand experience of working on patients with limited equipment, scarce materials and the Ghanaian heat really bought home the challenges faced by our sister organisations. However joint collaboration continues and any patient advice can now be set within a developing world context and not with pompous first world thinking.

## Conclusion

It was a true privilege to be able to go, set up the clinic, train Evelyn and treat patients in such a thought-provoking area of the world. The ocular prosthetic clinic now provides an invaluable service in an area of great need for eye care development. The trials and tribulations faced by this small team throughout the development of a new ocular prosthetic service have highlighted the unique challenges faced when working in the developing world.

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# Post-treatment Care Pathway in Long-term Survivors of Head & Neck Cancer with Oral and/or Facial Prostheses

E Worrell PhD, MIMPT, L Worrell BSc Hons, B Bisase BDS, MBBS, FDSRCS (Eng), FRCS (OMFS)

Corresponding author: Dr Emma Worrell

Principal Maxillofacial Prosthetist, Maxillofacial Laboratory, Queen Victoria Hospital Foundation Trust, East Grinstead, West Sussex RH19 3DZ

email address: emma.worrell@qvh.nhs.uk

## Abstract

The current evidence base of good practice in the delivery of long-term head and neck cancer (HNC) supportive care is sparse. Survivors were recruited to understand the experience of their post-treatment pathway, (N=10). The study cohort consisted of 6 males, mean age 72.3 years (age range 54-86) and 4 females, mean age 69.25 years (age range 67-73). The post-treatment pathway of care in this group of long-term HNC survivors received favourable ethical opinion (reference number 14/EE/0176) by the REC - NRES East of England. Exploration by structured interviews and two questionnaires investigated the surgical impact, perceived need and use of supportive care services and the outcomes valued by patients. The results of this study reveal that the patient experience is in line with the current HNC guidance and cancer treatment care pathways. Cancer survivorship was initially a fear, up to 1 year post surgery, with 20% of subjects reporting significant problems >5 years post-treatment. This small group of long-term HNC survivors maintained a very good/good quality of life in both physical and social-emotional function and any occasional limitations put more down to 'old age' and not their cancer diagnosis or rehabilitation. The importance of follow-up clinics remained a strong theme, to continue to reassure and advise each patient that 'all was well', the cancer had not returned. Throughout this study no significant differences were isolated by subgrouping the cohort by oral prostheses +/- facial prostheses.

## Introduction

Head and neck cancer (HNC) may arise in a variety of sites, including the oral cavity. This disease is the sixth most common cancer worldwide, accounting for 3.2% of all malignancies.[1,2,3]

Optimal HNC management is by a multidisciplinary approach, where treatment mainstays are surgery, radiotherapy and chemotherapy.[4] Treatment decisions are often complex, weighing up treatment efficacy and likelihood of survival, against potential functionality and quality of life outcomes.[5,6] The head and neck region is critical to speech, eating, swallowing, salivation, taste/smell, vision, and central to body image and personal identity. Treatment mode largely depends on primary site, stage of disease and the patient's overall health status. Most early stage HNC utilises single modality therapy. Surgery or radiotherapy is normally the treatment of choice, *figure 1*, with a 60–95% chance of cure. Multimodal therapy is often used for locally advanced disease, due to the higher risk of recurrence and development of distant metastasis.[7]

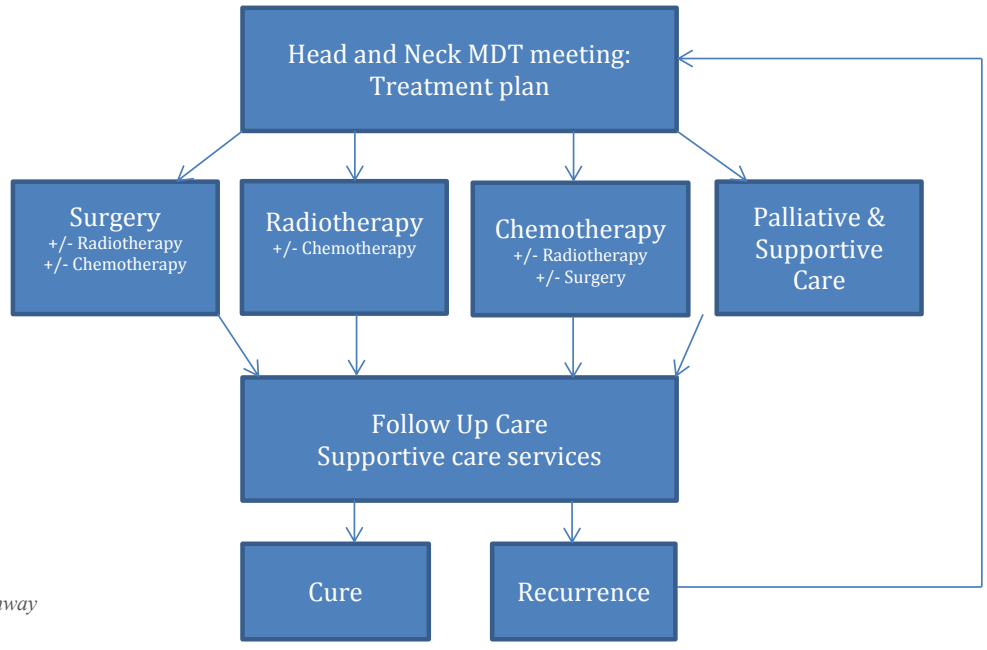



*Figure 1 Referral pathway*

Cancer survivors in the post-treatment phase often experience problems such as unintelligible speech, difficulty in eating, swallowing, loss of salivation, absent taste and/or smell.[8] With improvements in diagnosis and treatment, patients may survive many years after treatment but may encounter a range of issues and concerns at different times, including functional deficits, facial disfigurement, psychological distress, depression, anxiety and mood disorders.[9-12] Cancer recurrence is feared by many HNC survivors.[13,14] Caregivers often also experience psychological distress.[11]

However, with appropriate supportive care, patients can experience the survivorship trajectory better.[4] The 'Improving Supportive and Palliative Care for Adults with Cancer', produced by the Department of Health defines service models to ensure patients with cancer, their families and caregivers, receive support and care to help them cope with cancer and its treatment at all stages.[4]

The Queen Victoria NHS Foundation Trust (QVH) provides HNC services for several local multidisciplinary teams (MDT). Existing care pathways produced by local networks have focused on the referral, diagnostic and cancer treatment pathways.[15] No specific guidelines on post-treatment care pathways currently exist, post-treatment patients are customarily handed over to their local hospital-based and/or community-based teams for supportive and rehabilitative care, *figure 2*. Few reports of cancer users perceived need and usage of supportive care services exist.[15,18,19] Formal identification of what patients and their caregivers fundamentally want from their cancer network service is required.[20-22]

| | **Year 1** | **Year 2** | **Year 3** | **Years 4-5** |
|---|---|---|---|---|
| Early stage ($T_{1-2}$No) surgery or RT only | 8 – HNC MDT for first 6/12 then Local if no concerns | 12 Local | 12 Local | 26 Local |
| Combined modality | 6 – HNC MDT until PEG removed/PET-CT or 6 months (whichever is latest) then 8-Local | 12 Local | 12 Local | 26 Local |
| Advanced stage ($T_{3-4}$ or $N_3$) | 6 – HNC MDT until PEG removed/PET-CT or 6 months (whichever is latest) then 6-Local | 8-12 Local | 12 Local | 26 Local |
| In addition **all** patients follow up at 1,2 and 5 years from end of treatment or if any unresolved or new concerns | | | | |

*Figure 2 Follow-up by Head and Neck Cancer MDT or local maxillofacial clinic*

## Aims & objectives

Aims: To understand the experience of the post-treatment pathway of care in a group of long-term HNC survivors

Objectives: To explore the impact of ablative HNC surgery, by analyzing perceived need and use of supportive care services and which outcomes are valued by patients.

## Methodology

Design: Qualitative and quantitative study using semi-structured interviews and questionnaires

Subjects: Long-term survivors of HNC (i.e. > 5 years post-treatment) who have had HNC surgery and use oral and/or facial prostheses

Recruitment: Selection of NHS patients who currently attend regular follow up

Sample size: 10 HNC patients

Protocol: Identification of suitable subjects

The inclusion criteria for this study:

i HNC patients with > 5 years survival

ii Patients with a postoperative prosthesis

iii English speaking

iiii Mental capacity

The exclusion criteria for this study:

i Non-HNC patients

### Recruitment

Subjects were identified from patients currently attending the prosthetics revision clinic. Potential subjects were approached by the researcher at the end of their outpatient appointment and invited to participate. Information about the study was provided verbally and through a patient information sheet. Patients who agreed to participate were allocated an interview appointment.

### Interviews

Informed consent was formalized by the researcher (EW) at the interview appointment and the patient self-completed two health-related quality of life (QOL) questionnaires. The semi-structured interviews were audio-recorded (EW), transcribed (LW) and subjected to analysis using interpretative phenomenological analysis (IPA) by all authors.[23,24] Emergent themes were identified, and grouped into thematic clusters. Connections were established between main themes and subordinate themes. The primary outcome measures were themes relating to supportive care pathways and outcomes valued by patients. Additional themes identified the impact of ablative surgery and prosthetic rehabilitation.

### Questionnaire

Secondary outcome measures related to the health status and health-related QOL questionnaires in long-term HNC survivors.[25] The University of Washington-Quality of Life (UW-QOL) utilises 12 domains; pain, appearance, activity, recreation, swallowing, chewing, speech, taste, saliva, mood and anxiety.[26] In addition, three global questions asked how patients subjectively felt before developing cancer, their current health-related quality of life and overall quality of life.[27]

## Results

### Table 1 Study subjects

| ID | Sex | Oral and/or facial prosthesis | Age at Surgery | Current Age | Years post-op | Diagnosis | Site | Tumour staging | Treatment | Chemo/Radio therapy |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | F | Oral prosthesis | 30 | 68 | 38* | Adenocystic Carcinoma | Maxillary Sinus | N/K | Hemi-maxillectomy | Radiotherapy |
| 2 | M | Oral + facial prosthesis | 37 | 73 | 36 | Adenocystic Carcinoma | Maxillary Sinus | N/K | Radical Maxillectomy | None |
| 3 | F | Oral + facial prosthesis | 50 | 69 | 19* | Extensive Antral Carcinoma | Maxilla & Orbit | T2N0M0 | Radical maxillectomy and orbital exenteration | Radiotherapy |
| 4 | M | Facial prosthesis | 24 | 75 | 51* | Nasal Pharyngeal Carcinoma | Nose | N/K | Complete Rhinectomy | Radiotherapy |
| 5 | F | Oral + facial prosthesis | 56 | 67 | 11 | Adenocystic Carcinoma | Maxilla & Nose | T2N0M0 | Hemi-maxillectomy and Rhinectomy | Radiotherapy |
| 6 | F | Oral prosthesis | 66 | 73 | 6 | Squamous Cell Carcinoma | Premolar region | T2N0M0 | Hemi-maxillectomy Level IIb | None |
| 7 | M | Facial prosthesis | 55 | 66 | 10 | Adnexal Carcinoma & keratinizing Squamous Cell Carcinoma | Nose | T4N0M0 | Complete Rhinectomy | Radiotherapy |
| 8 | M | Oral prosthesis | 71 | 86 | 15 | Maxillary Ameloblastoma | Left Maxilla | T2N0M0 | Hemi-maxillectomy | None |
| 9 | M | Oral prosthesis | 67 | 80 | 13 | Maxillary Ameloblastoma | Maxillary Sinus | T2N0M0 | Hemi-maxillectomy | None |
| 10 | M | Facial prosthesis | 47 | 54 | 6 | Squamous Cell Carcinoma | Nose | T4N0M0 | Complete Rhinectomy | Radiotherapy |

## 1. Qualitative results

### Table 1.1 Main themes

| Emotional Impact | N= | Survival | N= | Anger & Denial | N= |
|---|---|---|---|---|---|
| Shock | 10 | Am I going to die? | 10 | Why me? | 8 |
| Horror | 10 | Fatalism | 10 | Denial of situation | 7 |
| Panic | 10 | - meet it head on | 6 | Unreal situation | 9 |
| Worry | 10 | - just get it out of me | 4 | Frustration – do it now, today | 7 |
| Fear | 10 | - it is what it is | 7 | Ostrich-like behaviour | 6 |
| Low mood | 10 | - do what it takes | 10 | - this isn't real? | 8 |
| Tearful | 7 | | | - this can't be happening | 4 |

## Discussion

Difficulties associated with altered body image, often result in psychological distress; depression, anxiety and mood disorders.[10,11,12] Structured interviews enable greater insight into the patient experience. [23,24,27]

Three main themes form the primary outcome measure of this study, *Table 1.1,* principally the emotional impact, the fear for life and then anger. Low mood and depression was identified, with 40% of this cohort having been prescribed anti-depressants. These findings have been reported in other studies.[18,19,20] Most subjects felt they had no choice or control, comments like: 'Just take my cancer away', accompanied by shock: 'the doctor explained my operation but I had no clue how bad it was going to be' *(Table 1.2)*.

Throughout the interviews the professional team working together, surgeons, ward nurses and Macmillan nurses spent time listening, allaying fears and answering questions. Comments like 'My surgeon, I class him as number one, as the man who saved my life', 'Coming to QVH was probably the best day of my life, as far as the hospital, the treatment and my surgeon, from day one I was reassured.' Family involvement was reported as being integral to achieving a coping strategy, a quicker recovery and return to 'normal'.[28]

The emotional impact of the surgical outcome was demonstrated by comments such as 'my ward nurse said Frankenstein couldn't have made a worse looking monster' (albeit from a patient who had his surgery 50 years ago), coupled with continued worry about recurrence 'I was happy with that (the surgery) providing he was telling the truth'. The reaction of family and especially children post-surgery was unsurprisingly a recurrent theme, 'I was worried about my wife's reaction, but she kissed me on the lips, with no nose and just a gauze dressing'.

Chemo/radiotherapy side effects were evident throughout: length of treatment, claustrophobia, tightness of the radiotherapy mask, reduction in saliva, associated difficulty in eating, the loss of taste, sores and resounding tiredness.

Table 1.2 Themes related to ablative surgery

| Surgery | Support | Emotional impact | Further treatment | Help & Support |
|---|---|---|---|---|
| No Choice | Surgeon and Nurses allayed fears | Horror at disfigurement | Chemo/radiotherapy length of treatment | Access to Psychology |
| Out of Patient's Control | Surgeon and nurses listened to me | Shock at appearance | Chemo/radiotherapy side effects - nausea | Access to Speech & Language therapy |
| On a Treatment pathway | Surgeon and nurses answered my questions | Pain | Chemo/radiotherapy Side effects - tiredness | Access to Physiotherapy |
| In the Cancer system | Professionals working as a Team brings comfort | Realisation of situation | Chemo/radiotherapy side effects - unpleasant but necessary | Access to Dietician |
| Not involved in treatment plan | Someone always there – Contact name and number | Worry - recurrence - coping with altered life - family/kids reaction | Chemo/radiotherapy side effects - loss of taste | Access to Patient Support Groups - Headstart - Let's Face It - Macmillan |
| Surgeon just needs to do his job | Family involvement – integral to achieving a coping strategy | Relief - rid of cancer | Chemo/radiotherapy side effects - loss of saliva | |
| Too much information to take in | Family involvement – quicker recovery | Blind Faith Trust in system | Chemo/radiotherapy side effects - sore, ulcers | |
| | Family involvement – quicker return to normality | Traumatic experience | | |

Table 1.3 Themes related to prosthetic rehabilitation

| Return to Normality | Emotional Impact | Prosthetic Rehabilitation | Acceptance & Reflection | Self-management |
|---|---|---|---|---|
| Supported and involved in Treatment plan | Relief | Long process to go home with something | Altered body image | Follow-up essential - reassuring - comforting |
| Ability to choose shape and/or design | Lucky to be alive | Difficult to learn how to use in beginning | Coping with disfigurement | Follow-up essential - someone to look inside |
| Ability to choose colour | Proud of prosthesis | Prosthetic 'routine' | Coping with others reactions - staring | Follow-up essential - pick up abnormalities |
| No Scars seen | Feels good about prosthesis | Long journey to acceptance – 'this is me now for life' | Prosthesis integral to me, part of me | Long journey to acceptance – 'this is me now for life' |
| Able to eat, drink & speak | Supported | Maxillofacial Prosthetic Team allayed fears | Prosthesis a necessary evil | Open Access to Maxillofacial Prosthetic Team |
| Able to enjoy life again - not a cancer victim any more | Realisation of situation | Maxillofacial Prosthetic Team listened to me | Return to normal life and relationships | Access to Patient Support Groups - Headstart - Let's Face It - Macmillan |
| | | Maxillofacial Prosthetic Team answered my questions | Return to work | |

'Radiotherapy was most unpleasant and the chemotherapy possibly worse'.
All subjects reported that supportive care services were readily available; Speech and Language Therapy, Psychology, Physiotherapy and Dietetics, which contradicts published literature.[4,8]

Prosthetic rehabilitation themes are shown in *Table 1.3*. Realistic patient outcomes were exhibited, comments such as: 'I've had all sorts of obturators, think he used me as a guinea pig but the confidence is there, you know, and that is a big thing'. Overall the ability to eat, drink, speak and get back to 'normal' was important. The open access to the prosthetic clinic provided support: 'Service is second to none, it works like clockwork'.

Relief and the feeling of being lucky to have survived resounded throughout the transcripts.

After rehabilitation there were so many references to being 'happy with my prosthesis', alongside the realisation of 'It was hard to think, this is me for life now'.

Feelings around altered body image and coping with disfigurement abounded but all agreed it was a long journey to acceptance, 'I said to my prosthetist, the surgeon saved me but you helped me live my life'.

Each subject achieved their own level of self management, 'I couldn't have always been coming back to the hospital, otherwise I'd never be able to live my life'. Supportive care services were well referenced but interestingly subjects felt over-burdened with information leaflets.

## 2. Quantitative Results

### Table 2.1 Presentation of 12 UW_QOL domain scores

| UW-QOL scores | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| UW-QOL | N | 0 | 25 | 30 | 50 | 70 | 75 | 100 |
| Pain | 10 | | | | 1* | | 3 | 6 |
| Appearance | 10 | | | | 1* | | 5 | 4 |
| Activity | 10 | | | | 1* | | 7 | 2 |
| Recreation | 10 | | | | | | 5 | 5 |
| Swallowing | 10 | | | | | 4 | | 6 |
| Chewing | 10 | | | | 4 | | | 6 |
| Speech | 10 | | | | | 3 | | 7 |
| Shoulder | 10 | | | 1* | | 2 | | 7 |
| Taste | 10 | | | | | 3 | | 7 |
| Saliva | 10 | 1* | | 1* | | 1 | 1 | 6 |
| Mood | 10 | | | | | | 5 | 5 |
| Anxiety | 10 | | | | | 3 | | 7 |

Significant Problem Key:

| | |
|---|---|
| Pain, appearance, activity, recreation, mood | Scores of 0, 25, 50 |
| Swallowing, speech, anxiety | Scores of 0 to 30 |
| Shoulder, taste, saliva | Scores of 0 to 30 |
| Chewing | Score of 0 |

### Table 2.2 Importance question - the three most important domain issues in the last 7 days (N=8) *(2 patients reported no issues).*

| UW-QOL (N=8) | N of patients choosing the domain | % of patients choosing the domain | Rank Order |
|---|---|---|---|
| Swallowing | 4 | 40% | **1** |
| Saliva | 3 | 30% | **2** |
| Speech | 3 | 30% | **2** |
| Pain | 2 | 20% | **4=** |
| Appearance | 2 | 20% | **4=** |
| Chewing | 2 | 20% | **4=** |
| Mood | 2 | 20% | **4=** |
| Anxiety | 1 | 10% | **8=** |
| Taste | 1 | 10% | **8=** |
| Activity | 1 | 10% | **8=** |
| Recreation | 1 | 10% | **8=** |

### Table 2.3 Global questions

| UW-QOL score | N | 0 | 25 | 30 | 50 | 60 | 80 | 100 |
|---|---|---|---|---|---|---|---|---|
| | | POOR | | FAIR | | GOOD | VERY GOOD | OUTSTANDING |
| A. Health –related QOL compared to month before had cancer | 10 | | 4 | | 3 | | | 3 |
| B. Health-related QOL during past 7 days | 10 | | | | | 8 | 2 | |
| C. Overall during the past 7 days | 10 | | | | | 6 | 4 | |

'Information leaflets, they must have cut down two or three trees to give me them all'. Follow up remained an essential component of the long-term care, the continued reassurance and comfort of 'someone looking inside'. Annual follow up through the maxillofacial prosthetic clinic identified tissue abnormalities, with 40% of this cohort having recurrence detected.

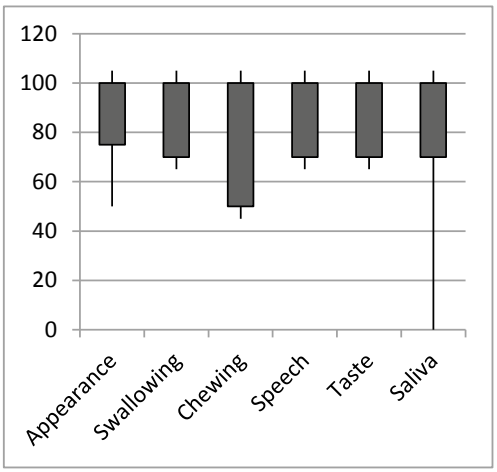
Everyone felt they had a future to look forward to, a feeling of 'Very lucky, I've been lucky' but 'It's a journey I'd rather not have had but I think it's been managed well – we've all done well.'

Quantitative data evaluated subject's QOL *(Table 2.1)* through the 12 UW_QOL domains. [22,25-27]

Importance issues were ranked, as seen in *Table 2.2*, highlighting swallowing as a residual difficulty in 40% of patients, followed by a saliva deficiency and speech quality. Residual problems with swallowing, saliva, and associated speech problems may be attributable to early radiotherapy treatment, prior to the introduction of intensity modulated radiotherapy (IMRT) or any kind of conformal radiotherapy techniques (N=3, shown in Table 1). Significant existing problems included a complete absence of saliva, daily pain, change in appearance and an inability to maintain their usual level of activity are highlighted (*) in *Table 2*.1.[21,22]

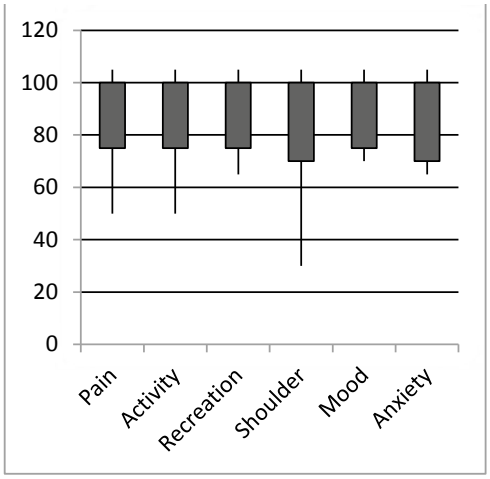
Global analysis *(Table 2.3)* showed that 40% felt somewhat worse than the month before they had cancer, 30% felt they were about the same, and 30% felt much better. [27] Composite scores can be drawn from the data in Table 2.1, considering the patients overall health-related scores in accordance to their physical and social-emotional function, as shown in *Graphs 2.1* & 2.2.[27] Overall patients report high scores in all fields, implying no limitations to normal life after their HNC experience. Interestingly mood is scored as excellent (unaffected by cancer) or generally good, in contrast to the 40% of patients having been prescribed antidepressants in the structured interviews. Patients attributed their low mood then to a death of a parent or loved one, not their cancer diagnosis. Most patients were not anxious about the future and managing normal day to day activities. *(Graphs 2.3 & 2.4)* However, more subjects remarked that their own ageing process impacted more on their physical ability than their cancer diagnosis, treatment and subsequent rehabilitation.

Graph 2.1
Physical Function composite score (N=10)

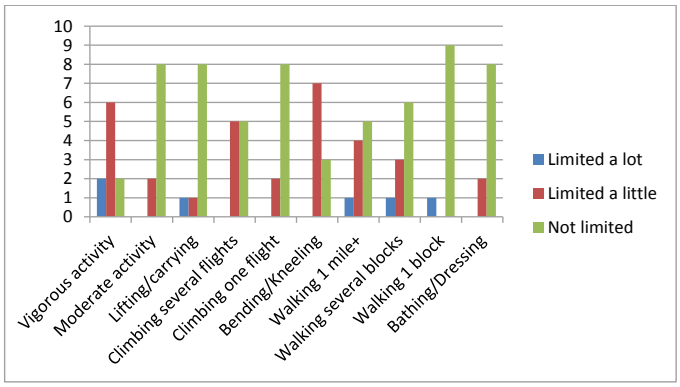




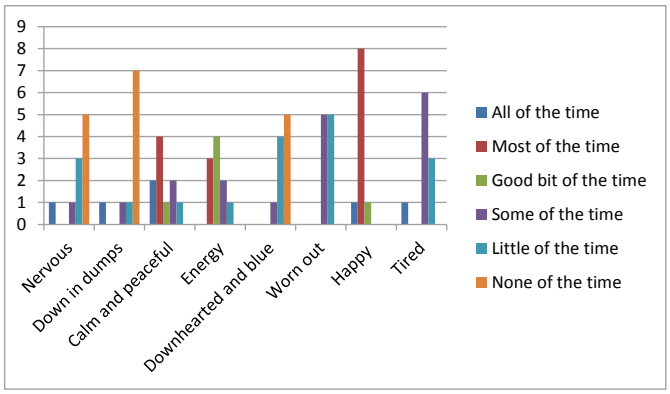
Graph 2.2
Social-emotional Function composite score (N=10)




Graph 2.3 Health limiting activities




Graph 2.4 Emotional health




In this study the perceived need versus the use of supportive services was highest immediately post-surgery, continuing for up to the first year, by which time all patients reported self-management.

However, 20% reported they were 'carried along on a wave' along a cancer pathway but after one year felt dropped and left to their own self-management, this being despite the long-term follow up by the HNC MDT and maxillofacial prosthetic team. It is true that the support care trajectories do evolve after the initial post-cancer surgery treatment plan of being seen every 6 to 8 weeks for the first 6 months and then annual checkups after that, as detailed in *figure 2*. But seemingly this change from MDT-led contact pre-op and immediately post-op to patient led contact was reported to be a difficult transition.

The overwhelming results of this study reveal that patients do feel treated as individuals, given time to ask questions and discuss their fears, which is in line with current HNC guidance and cancer treatment care pathways.[4] Few subjects report remaining significant problems >5 years post-treatment.

Cancer survivorship was reported to be an initial worry, up to 1 year post op. The use of supportive care services, namely psychological services, dietetics, speech and language therapy and physiotherapy was only required during the first year post ablative surgery, with most subjects achieving a level of self-management.

No broader range of supportive care services were requested or reportedly required. General day to day activities were not limited for 80% of study participants, however 20% of subjects put their occasional limitations more down to 'old age' and not their cancer diagnosis or rehabilitation.

All subjects appreciated and valued the level of supportive care service they received in person, there was no waiting list or delay in service provision. Each patient reported receiving good quality care from the MDT through to the care from the allied health professionals and patient support groups. The importance of follow-up clinics remained a strong theme, to continue the reassurance that 'all was well'.

However, an interesting finding from this study was the reporting of feelings of being bombarded with numerous information leaflets, and the inability to make sense of them at the time of issue. Should it be considered that discussion of available support services should be broached at clinical follow up, once the patient has comes to terms with their diagnosis?

Or are we as professionals just trying to prepare the patient pre-op for every eventuality, even those they may not face? If we waited until post-op to describe the early days recovery then that would be too late and the burden of care (during the recovery period) could prove problematic for caregivers?

Supportive care is an 'umbrella' term for all services, both generic and specialist HNC MDTs.

This study has shown that patients have needs for supportive care from diagnosis and do find a level of selfmanagement >5 years post-treatment.

## Conclusion

The experience of the post-treatment pathway of care in a group of long-term HNC survivors was examined to explore the impact of ablative HNC surgery. Analysis of the perceived need and use of supportive care services and the outcomes valued by patients found that all needs were met and care supportive services were readily available for this cohort of patients. This study has shown, on a small sample that when the HNC service follows the NICE guidelines, as described in Care for Adults with Cancer, then good practice in the delivery of supportive care is evidenced. [4] The supportive care services offered were utilized and valued by this study cohort but cancer survivorship was reported to only be an initial worry in the first year post ablative surgery. A larger multi-centre study may show different results or shortfalls care services.

However, there will always be differences in treatment regime or historical memory of experiences, with the large variance in post-operative periods, 6 years to 51 years, observed in this study cohort.


## Acknowledgement

We are grateful to Naseem Ghazali who worked with us in the early stages, providing assistance in gaining ethical approval and the initial set-up of this study.

## Conflict of interest statement

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# Incorporated Hearing Aid in an auricular prosthesis.

N Webster DPS OTA,[1] M Cameron MBBS BDS FRCS (Eng) FDSRCS (Eng) FRCS (OMFS)[2]

1. Maxillofacial Prosthetist, The Maxillofacial Laboratory, Cambridge University Hospitals, Hills Road, Cambridge, CB2 0QQ.
2. Consultant Oral & Maxillofacial Surgeon, Cambridge University Hospitals, Hills Road, Cambridge, CB2 0QQ.

Corresponding author: Nigel Webster
email: nigel.webster@addenbrookes.nhs.uk

## Abstract

This case study describes an implant retained ear incorporating a hearing aid within the prosthesis design. In this case the patient was suffering from Parkinson's disease and struggled attaching his hearing aid to his previous prosthetic ear. The materials and methods used to integrate the hearing aid throughout the prosthetic rehabilitation process are demonstrated.

## Introduction

The patient was first referred to the maxillofacial laboratory requiring an auricular prosthesis in 2012, following surgery for the removal of a squamous cell carcinoma on his ear and external auditory canal. The primary device was fabricated to enable the patient's hearing aid to wrap over the top of the prosthesis in the normal hearing aid position. However this was found to be unstable on fitting. At the clinical review appointment, the patient enquired as to the feasibility of incorporating the hearing aid into the prosthesis itself and therefore solving the problems of trying to pair the two devices.

## Method and materials

New impressions of both the external fitting surface and the internal of the ear canal were taken and two separate dental stone models were fabricated. A wax pattern and try-in was constructed and trial fitted in the usual manner. Prior to flasking, the ear canal model was trimmed down to size and placed in the correct position under the fitting surface model. The two plaster models, once located accurately, were then joined together, shown in *figure 1*.

A direct replica of the patient's hearing aid needed to be fabricated, the battery component illustrated in *figure 2*, was then made in cold cure acrylic (Monospray : DB Orthodontics).[1] The prototype hearing aid battery compartment was then attached to the middle section of the mould, prior to the silicone packing stage, *figure 3*.

A hole was then drilled into the internal ear canal half of the mould to locate the 1.5mm stainless steel wire of the prototype tubing extension. The wire is bent to form the connector tubing from the internal ear canal to the tip of the ear hook, ensuring there is space around the wire for both a silicone sleeve and to allow for the preformed hearing aid tube to be inserted. The preformed tubing was then threaded onto the wire by using a small amount of petroleum jelly, ensuring a small amount of wire is left exposed to enable the join at the tip of the ear hook. A secure location of all the components ensured no movement when packing silicone into the mould.

Once the hearing aid portion was located in the correct position,

*Figure 1 Plaster models waxed in place*

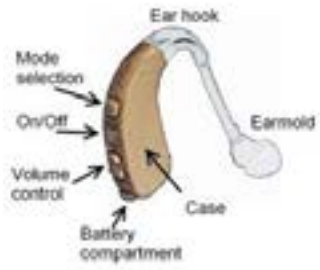


*Figure 2 Hearing aid component parts*

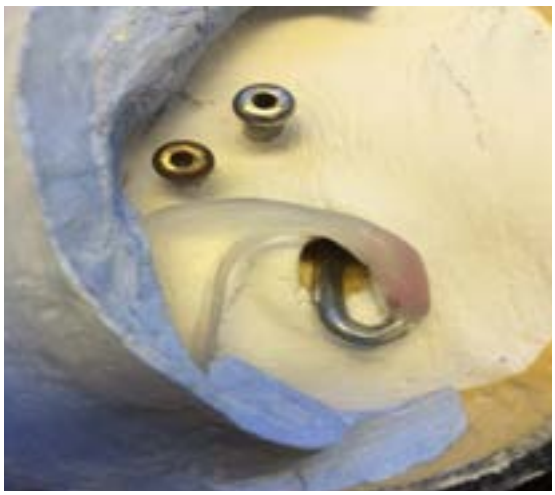

*Figure 3 Prototype hearing aid secured into mould*

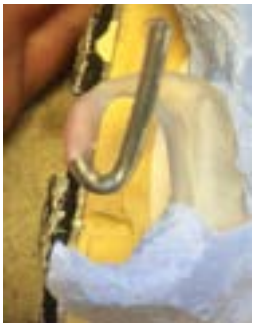

*Figure 4 Ear hook and hearing tubing joint*

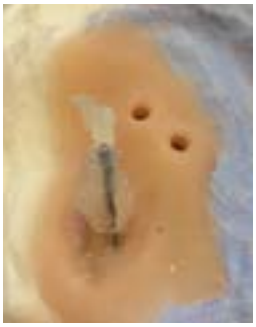

*Figure 5 Both the wire and tube in the silicone*

*Figure 6 Lateral view of prototype aid in situ*

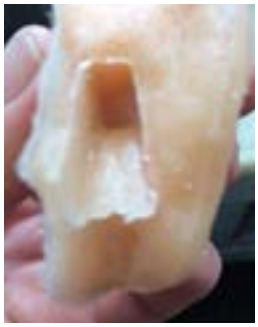

*Figure 7 Void on prototype removal*

the ear hook and tubing component needed to be adjusted not only in length but to locate accurately with the replica battery compartment, *figure 4*. The tube should extend down into the internal ear canal section of the mould and the tubing with connected ear hook component is then secured to the cold cure replica hearing aid with wax, close to the entry of the ear canal within the prosthesis.

The ear mould was then packed with the TechSil25 silicone (Technovent). In this case coloured silicone was used for the auricular prosthesis but a clear TechSil 25 silicone was used for the internal auditory canal section to enable visual placement of the hearing extension tube through the silicone.

Once the silicone has cured, the flask can be carefully separated. The location of the wire, replicating the hearing tube position can clearly be seen within the clear silicone in *figure 5*.

The prosthesis is then removed from the flask, taking special care of the clear silicone ear canal component, *figure 6.* The hearing aid prototype is removed, *figure 7,* but the wire and tubing remains in situ.

Through an incision at the fit surface the wire extension can now be removed from within the preformed tubing, and the actual hearing aid can be connected to the auricular prosthesis. Once the aid is positioned correctly, ensure the hearing aid microphone is not obscured shown in *figures 8 and 9*.

## Results

At the fit appointment, time was spent on instruction for the insertion and removal of the component parts, the patient and his carer became familiar with the assembly of the device and the removal of the hearing aid. On review, the patient reported this device to be comfortable, stable and his hearing to be much better now with this new custom-made incorporated hearing aid prosthesis design. Some audio feedback was reported, whether this could be attributed to the proximity of the implants or silicone remains unclear. Further examination in this regard will be undertaken at the six month review appointment.

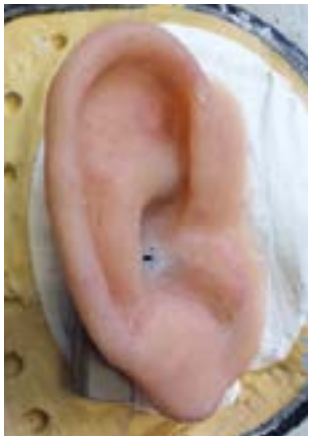

*Figure 8 Finished device with hearing aid in situ*

*Figure 9 Finished device with hearing aid, posterior view*

## Discussion

This case study describes a new technique for the construction of a combined hearing aid and auricular prosthesis device. Hearing aids used in combination with auricular prosthetic rehabilitation have been reported previously with limited success.[2] The unique approach to fully integrate the patient's hearing aid within the actual prosthetic structure dramatically improved the life of this patient. The ability to independently attach his device and hearing aid, without help, restores a level of self-management and dignity which previously seemed unattainable. From the outset, this was going to be a complex case incorporating a bone anchored auricular prosthesis with mushroom attachments and the different hearing aid components. However this design has restored this patient's independence.

## Conclusion

An implant retained ear incorporating a hearing aid within the prosthesis design has been fully demonstrated. The method, production technique, through to the review of the patient has been described.

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# A meta-analysis of keloid and hypertrophic scar treatments.

S.Zaulifqar MSc BSc AIMPT, E Worrell PhD, MIMPT

Corresponding author: S.Zaulifqar
Queen Elizabeth University Hospital, 1345 Govan Road, Glasgow G51 4TF
email address: sabah.zaulifqar@ggc.scot.nhs.uk

## Abstract

There are a great number of treatment options available for keloid and hypertrophic scarring that range from surgical excision and pressure splints to radiation and the use of topical agents such as onion extract and salicylic acid. A meta-analysis, an in-depth statistical review, was carried out to identify the most effective treatment methods in order to inform evidence based practice. A systematic review of articles in PubMed and EMBASE databases was carried out, 38 treatments from 27 studies met the criteria. The meta-analysis found the three most effective treatment modalities based on high quality evidenced based research.

## Introduction

Keloid and hypertrophic scars (KHS) present as benign red/purple raised dense fibrous growths that result from the uncontrolled proliferation of collagen during the process of wound repair of the dermis. For keloids, shown in *figure 1*, the resulting scar exceeds the boundaries of the original wound and can progressively invade the surrounding skin whereas hypertrophic scarring *(figure 2)* remains within the boundaries of the original wound.[1]

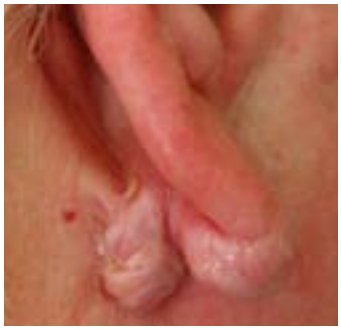

*Figure 1 Keloid Scar*

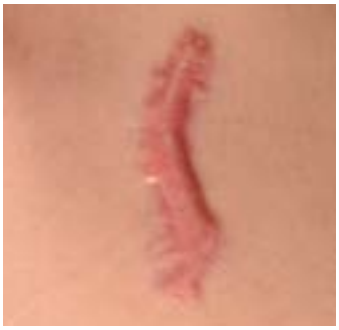

*Figure 2 Hypertrophic Scar*

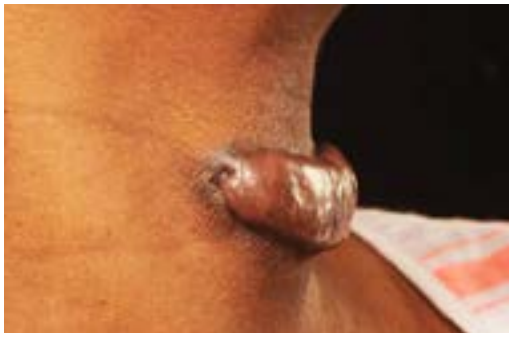

*Figure 3 Keloid scarring*

The incidence of keloid and hypertrophic scars within the NHS has been reported at 10-15% of all wounds.[2]

The scarring tends to occur in areas of increased tension such as the chest, shoulder, neck and earlobes (increased risk from piercings). Scars usually resulting from trauma e.g. surgery, acne, burns, injury or can even be spontaneous.[3] Symptoms can include erythema, pruritus and pain as well as a functional deficit due to contracture over joints leading to reduced mobility. The main concern for patients however is the aesthetic disfiguration, with a number of studies reporting a reduced quality of life.[3,4,5,6]

### Aetiology

The exact aetiology of the conditions is undefined however a number of contributory factors have been identified: increased incidence in certain races e.g. Afro-Caribbean, Hispanic and Asian populations *(figure 3)* have an increased risk increased risk of developing scars during pregnancy and puberty and a genetic predisposition demonstrated by a familial tendency to develop either type of scar.[4]

### Pathology

Both types of scar occur due to abnormal wound healing. The early presence of fibroblasts remains longer in KHS than in normal wound healing, *figure 4*. During normal wound healing, fibroblasts and other connective elements regress at approximately three weeks whereas the fibroblasts continue to deposit more collagen in dense formations around vascular structures.

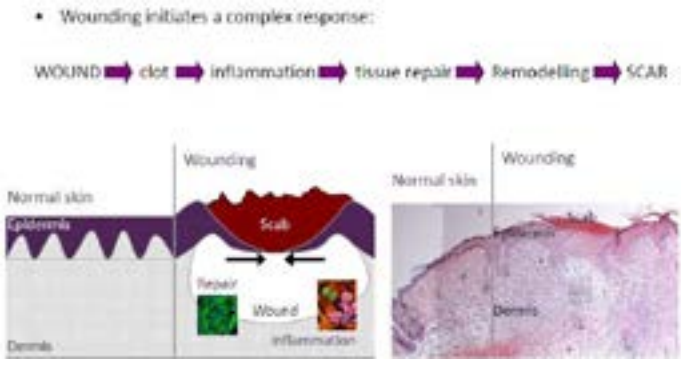


*Figure 4 Wound healing*

The initial stage of proliferation in keloid scarring can be ongoing, for a number of years, the length of time and rate of growth determine the size of the scarring. Hypertrophic scars in comparison have a limited proliferation phase with the scarring likely to mature over the period of a year. The mechanism for the action of the fibroblasts has been suggested to be an exaggerated reaction to transforming growth factor-beta-1.[7,8]

### Treatment methods

A variety of methods are commonly used in scar treatment, these treatments include surgical excision, intralesional injections, topical applications, cryotherapy, laser *figure 5*, silicone gel and dressings, sometimes in combination with radiotherapy. Other novel approaches have also been reported such as the use of onion extract and bleomycin.[9,10,11]

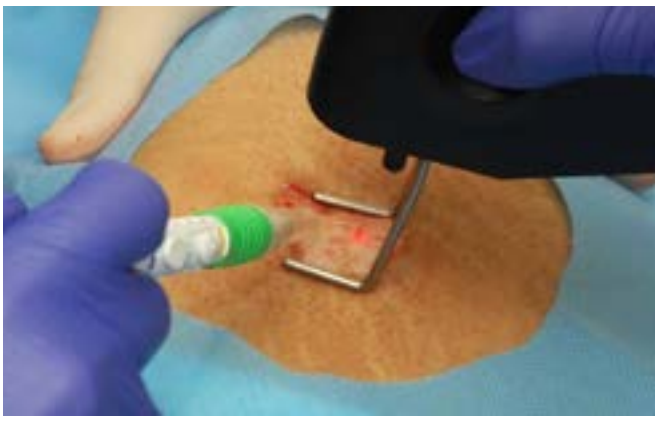

*Figure 5 CO2 laser treatment on upper thigh*

### Previous research

Despite scarring being a relatively common occurrence (1:10) and a wide variety of treatment modalities available, no gold standard of scar treatment has been determined.

Only one previous study in the published literature looked at the effectiveness of more than one treatment. With this study being more than ten years old, a gap in the research was identified. Presentation of new research, such as following the increased use of laser highlighted the need for an evidence-based investigation into the efficacy of each scar treatment modality.[12]

The use of a meta-analysis to inform evidence based practice is more reliable and accurate than a simpler literature/systematic review as the outcomes of studies are statistically combined and each study is weighted depending on influential factors such as the number of patients treated and the risk of bias presented.

## Materials and methods

The eligibility criteria and outcome measures approach was based on information from the previous multi-treatment mode meta-analysis and subsequently carried out by the author. The statistical methodology was taken from the Cochrane handbook for systematic reviews of interventions version 5.1.0.

### Eligibility criteria

Intervention studies for KHS with clinical outcomes from randomised controlled trials and non-randomised clinical studies were included. Studies that were of evidence level 3 or higher were included to ensure reliability of the results. All scarring research papers on burn injuries were excluded, plus studies reporting on non-clinical outcome measures.

### Outcome measures

Clinical parameters such as scar appearance and symptomatic relief or objective such as change in size or incidence of recurrence were scored as outcome measures. Studies reporting multiple treatment modes were notated separately, denoted as A and B.

### Scoring of results

Results were divided into two categories, favourable and unfavourable. Favourable results demonstrated an improvement score of 50% or more and unfavourable scored below 50%.

Where an assessment scale was reported, values greater than or equal to the midpoint was deemed to be the 50% threshold and were placed in the favourable category.

In surgical excision technique papers, recurrence rates were recorded as the outcome measure. Only the clinical outcome measures were recorded and patients who did not complete their follow up were excluded from the study data. The quality of each study was graded according to the approach by the Oxford Centre for Evidence-based Medicine.[13]

Sources: Studies were identified using the terms keloid* and hypertrophic scar* on electronic databases and scanning reference lists. This search was applied to PubMed and EMBASE databases (1st November 2005 to 31st October 2015) as shown in the flow diagram in *figure 6*.

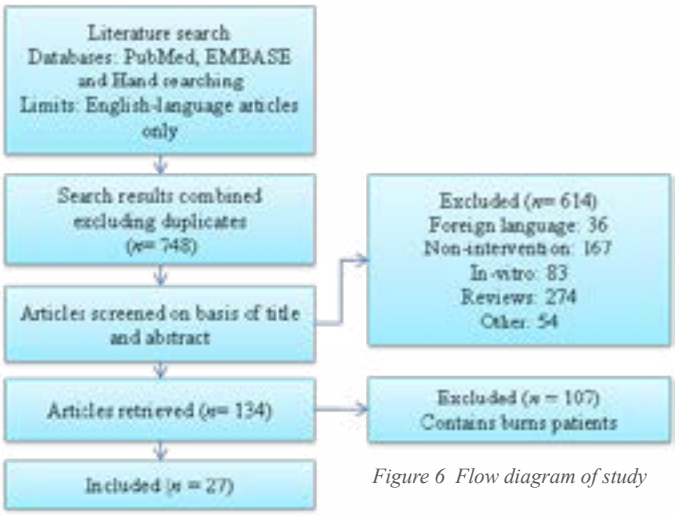


*Figure 6 Flow diagram of study*

A data extraction sheet recorded: author(s), year, study type, quality assessment, treatment type, outcomes and risk of bias.

### Summary measures

Studies were sub-grouped according to the treatment type and categorised under main headings of: excision, radiotherapy, silicone, topical agents, Intralesional (e.g. hydrocortisone injection), cryotherapy, laser and others. Where studies combined treatment methods, the study was used in more than one category as required. The meta-analyses were performed using the software Cochrane Review Manager (RevMan).[14]

Relative risk of favourable treatment outcome was the primary measure of treatment efficacy. In statistics and epidemiology, the relative risk or risk ratio (RR) is the ratio of the probability of an event occurring in an exposed group in comparison to a non-exposed group.

The meta-analyses were completed by computing relative risks (RR) using the random effects model and Mantel-Haenszel statistical method, with 95% confidence interval.[15]

### Planned method of analysis

Forest plots are generated to graphically represent the results of the meta-analyses. Inevitably studies brought together in a systematic review will differ. Any kind of variability among studies may be termed heterogeneity. In order to know whether the results from a meta-analysis are reliable, the heterogeneity between the studies needs to be tested to assess whether the differences are caused by chance or another cause. To test for heterogeneity, the $I^2$ test was used.[15]

### Results

Following the systematic review 27 studies were included in the meta-analysis reporting on 38 treatment modalities, shown in the flow diagram in *figure 6*.

A summary of all the studies used in the systematic review is shown in *Table 1*.

The meta-analysis was completed on all studies and demonstrated heterogeneity of $I^2 = 85\%$.

When analysed by treatment type, the highest effects were seen for the treatment modalities of:

Cryotherapy RR 8.79 (95% [CI] 3.87 to 19.98])
*shown in Table 2*

Topical RR 6.15 (95% [CI] 2.79 to 13.54)
*shown in Table 3*

Intralesional RR 5.14 (95% [CI] 2.95 to 8.94)
*shown in Table 4*

As a laymans guide, using this example, all the studies favoured Cryotherapy treatment. The forest plot graph, shown on the right-hand side of *Table 2*, has a line to represent each study in the meta-analysis, which is plotted according to the standardised mean difference,

denoted by the small box under each line. The black diamond denotes the combined effect size seen in these three studies.The more the studies overlap each other and the black diamond, demonstrated by the blue shaded area, the higher the efficacy of this treatment,

In heterogeneity terms, the lower the figure the more reliable the outcome of the meta-analysis, therefore the subgroup analysis observed for Cryotherapy is a heterogeneity $I^2 = 55\%$, demonstrating minimal variability. Heterogeniety must be considered alongside the RR values obtained.

Topical and Intralesional treatment therapies demonstrated minimal to moderate variability with heterogeneity scores of $I^2 = 37\%$, Table 2 and $I^2 = 77\%$, *Table 3*.

The remaining groups demonstrated heterogeneity ranging $I^2 = 77\text{-}90\%$, representing substantial heterogeneity. The closer to 100%, the more unreliable the study data, the data reported is too different from the comparison cohort and therefore unable to be reported as efficacious. The sub-group analysis for surgical excision, *Table 5,* shows substantial heterogeneity, very few lines on the forest plot overlap eachother and therefore no firm evidenced based conclusions can be drawn from this meta-analysis about Surgery as a treatment modality. Heterogeneity by sub-group were Surgery=87%, Other=87%, Silicone=88%, Laser=89%, Radiation=90%.

| Study | Type | Treatment | Improved n/N (%) |
|---|---|---|---|
| Campanati et al 2010[16] | CCT | Topical allium cepa, Allantoin and Pentaglycan | 15/15 (100%) |
| Cho et al 2010[17] | RCS | Nd:YAG laser | 7/21 (33.3%) |
| Cicco et al 2014 A[18] | RCS | Excision + Brachytherapy low dose rate | 33/46 (71.7%) |
| Cicco et al 2014 B[18] | RCS | Excision + Brachytherapy high dose rate | 31/50 (62%) |
| Grella et al 2015[19] | PCS | Liquid Silicone gel | 16/18 (89%) |
| Harshai et al 2008 [20] | PCS | Intralesional Cryosurgery | 9/11 (81.8%) |
| Haurani et al 2009 A[21] | PCS | Excision + Intralesional 5-fluorouracil | 26/32 (81%) |
| Haurani et al 2009 B[21] | PCS | Intralesional 5-fluorouracil | 18/21 (86%) |
| Hayashi et al 2012[22] | RCS | Excision + TAC + Topical steroid | 18/21 (85.7%) |
| Kang et al 2006 [23] | PCS | Intralesional Collagenase | 0/7 (0%) |
| Khan et al 2014 A[24] | RCT | TAC | 51/75 (68%) |
| Khan et al 2014 B[24] | RCT | TAC + 5 flourouracil | 63/75 (84%) |
| Koc et al 2008 A[11] | RCT | TAC + onion extract | 14/14 (100%) |
| Koc et al 2008 B[11] | RCT | TAC | 13/13 (100%) |
| Manca et al 2013[25] | PCS | Electrochemotherapy | 33/35 (94%) |
| Martinez et al 2013[26] | PCS | Bleomycin + TAC | 39/43 (90.6%) |
| Meshkinpour et al 2005 A[27] | PCS | Radiofrequency 2 treatments | 0/10 (0%) |
| Meshkinpour et al 2005 B[27] | PCS | Radiofrequency 1 treatment | 0/10 (0%) |
| Ogawa et al 2007 A[28] | RCS | Excision + radiation 10, 15 or 20 Gy (by location) | 104/121 (86%) |
| Ogawa et al 2007 B[28] | RCS | Excision + radiation 15 Gy | 176/249 (76.1%) |
| Ogawa et al 2013 B[29] | RCS | Excision + 10 Gys Radiation + Taping | 122/127 (96.1%) |
| Ogawa et al 2013A[29] | RCS | Excision + 15 Gys Radiation + Taping | 45/47 (95.7%) |
| Payapvipapong et al 2015 A[30] | RCT | TAC | 11/12 (92%) |
| Payapvipapong et al 2015 B[30] | RCT | Bleomycin | 13/14 (93%) |
| Perez et al 2010 A[9] | RCT | Onion extract gel | 9/10 (90%) |
| Perez et al 2010 B[9] | RCT | Hydrocortisone, silicone + vitamin E lotion | 10/10 (100%) |
| Piccolo et al 2014[31] | PCS | Intensed pulsed light | 9/10 (90%) |
| Rusciani et al 2006[32] | RCS | Cryotherapy | 156/166 (94%) |
| Sadeghinia and Sadeghinia 2012 A [10] | DBCT | 5 Fluorouracil tattooing | 19/20 (95%) |
| Sadeghinia and Sadeghinia 2012 B [10] | NRT | TAC | 10/20 (50%) |
| Sakuraba et al 2010[33] | PCS | Silicone gel sheets | 4/9 (44.4%) |
| Scrimali et al 2010 [34] | RCS | CO2 laser | 12/12 (100%) |
| Seo and Sung 2011[35] | PCS | Topical mitomycin | 6/9 (66.7%) |
| Shin et al 2014 A[36] | RCS | Intramarginal excision | 0/7 (0%) |
| Shin et al 2014 B[36] | RCS | Extramarginal excision | 6/9 (66.67%) |
| Stahl et al 2010[37] | RCS | Extralesional Excision + Sandwich Radiotherapy | 13/19 (68.4%) |
| Weshahy and Hay 2012[38] | PCS | Intralesional Cryosurgery + Steroid | 19/22 (86.4%) |
| Yang and Yang 2012[39] | RCS | CO2 laser + Brachytherapy | 111/151 (73%) |

*Table 1 Summary of studies*

| | |
|---|---|
| TAC = Tramcinolone acetonide | RCS = Retrospective Cohort Study |
| RCT = Randomised Controlled Trial | PCS = Prospective Cohort Study |
| NRT = Non-Randomised Trial | DBCT = Double Blind Clinical Trial |
| CCT = Controlled Clinical Trial | |

*Table 1 Legend*

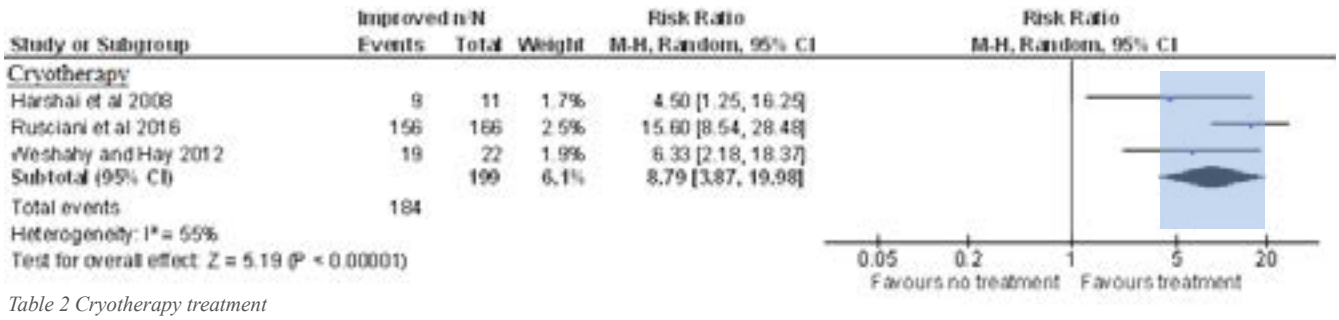


*Table 2 Cryotherapy treatment*

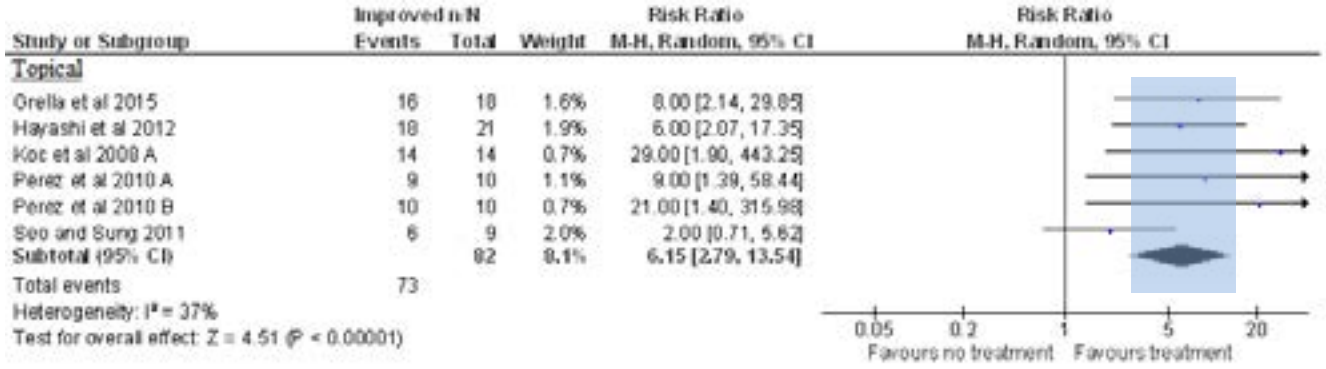


*Table 3 Topical treatment*

## Discussion

The results of this meta-analysis show that Cryotherapy, Intralesional and Topical modes are the most reliable and effective treatments for Keloid and Hypertrophic scars.

The overall heterogeneity seen for this study data is $I^2$ = 85% which is similar to the research published by Leventhal, Furr & Reiter in 2006 of $I^2$ = 86%.[12]

However, Leventhal et al did not report any statistical differences between treatment modalities, but examined individual treatment method's standard deviation and confidence intervals. It was for this reason that a sub-category analysis was carried out for this study. It is important to remember whilst looking for efficacy of each treatment mode, to consider the level of heterogeneity, the ability to determine how similar or different each data sample is, to enable the reliability and effectiveness of each treatment by sub-category.

Surgical excision and laser treatment demonstrated a low RR and therefore treatment effect as well as substantial heterogeneity therefore were not found to be reliable as a successful treatment mode. This sub-category demonstrated variety in both sample size and favourable results. Ogawa published papers in 2007 and 2013 reporting on over 500 subjects with KHS, with favourable results.[28, 29] Whereas others report unfavourable results, such as Shin et al. [36] Surgical excision of KHS demonstrates a widely used treatment method known for its risk of inducing recurrence but is an effective tool none the less to manage bulky scarring.

Inevitably due to the nature of a systematic review used to pool various treatment methods there will be differences noted, such as sample size of each individual cohort. Clinical and methodological diversity are evident whilst extracting data for this study. Clinical diversity was seen in the variability of participants age, gender, whether previous treatments had been undertaken, the age of the lesion, skin phototype (often not provided even though this is a known risk factor), aetiology and location of the scarring.[4] Some studies provided no indication to the age of the scars, whilst others reported scar age as old as 25 years.[22] A number of studies reported patient follow up only ≤6 months post-treatment.[16,24] Such a short follow up period may not adequately allow for the potential of KHS recurrence, which obviously could alter the treatment outcome result. In comparison some studies demonstrated a follow up of up to ≤8 years.[9,20] However, the lack of patient follow up in some papers could be explained by the economic and cultural challenges of the research environment.[24] Diversity was also seen in the characteristics and method of assessment used to analyse the outcome measures.

Studies that demonstrate a 0% improvement in scarring such as by Kang et al 2006, where none of the seven subjects showed improvement, still may provide a valuable contribution to this evidence base, by demonstrating the unsuitable use of an enzyme for treatment.[23] Arguably though seven subjects is never going to give reliable data on the efficacy of any treatment.

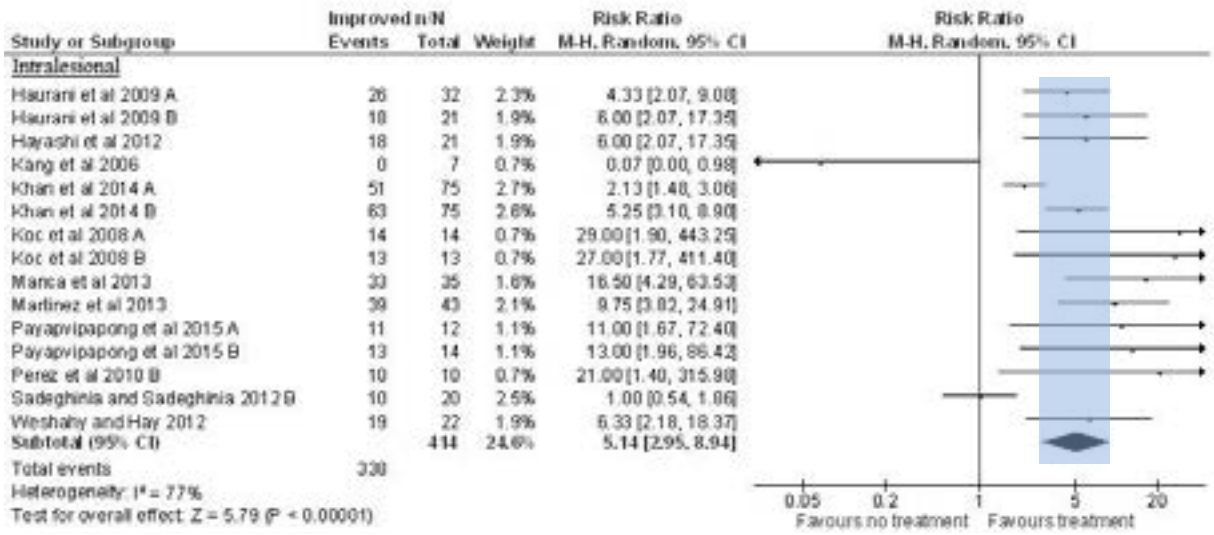


*Table 4 Intralesional treatment*

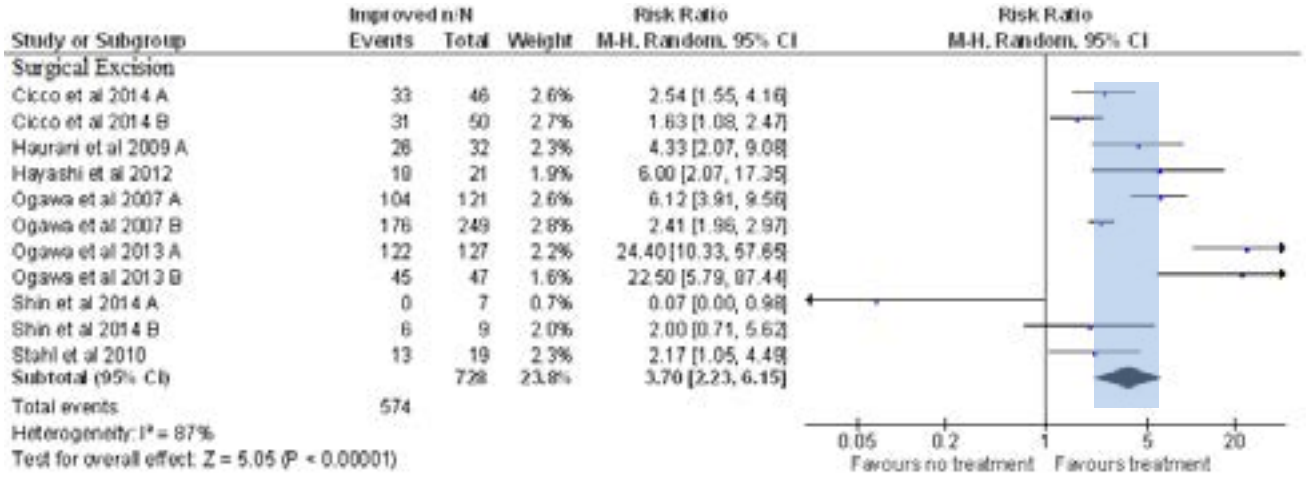


*Table 5 Surgical excision*

## Scar assessment

The most common scar assessment scale used was the Vancouver Scar Scale (VSS), although Patient and Observer Scar Assessment Scales (POSAS), which are variations of the VSS, record the height, volume, pliability and erythema of each scar.

Scar assessments were performed in a variety of ways, double blind assessment by professionals (dermatologists) to patient self-assessment. A more reliable approach to the scar assessment could be achieved by using the VSS by more than one observer, in combination with a patient satisfaction score and volumetric analysis. Haurani et al 2009 reported that volume analysis was vital when standardising scar assessment protocols.[21] It would seem that a standardised method of grading scars both pre and post treatment is needed to provide more comparable data sources in the evidence based medicine approach to HKS treatment.

Recurrence or non-recurrence of scarring seems a rather blunt measure when assessing the treatment outcome. The VSS could be utilised more to assess the efficacy of a given treatment modality, or describe a range of scar presentations on pre-assessment prior to treatment, in addition to enabling a finer tool to highlight any residual aesthetic or clinical problems post-treatment. The significant heterogeneity observed in this study suggests that not all studies are measuring or weighting the same characteristics.

Furthermore, finer characterisation by scar type should be reported and differentiation made between keloid or hypertrophic scars pre-treatment. As there is a definite histological and clinical difference between the two, surely treatments could affect each scar type differently.

Notably, no studies reported the use of pressure splints as a mode of treatment. Although within our experience as maxillofacial prosthetists (auricular) and regarded to be a commonplace method of treating keloid scarring, should the work that we do not be presented in evidence, it cannot inform evidence based practice.

The included studies within this meta-analysis have included small samples sizes, differences in follow up

durations, non-standard assessment tools for grading KHS and diverse statistical approaches to their results. In an ideal world follow up durations would be for at least one year post-treatment intervention, have larger sample sizes, more detailed patient information and history, a standardised assessment of the scars (VSS) and detailed reports of adverse effects of treatment.

Meta-analysis proved to be a valuable tool in assessing not only the success of individual treatment modes but also the level of study sample heterogeneity. Benefits would be gained from a more detailed universal grading system and a more thorough patient history for future research to enable further analysis on the effects of skin photo-type, aetiology and location of the scarring, to facilitate a clearer evidence base to apply to patient care.

## Conclusion

This meta-analysis examined the different treatment options available for keloid and hypertrophic scarring. The results show Cyrotherapy, Intralesional and Topical therapy to be the most reliable and effective treatments for KHS.

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# The design and effectiveness of an expansion screw incorporated into a microstomia splint

A Simpson MIMPT, N Sykes MIMPT, G Woolley MIMPT
Corresponding author: A Simpson,
Whiston Hospital, St Helens and Knowsley NHS Trust, Prosthetics Department, Warrington Road, Prescott, Merseyside L35 5DR
email address: Anthony.simpson@sthk.nhs.uk

## Abstract

This paper describes the manufacture of a microstomia splint incorporating an orthodontic rapid maxillary expansion screw. The manufacture technique, materials and indications for use are described. To reduce hospital appointments the treatment plan was modified to create a custom-made device incorporating an expansion screw with lateral acrylic splints. Patient compliance was good and mouth opening is reported to be less restrictive.

## Introduction

This case study describes a patient who presented in clinic having burns as a result of a flash flame injury. Initial assessment showed the patient to have 52% partial thickness burns to the hands, face, neck, chest, abdomen and right leg. Surgical excision of the burns and skin grafts were required in the first two months post-injury.

Whilst the patient was an inpatient at the hospital an appointment was made in the maxillofacial clinic after receipt of a referral for a face and neck burn splint alongside a microstomia device which would aim to prevent further contraction of the mouth. Different ways of scar management exist, and one method is to use facial splints with integrated oral formers.[1] However, in this case a patient requirement was that the mouth extended autonomously, therefore a decision was made to use separate splinting devices for the face, neck, and the mouth. Published literature reports similar devices have been made using Hyrax screws with elastic traction, with good results.[2,3] Conventional silicone splints for microstomia *(figure 1)* were tried by the patient with little success resulting in a reduction of and further contraction of mouth opening.

*Figure 1 Conventional silicone splint for microstomia*

## Treatment plan

A rapid maxillary expansion screw (Orthocare) was discussed with the patient as a way of offering expansion in a controlled delivery manner, thus reducing clinic time and the hospital visits, which the patient had requested. The manual dexterity required for this device was an initial concern due to the partial thickness burns to the hands. After much consideration the patients relatives expressed their willingness to help until such a time as the patient was able to use the expansion key himself. After further contemplation a larger handled stock key was considered, thus enabling the patient to have more independence, less reliance on his carers and the ability to control the requisite expansion.

In this case, difficulties were experienced, not only adapting to wearing the splint but also the limited success of the conventional silicone splints. A new custom-made device was required to target the microstomia areas more effectively. Patient compliance up to this point had been good, coupled with the willingness to try a new splinting method, which meant this patient was a good candidate to try this adapted innovative expansion device.

## Method

A 13mm rapid maxillary expansion screw was prepared and retention slots were cut into each wire extension, *(figure 2)*, to ensure a mechanical location within the wax pattern in addition for the final acrylic device. Wax was moulded into the splinting shape for both sides to allow a comfortable fit into the commissure of the mouth. Once the patient was happy with the shape and size of the moulded wax attachments these were firmly attached to the inactivated expansion screw. The width of the overall splint was double-checked. The microstomia wax pattern was then flasked in the conventional method *(figure 3)*. Careful attention was taken on packing the acrylic, (Metrocryl heat cure acrylic, Metrodent), to ensure a there was no movement of the expansion screw. Normal attention to detail was taken throughout the de-flasking, trimming and polishing of the device.

*Figure 2 Expansion screw with location cuts*

*Figure 3 After trimming and polishing*

On fitting time was spent explaining the insertion, removal and activation of the device with both the conventional and long handled activation keys, *(figure 4)*, until the patient and his carers felt confident and competent.

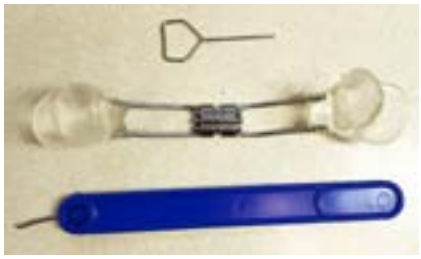

*Figure 4 Splint prior to fitting with large and conventional size adjustment keys*

## Results

Despite burns to the hands this patient maintained good compliance, he was able to insert the splint himself, *(Figure 5)* but reported difficulties in performing the necessary adjustments. The patient's carers/relatives adjusted the microstomia splint when required.

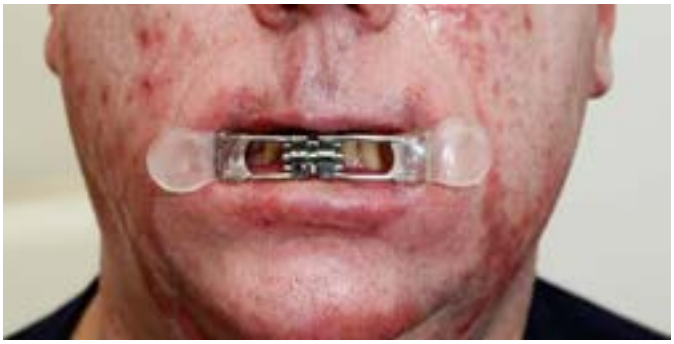

*Figure 5 Activated device in situ*

The face and neck splint were worn continuously to help reduce any hypertrophic scarring, which usually present as raised red itchy painful areas. Hypotrophic scars are easily distinguished from keloid scarring by the fact that the scar growth is confined to the boundaries of the original wound or injury.

The importance of achieving expansion over a longer period was stressed to the patient on fitting this custom-made device. Time was spent explaining how to activate the screw, to turn the screw just one quarter of a turn, to achieve some expansion of the microstomia device. This was shown to the patient and his carers, in hope of negating the possibility of over expansion.

## Discussion

The fit of the splint was excellent, and the patient reported this device was markedly smaller than his previous silicone splints and therefore much more comfortable to wear. The targeted fit of the splint, utilising the commissures of the mouth, achieved good retention, a comfortable fit and the desired expansion. Any further expansion was then controlled primarily by the patient. With this adapted treatment plan approach, hospital visits could be less frequent, but with the express instruction for the patient to contact the department should there be any contraction issues or problems with the expansion splint. This microstomia splinting therapy remains ongoing, being worn daily, and is reported to be maintaining good mouth opening and is comfortable to wear.

This technique can be transferable with good patient compliance. This adaptation of a conventional expansion technique has proven to work, is comfortable to wear, and the lips and skin are adapting well at this expansion rate. Overall the patient reports mouth opening to be less restricted, enabling improved speech and eating.

Hypertrophic scars usually develop within weeks following the initial trauma or injury and may take several months or even years to eventually become pale and flattened out. Patient compliance is a vital factor when wearing combined face and neck splints, and in this case resulted in a pleasing aesthetic outcome in this area in a short space of time. Furthermore with continued splint therapy the hypotrophic scarring has been significantly reduced.

Targeting the commissure area allowed successful expansion of the mouth thus ensuring surgical intervention, such as a commissuroplasty was not required.[4]

## Conclusion

This paper described the manufacture of a microstomia splint incorporating an orthodontic rapid maxillary expansion screw. The manufacture technique, materials and indications for were described and mouth opening is reported to be less restrictive.

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# Technical Note - Construction of artificial eyes – a duplication method

Karen Boyd MIMPT GCGI

Corresponding author: Karen Boyd
Aberdeen Royal Infirmary, Foresterhill, Aberdeen AB25 2ZN
email address: karenboyd@nhs.net

## Abstract

Existing artificial eye wearers are commonly unwilling to try or wear anything new. This technical note describes a method of using the patient's original artificial eye prosthesis to create an identically shaped replacement eye but with an updated, more accurate fitting surface. This 'compromise' in treatment planning can alleviate patient's anxiety, and dependency on their primary prosthesis when making a new artificial eye.

## Introduction

Artificial eyes need to be replaced for a variety of reasons. The socket changes over time in addition to the surrounding features. Prosthetic eye users often experience lower lid laxity, and a sagging inferior fornix may inhibit good placement or retention of an ocular prosthesis. The ageing process also can affect the fit of a prosthesis, a descent of the lateral canthus, sagging of the tissues and gravitational descent of the lateral canthus and eyelids. The ability to retain an ocular prosthesis in place becomes more and more challenging as lid laxity progresses.[1] Furthermore the aesthetics of the ocular prosthesis must be kept in line with common age-related corneal degeneration, such as the development of an arcus senilis, which is frequently found in our long-term eye users.

Eye socket changes over time may result in voids or pockets behind an ill-fitting eye which could allow discharge pooling, a breeding ground for bacteria.[1] Long-term use of Polymethylmethacrylate (PMMA) can show evidence of crazing, surface blemishes or scratches and signs of some material break down. These changes could affect the appearance of the prosthesis and increase micro trauma within the eye socket and ultimately the comfort of the prosthesis.

Routinely many patients attend clinic still wearing their 'old favourite' artificial eye despite having had better fitting new replacement prostheses provided. Patients often revert to wearing their trusted original eye rather than adapt to a new prosthesis.

This syndrome has been referred to as Primary Eye Prosthesis Dependency (PEPD).[2] Haylock found that patients generally consider their original prosthesis to be correct and are unable to accept any of the benefits of having a new prosthesis.

This paper describes a technique adapted from the principals of the duplicate denture technique, which has been found useful for some PEPD patients.[3]

The case presented is of a long-term PEPD patient from our clinic who over many years refused to wear any new prostheses, always preferring to revert back to wearing her original eye. Thus the duplicate eye technique was undertaken, as a compromise, to see if these hurdles could be overcome.

## Materials and method

Firstly, the artificial eye is removed from the eye socket, decontaminated and prepared for duplication as a two-part mould, using lab putty (Finopaste, Wrights Dental Supplies, Dundee, UK). Wax is added directly onto the pupil to indicate the position of the iris pupil unit at a later stage. The eye is enveloped in putty and when set, the mould is carefully divided using a scalpel to introduce location keys in the putty matrix as shown in *figures 1 & 2.*

*Figure 1 Patient with right artificial eye removed for duplication*

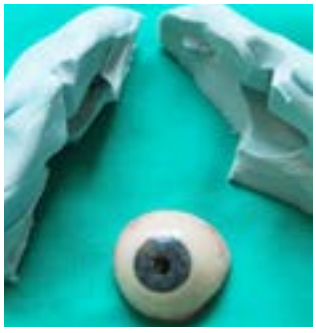


*Figure 2 Artificial eye with duplicate putty mould*

The eye should then be removed from the mould, polished and sterilised before returning to the patient. At the same appointment, an iris unit is selected and painted to match the patient's eye.

Ocular wax (OPS,Crawely, UK) is then melted and poured into the mould and allowed to cool. Once set, the pattern is removed from the putty and smoothed. The duplicate wax pattern is then sterilised and tried back into the patient's socket.

Any small adjustments to the wax pattern can be made at this stage. Next, the pattern is removed and a small hole is made through to the other side of the wax pattern, close to the centre, *figure 3*. The hole must be accessible whilst the wax pattern is in the socket.

*Figure 3 Hole for insertion of impression material*

The pattern is re-inserted into the eye socket and the impression material is gently applied through the hole into the back of the eye socket, the fit surface, as shown in *figure 4*. The impression material is applied until the material is seen to gently ooze from under the wax pattern and slightly around the sides, (Doric impression material, Davis Schottlander, Letchworth, UK). Gentle pressure is applied to the wax pattern throughout the impression technique to ensure that the socket is not over filled, any excess material can be expelled through void in the centre of the wax pattern. During impression setting, the pupil alignment is verified with the patient's existing eye.

*Figure 4 Impression technique*

Once set the wax pattern is then removed and tidied up by cutting away any excess material from around the wax pattern. The pre-painted iris unit can now be positioned onto the wax in the usual manner. The pattern is tried in once more to confirm the iris pupil (IP) alignment and that the IP unit's orientation in the socket is correct.

Once satisfied that the correct position has been achieved, the eye is finished in the normal manner. The scleral acrylic with any over painting, sclera shading or veining is added before the clear PMMA lens covering. The finished eye can now be fitted, as shown in *figure 5*.

*Figure 5 New eye fitted*

## Results and discussion

The result was very pleasing to the patient, although the eye filled the socket more, the overall shape of the eye was very similar to her primary eye. Furthermore at the three month review appointment the patient was still wearing her new eye and had not reverted to her old favourite one. The patient reported that it had still taken some getting used to, but the fact that it was nearly an exact copy of her original eye meant she was more willing to persevere. This technique may not be ideal, but it is preferable to long-term artificial eye patients wearing timeworn, ill-fitting prostheses, who remain unwilling to try anything new.

## Conclusion

This paper has addressed some of the issues frequently experienced in long-term prosthetic eye users and patients with PEPD. Overall the result achieved by using this duplication method has proven successful.

### References


1. Worrell E. What factors affect Maxillofacial Prosthetists in the rehabilitation of the anophthalmic patient – Part 3.Part 3 of 3 in an ocular prosthetic series. Maxillofacial Prosthetist. WCA Journal Summer 2014 Vol. 1 Issue 1 pg 17-20. ISSN2056-3957
2. Haylock C. Primary Eye Prosthesis Dependency. Journal of Maxillofacial Prosthetics and Technology Vol 5; Issue 1: P35-36 2002.
3. Soo S, Cheng AC. Complete Denture Copy Technique – A Practical Application. Singapore Dental Journal Vol 35; P65-70, December 2014.

# Articles of interest

Compiled by Emma Worrell & Caroline Reed

Welcome to this edition's 'articles of interest' page, which aims to highlight recent articles. Interestingly more 3D articles within our field are now published.

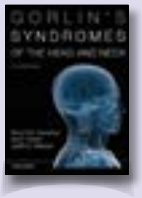
Maxillofacial Rehabilitation – Prosthodontic and Surgical Management of Cancer-related, Acquired, and Congenital Defects of the Head and Neck.

*Beumer III, John. Marunick, Mark T. Esposito, Salvatore J.*

Quintessence Publishing

**ISBN 978-0-86715-498-6**

This textbook offers a comprehensive look at the topic of maxillofacial rehabilitation. It is an evidence-based textbook with emphasis on a multidisciplinary approach to treatment and provides insights into the latest developments in maxillofacial prosthetics, reconstructive surgery, dentistry and tissue engineering. Individual chapters cover rehabilitation of defects in the maxilla, mandible, tongue and soft tissues, through to congenital defects. The reader will take away practical knowledge of state-of-the-art treatment techniques.



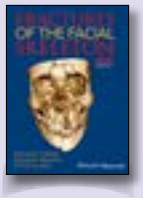
Gorlin's Syndromes of the Head and Neck..

*Hennekam, Raoul.C.M, Allanson, Judith. E. Krantz, Ian.*

Oxford University Press 5th Ed. 2010

**ISBN 978-0195307900/0195307909**

This classic text covers over 700 different genetic syndromes involving the head and neck. A well-established reference book, whether it be for education or daily reference book within the workplace. This new edition offers more information on genetic dysmorphology and clinical genetics. New headings describe the clinical history, gene base information on the aetiology of each syndrome and its characterisation. Fascinating imagery on each condition make this a useful addition in any maxillofacial rehabilitation setting.



Fractures of the Facial Skeleton.

*Perry, Michael. Brown, Andrew. Banks, Peter.*

Wiley-Blackwell Publishing 2nd Ed. 2015.

**ISBN: 978-1-119-96766-8**

A clear, concise, easy to read overview of the management of maxillofacial injuries. This updated edition includes recent developments within facial trauma management, emergency and early treatment of soft tissue injuries through to major maxillofacial injuries. Great colour illustrations explain the incidence, aetiology, clinical features of different fracture types. The early management of dento-alveolar, maxillary and mandibular fractures alongside their complications are neatly summarised in this new edition.

## Monoscopic photogrammetry to obtain 3D models by a mobile device: a method for making facial prostheses.

*Salazar-Gamarra R, Seelaus R, da Silva JV, da Silva AM, Dib LL.*

J Otolaryngol Head Neck Surg. 2016 May 25;45(1):33.doi: ID.1186/s40463-016-0145-3.

**Keywords:** 123D Catch, 3D photography, Facial prosthetics, Maxillofacial rehabilitation, Oral rehabilitation, Photogrammetry.

An interesting paper on the development of a new approach in obtaining 3D models using photogrammetry. This method makes digital facial impressions of patients with maxillofacial defects for the final purpose of 3D printing of facial prostheses. The facial anatomy was reported to being reproduced with no major irregularities.

## Creating a digitized database of maxillofacial prostheses (obturators): A pilot study.

*Elbashi M, Hattori M, Sumita Y, Aswehlee A, Yoshi S, Taniquchi H.*

J Adv Prosthodont. 2016 Jun;8(3):219-23. Doi: 10.4047/jap.2016.8.3.219 Epub 2016 Jun 17.

**Keywords:** 3D printing, Digitized database, Emergency, Intra-oral scanner, Modelling, Obturators

This study claims to provide a proof-of-concept for the use of digital technology with regard to obturators.
An intra-oral scanner was used to scan the surfaces of an acrylic resin obturator and from this data a simulated obturator model was accurately manufactured, from which a digitized database of obturators can be collated.

## Evaluation of the effect of ultraviolet stabilizers on the change in color of pigmented silicone elastomer: an in vitro study.

*Kheur M, Sethi T, Coward T, Kakade D, Rajkumar M.*

J Indian Prosthodont Soc. 2016 Jul-Sep;16(3):276-81. Doi.10.4103/0972-4052.176535.

**Keywords:** Color change, Maxillofacial prosthesis, pigments, ultraviolet stabilizers

An interesting study comparing and evaluating the effect of ultraviolet stabilizers on the color change of pigmented elastomer. The findings report all groups showed significant changes, and that the addition of UV stabilizers helped reduce color change.

## Do CAD/CAM dentures really release less monomer than conventional dentures?

*Steinmassi PA, Wiedemair V, Huck C, Klaunzer F, Steinmassi O, Grunert I, Dumfahrt H.*

Clin Oral Investig. 2016 Oct 5.
[Epub ahead of print]
doi.10.1007/s00784-016-1961-6.

**Keywords:** CAD/CAM dentistry, Complete dentures, Monomer release, PMMA

This article tests the assumed favourable material properties of CAD/CAM dentures in comparison to conventional denture fabrication. All tested dentures released very low amounts of methacrylate monomer but not significantly less than conventional dentures. Therefore the hypothesis that CAD/CAM dentures release less monomer could not be verified.

## Craniofacial implants at a single centre 2005-2015: a retrospective review of 451 implants.

*Elledge R, Chaggar J, Knapp N, Martin T, White N, Evriviades d, Edmondson S, Parmar S.*

Br J Oral Maxillofac Surg. 2017 Apr:55(3):242-245. doi.10.1016/j.bjoms.2016.11.324. Epub 2017 Feb 16.

**Keywords:** Craniofacial implants, Maxillofacial prosthetics.

A 10 year review of craniofacial endosseous implants examined the impact of radiotherapy, timing of placement and the survival of each implant. A total of 451 implants were analysed, which included 222 auricular, nasal and orbital implants. Lots of interesting points raised but the failure rate of implants in irradiated bone was reported to be significantly higher than in non-irradiated bone, a finding found in commonly in the published literature that radiotherapy adversely affects success.

## Novel treatment planning of Hemimandibular Hyperplasia by the use of 3D CAD/CAM technologies.

*Hatamleh MM, Yeung E, Osher J, Huppa C..*

J Craniofac Surg.2017 Jan 23; doi 10.1097/SCS.0000000000003438.

**Keywords:** Hemimandibular hyperplasia, CADCAM,

A novel methodology of applying 3D CAD/CAM principles, in improving the outcome, for 2 mandibular hyperplasia patients is described. Concluding that 3D technologies are accurate and reliable methods in the diagnosis, treatment planning and design of cutting guides, that optimize surgical correction.

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## Conclusion

A brief summary of the paper and what it has achieved.

## References

The accuracy of references is the responsibility of the author. References should be entered in the Vancouver style, superscripted after the appropriate text and in numerical order at the end of the sentence.

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The actual references are then placed at the end of the article in numerical order as they appear in the text for the reader's convenience. References to journal articles should include the author's surname and initials. List all authors when five or fewer. If six or more, list the first three then "et al". Follow this with the full title of the article, journal title abbreviations only e.g. Journal of Dental Research should be written J Dent Res. Followed by the year of publication, edition and /or volume number and first and last page numbers.

For example:
1. Kingsmill VJ, Boyde A, Davis GR, Howell PG, Rawlinson SC. Changes to bone mineral and matrix in response to a soft diet. J Dent Res. 2010, 89 (5): 510-4

References to books should be set out as follows:
1. Ward Booth P. Maxillofacial surgery. 2nd ed. Churchill Livingstone. Dover M. Advanced oral implantology. Chap 80. 1550. 2007

Electronic citations should be set out as follows:
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Electronic journal articles
1. Morse SS. Factors in the emergency of infectious diseases. Emerg Infect Dis 1995 Jan-Mar:1(1). www.cdc.gov/nciod/EID/vol1no1/morse.htm (accessed 5 Jun 1998).

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1. Vole P, Smith H, Brown N, et al. Treatments for malaria: randomised controlled trial. Ann Rheum Dis 2003:327:765–8 doi:10.1136/ard.2003.001234 [published Online First: 5 February 2002].

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