Title page

Title:

3D Photography and Computer Modelling in Nasal Reconstruction

Authors:

Dr Ryan Faderani, MBBS, BSc[1, 2]

ryanfaderani@gmail.coma

Mr Prateush Singh, MA MBBChir MRCS[2, 3]

singh.prateush@gmail.com

Prof. Eva Krumhuber, PhD[4]

e.krumhuber@ucl.ac.uk

Prof. Afshin Mosahebi, MBBS MBA PhD FRCS(Plast)[2, 3]

a.mosahebi@ucl.ac.uk

Mr Allan Ponniah, MBBS, MSc, FRCS(Plast)[2]

aponniah@gmail.com

Affiliations:

[1]Faculty of Medical sciences, University College London, UK

[2]Department of Plastic and Reconstructive Surgery, Royal Free NHS Foundation Trust Hospital, London, United Kingdom

[3] Division of Surgery & Interventional Science, University College London, UK

[4]Department of Experimental Psychology, University College London, UK

Corresponding author:

Dr Ryan Faderani, MBBS BSc

Department of Plastic and Reconstructive Surgery, Royal Free NHS Foundation Trust Hospital, London, United Kingdom

Email: ryanfaderani@gmail.com

Phone number: +44(0)7714230424

Short running title

3D photography in nasal Reconstruction

Conflicts of interest/financial disclosure

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

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All listed authors contributed to; 1) conception and design, acquisition of data, analysis, and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; 3) final approval of the version to be published; 4) agreement to be accountable for all aspects of the work.

Key words

Reconstruction, 3D photography, Computer modelling, Forehead flap,

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3D photography and computer modelling in nasal reconstruction

Abstract:

Advances in high resolution 3D photography and computer modelling are revolutionising patient workup, surgical planning, patient satisfaction, clinical outcomes, and surgical training.

We present a case in which this technology is utilised for a patient undergoing a forehead flap for reconstruction of a nasal defect, allowing us to develop a novel reconstructive algorithm. 3D photographs were taken pre-operatively, a computer model rendered and follow up photographs taken at each stage of the reconstruction using a Vectra XT camera. Patient satisfaction was measured qualitatively postoperatively.

Prior to each stage we were able to use the 3D photographs to make thorough preoperative plans whilst minimising the number of outpatient appointments the patient required. With the images always at hand, we had much more time to make measurements and consider alterations. Utilising the 3D models in clinic and MDT allowed us to have more insightful outpatient appointments, in which we were able to discuss and illustrate each subsequent stage.

The use of 3D photography and computer modelling allows for a greater level of care to patients by improving understanding and satisfaction and alleviating anxiety. It also reduced operative time, improves surgical planning, and acts as an excellent resource for surgical trainees and future patients.

Intro:

Advances in high resolution 3D photography and computer modelling are revolutionising patient workup, surgical planning, patient satisfaction, clinical outcomes, and surgical training. (1,2) Facial defects are complex and often multilamellar, limiting the use of 2D photographs in accurately illustrating the true extent of the defect. (3) This is turn limits the usefulness of multidisciplinary discussion, surgical training and planning, and patient understanding as to the full extent of their reconstructive requirements.

At our plastic surgery unit, we are embracing clinical photography and 3D modelling by integrating it into all craniofacial reconstructive cases. In this paper we present a case in which this technology and reconstructive algorithm is utilised for a patient undergoing a forehead flap for reconstruction of a nasal defect. A 71-year-old woman underwent Mohs micrographic surgery for a large, infiltrative basal cell carcinoma (BCC) on the right nasal sidewall, leaving her with a large trilamellar defect (figure 1). Given the extent of the defect, and a background of chronic smoking, the decision was taken to plan a 3-stage reconstruction. (4) 3D photographs were taken pre-operatively, a computer model was rendered and follow up photographs taken at each stage of the reconstruction (Figure 1 - 4) using a Vectra XT camera. This was beneficial in illustrating the reconstructive journey to the patient and in surgical planning and training.

In the first stage (figure 2) we utilised a septal mucosa turn over flap, added a conchal cartilage graft, and raised and inset a paramedian forehead flap. In the second stage (figure 2), the flap was thinned, and the contour improved. In the third stage the pedicle was divided, and further contouring was done (figure 3).

One month following completion of the final stage of the operation, our patient completed a modified FACE-Q craniofacial questionnaire, which showed high satisfaction in her appearance, functions (breathing, eating/drinking, eye functions and facial functions such as smiling, frowning, and speaking), health-related quality of life (appearance related distress, psychological and social functions) and experience of care.

Our modifications to the experience of care section included specific questions regarding the use of 3D photography in the patient journey.

Discussion:

Prior to each stage we were able to use the 3D photographs to make thorough preoperative plans whilst minimising the number of outpatient appointments. With high resolution, 3-D images always at hand, there was ample time to take and check measurements and plan reconstructive stages. This meticulous planning in turn resulted in reduced intraoperative time. Utilising the 3D models in clinic and MDT allowed us to have more insightful outpatient appointments, in which we were able to discuss and illustrate each subsequent stage. Using questionnaire analysis, our patient reported that the use of 3D photography had given her an improved, insightful understanding of the stages involved in her reconstructive journey; a significant improvement to the comprehensive difficulty she had originally faced when procedural steps were initially explained in clinic with the aid of 2D photographs. Furthermore, she reported this to be greatly beneficial in reducing her pre-operative anxiety. She also suggested the use of her images as an educational resource for other patients undergoing forehead flap reconstruction of the nose. For many patients it is difficult to develop a conceptual and morphological understanding of the involved stages of a forehead

flap reconstruction; a greater conceptual understanding is achievable when one can explain the stages of the reconstruction with 3D images.

Our patient's images were also used as a training resource for a group of 10 surgical trainees with registrar level experience in forehead flap reconstruction. All trainees stated that the use of 3D photographs significantly improved their conceptualisation of the operation. Several trainees also stated that they found the images more useful than procedural videos due to the dynamic ability to manipulate the 3-dimensional point of view.

Conclusion:

The use of 3D photography and computer modelling allows for a greater level of care to patients by improving understanding and satisfaction and alleviating anxiety. It also reduces operative time, improve surgical planning, and acts as an excellent resource for surgical trainees and future patients. As a safe and innovative, non-invasive option, this has become the mainstay management algorithm for our craniofacial patients. We plan to now create a databank of 3D photographs for several craniofacial procedures that can serve as an educational resource for both surgeons and patients. Through PROMS assessments such as the FACE-Q questionnaires we are monitoring improvements in patient satisfaction when passing through this reconstructive journey. (5) Further areas of development would be in the use of intraoperative 3D photographs as well as the use of augmented reality in combination with these photos as an educational tool. As the technology progresses, automating reconstructive stages and outcomes will become the gold standard.

Conflicts of interest/financial disclosure

The authors declare that they have no conflicts of interest to disclose.

Statement of human and animal rights/ethical approval

Not applicable

Informed consent

The patient has given written consent for the use of photos and case – available upon request.

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Figure Legends

Figure 1: Pre and post Mohs excision of BCC on right nasal alar subunit in 71-year-old female patient; leaving her with a trilamellar defect.

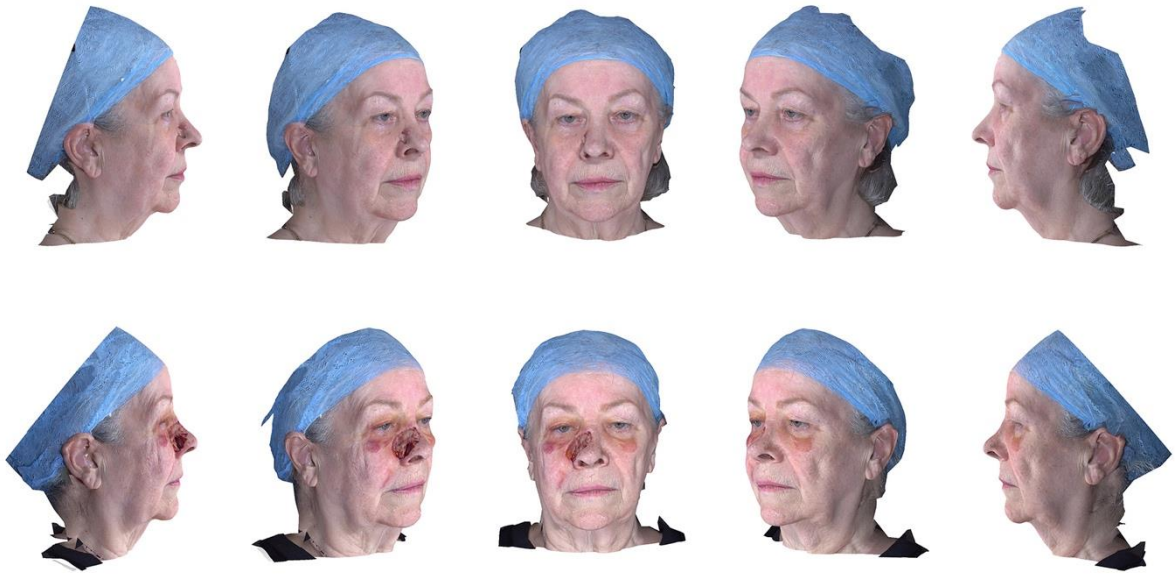

Figure 2: Following stage 1 and stage 2 of forehead flap reconstruction. Here, in stage 1 we utilised a septal mucosa turn over flap, added a conchal cartilage graft, and raised and inset a paramedian forehead flap. In the second stage, the flap was thinned, and the contour improved

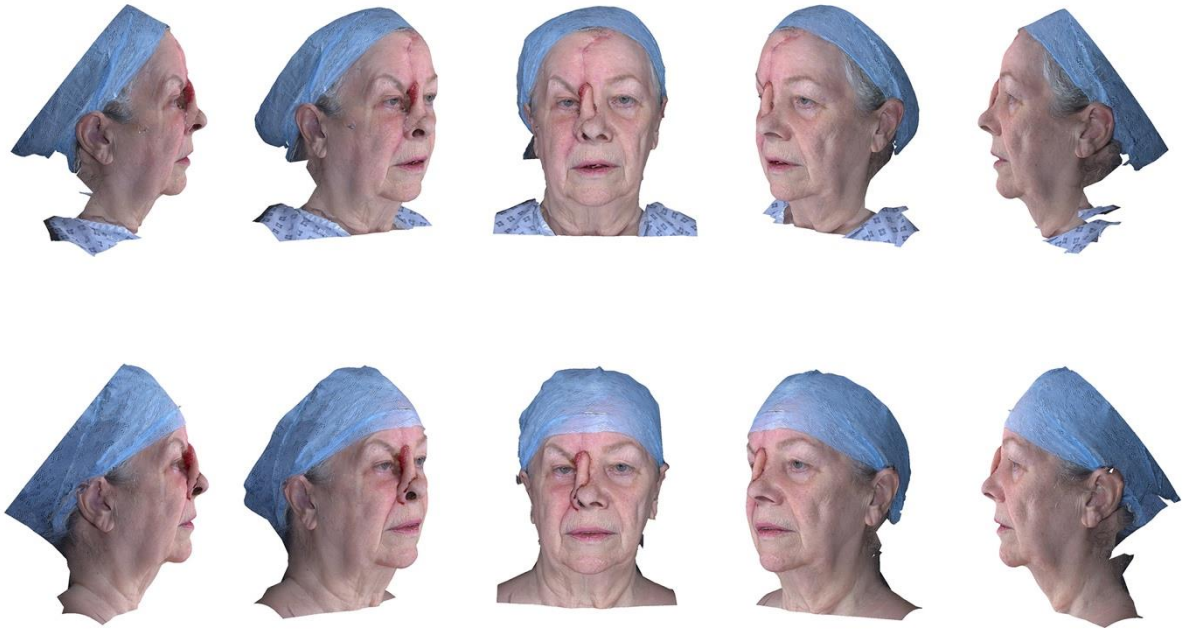

Figure 3: Following stage 3 of forehead flap reconstruction. Here, the pedicle was divided, and further contouring was done.

Figure 4: The patient journey. Computer modelled 3D photographs showing all the stages our patient went through chronologically.