et al. as well as Agarwal et al.[2,3] The measurement tool should be validated in the future as a measurement tool for assessing plastic surgery scope of practice.

Our findings indicate that a single succinct information session is an effective means of educating students on the scope of practice of plastic surgeons and increasing general and research interest in plastic surgery. From our experience, a career night event hosted by plastic surgery faculty and residents is an effective means of promoting awareness and understanding of the field of plastic surgery, and provides a valuable networking opportunity among medical students, residents, and staff plastic surgeons.

Conflict of interest

None.

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A fast and improved method of rapid prototyping for ear prosthesis using portable 3D laser scanner

Dear Sir,

Introduction

When reproducing an anatomically correct morphology of an ear, operators usually face difficulty in wax sculpting. This procedure is extremely time consuming and operators had to rely on skilled artistic approaches. Furthermore, to achieve an acceptable result, it is essential to recreate a mirror image of contralateral healthy side in the defect portion.[1–3]

A review of the literature has highlighted a computer-assisted rapid prototyping technique to sculpture facial prostheses.[4–8] Several techniques have been reported to fabricate a mirror-image wax cast for maxillofacial prostheses. However, to support these methods, the patient is exposed to considerable amounts of radiation under computed tomography (CT) or costly magnetic resonance imaging (MRI) for obtaining three-dimensional (3D) data.[9,10] To overcome this issue, laser-scanning techniques and CAD/CAM systems were used to design and develop auricular prostheses.[11] However, several limitations need to be addressed in terms of laser scanning, such as the cost, size and mobility of laser scanners, and sometimes, the positioning of the subject to the scanner.

This article describes the use of a portable 3D laser scanner in a congenital ear defect case; where a model of the opposing healthy ear was simultaneously scanned from different directions. The obtained data was mirrored, followed by 3D printing of the prosthesis. This system is both portable and easy to use.

Technique

Impression

1. A combination of a light and regular body of polyvinyl siloxane (Aquasil, Dentsply, USA) was used to take the impression of defect side. For the non-defect side's impression, alginate (Kerr, Switzerland) was used (Figure 1).
2. A model of the non-defect side and a refractory cast of the defect side was made using dental stone type IV (Suprastone, Kerr, Switzerland).

Data accession

3. Using a portable laser scanner (Next Engine Desktop 3D Scanner, model 2020i, NextEngine Inc., Santa Monica, CA) the ear cast was scanned. The scanner was connected to a laptop (Dell Precision M4800, Intel Core i7-4600M CPU @ 2.90GHz, 8 GB RAM, Dell Inc., Texas) to

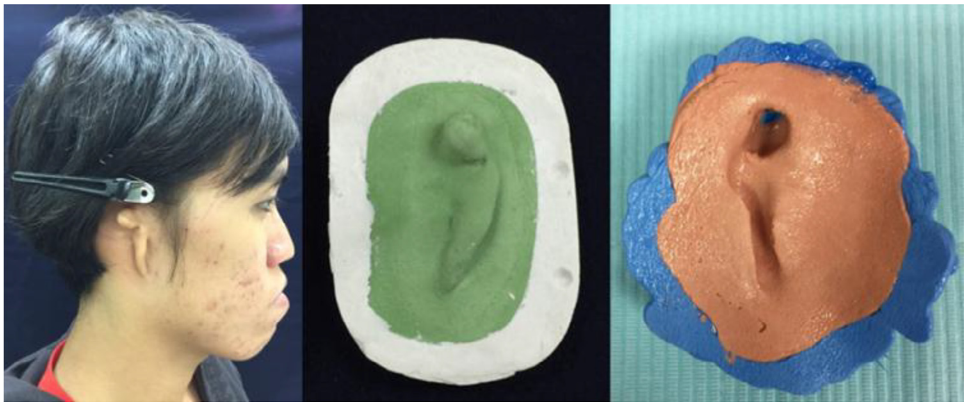

Figure 1 Impression of defected ear.

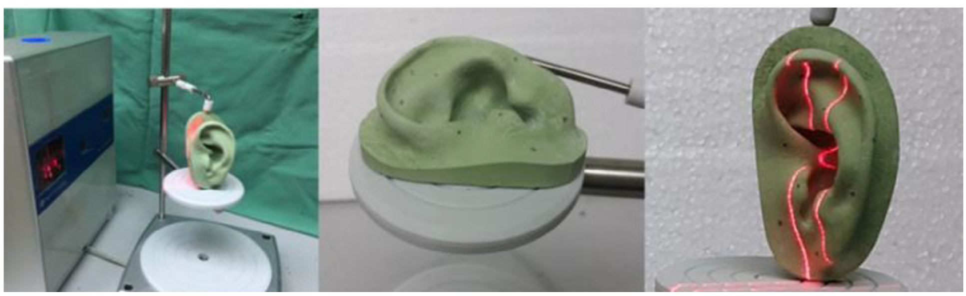

Figure 2 Scanning of normal ear cast.

acquire the 3D images and coordinates using built-in software (NextEngine ScanStudio Pro software) (Figures 2 and 3).

4. The cast was positioned in two ways. Several dots were placed on the cast using a pencil to align the images later. Every position was scanned using 16 angles – making 32 angles overall for 2 positions – in order to increase the precision of the scan.
5. The data was captured as a set of XYZ points, which were then automatically converted into a mesh surface comprised of triangles.

CAD/CAM technology and rapid prototyping procedure

6. The 3D scanned data was imported into Rapidworks64, Version 4.1.0 (3D System, Inc., Rock Hill, USA); which also came with the Next Engine 3D Scanner.
7. The Mesh Buildup Wizard was used to merge 2 differently positioned images. After preparing the images, editing the noise, and aligning the image based on the (pencil) dots with the corresponding one in the other position, the 2 images were finally merged.
8. The Mesh mode was used to repair various defects in the mesh using the healing wizard. The editing tools were used to refine the scanned data or remove noise.
9. A mirror image was created by applying the mirrored mesh function (Figure 4a).
10. Split function was used to cut the base (Figure 4b).
11. Mesh was in surface mode; which was very thin for 3D printing.
12. The model was created using the Thicken function i.e., thickening the entire mesh to create a thin-walled mesh by 2-mm (Figure 4c).
13. It was then exported to STL format.
14. The model with the correct dimensions, anatomy and angulation was printed (Figure 5) using Objet30 Scholar 3D Printer (Stratasys, Eden Prairie, MN) (Figure 6).
15. Industrial grade silicone (Aftek industrial grade silicon, NSW, Australia) was used to produce a mould from the 3D printed model by negative impression. The silicone mould had the exact dimensions, anatomy and angulation as the printed model (Figure 7a). Industrial grade silicone was the choice of material for the mould as it was cheaper and had better stability during removal of wax replica in the next step.
16. A wax replica was created by pouring molten modelling wax (Modelling wax, Dentsply, USA) into the silicone mould (Figure 7b). The wax replica was adapted onto the refractory cast of defective side; and used for final try-in for checking the fitting surface to the soft tissue of the patient and to modify the angulation and positioning of the future prosthesis compared to normal ear (Figure 7c). The adaptability and easy manipulation of wax always make it convenient to perform the adjustments in the try-in stage. Consequently, the three-piece mould was produced using the wax replica (Figure 8a).