in their practices to help patients understand what their surgical result following rhinoplasty may look like. The development of polymer filaments, laser, and computer-aided design has permitted the creation of three-dimensional (3D) scanning and printing technology. Most recently, 3D domestic scanning and printing has become available. This new technology allows the surgeon and the patient to view a sculpture of the nose. The labored mould can be palpated, rotated and viewed from many angles, this technology goes beyond a simple 3D-shaded visualization on a flat monitor.

PURPOSE: This study was aimed to describe an objective method of domestic 3D scan and print of the patient's actual anatomy to use as an intra-operative aid.

METHODS: Patients undergoing rhinoplasty had preoperative facial scan taken. The reference model was then cropped, trimmed and solidified using a 3D software on the patient scan. The file was then transferred to a 3D printer in order to create a statue of the nose with Polylactic Acid filament prior to the surgery. This sculpture is taken to sterilization, then it can be used trans-operatively in order to help surgeon to compare the obtained results following his maneuvers, to check his adherence to the surgical plan and to improve his surgical decision-making.

RESULTS: The creation of a three-dimensional nose sculpture were performed in twenty patients. All of them were caucasian, the average age was 41 years old, and 85% were female. 75% of the cases were primary rhinoplasty.

No patients in this study developed infection post-operatively, and there were no major complications (eg, necrosis).

CONCLUSION: The application of 3D printing of the patient's actual anatomy to use as an intraoperative aid proves to pose a positive effect on the treatment of aesthetic nose disorders, whereas prospective controlled study with larger samples is needed to explore and elucidate the efficacy of this technology.

Validation of Vectra 3D Imaging for Quantitative Volumetric Measurement of Upper Extremity Lymphedema

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INTRODUCTION: Secondary lymphedema of the upper limb is a common sequela following lymph-adenectomy during oncologic surgery. The gold standard for evaluating treatment outcomes in upper limb lymphedema is limb volume measurement, with tape measurement being the method most commonly used. However, current techniques lack sensitivity to localized changes. In this study, the Vectra 3D imaging system was utilized to accurately and precisely obtain volume measurements of the upper limb in patients with lymphedema.

METHODS: A feasibility study was performed in 11 patients with lymphedema and 22 upper extremities; 24 arms were evaluated in total. Three-dimensional images were taken of the upper extremities and Vectra 3D software was used to calculate the volume of the hand, forearm, and upper arm. These measurements were compared to traditional circumference (tape) and water displacement measurements.

RESULTS: The twenty-four arm volumes ranged from 1517 to 4050 cc. The Vectra 3D provided precise and accurate volume measurements (average standard deviation ±1.0% of total volume). Measurements of the forearm and upper arm correlated with circumference measurements ($R^2 = 0.991$) and were in good agreement, with the mean difference between measurement techniques being 2.8±2.0%. Three-dimensional measurements of hand, forearm, and upper arm correlated with water measurements ($R^2 = 0.990$) and had a mean difference between measurement techniques of 2.6±2.1%.

CONCLUSION: The Vectra 3D system provides precise and accurate data comparable to the most commonly used technique to estimate limb volume (tape measurement) and gold-standard water volume measurement. Three-dimensional imaging also offers several advantages, including time efficiency and obtaining localized measurements with high spatial resolution.

Automated Identification of Severity Level of Unilateral Cleft Lip Using Facial Dysmorphology Novel Analysis

Presenter: Meghan McCullough, MD

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INTRODUCTION: There is no universally accepted severity scale for unilateral cleft lip that quantifies the spectrum of disease. Furthermore, measurement systems utilizing calipers are cumbersome, time-consuming and difficult to standardize. Facial Dysmorphology Novel Analysis technology (FDNA, Inc, Boston MA) enables automatic detection and evaluation of subtle craniofacial dysmorphology, as well as recognizable facial patterns associated with multiple rare diseases, by processing and analyzing regular two dimensional facial photographs. This study serves as a preliminary technical analysis to assess the potential of FDNA's technology to automatically identify severity levels of unilateral cleft lip.

METHODS: 30 frontal facial images of patients with cleft-lip were uploaded to the HIPAA compliant Face2Gene tool. These images were collected on four different Operation Smile missions in Bolivia, Madagascar, Morocco and Vietnam, representing broad ethnic diversity. Three cases were excluded from this cohort due to image problems, leaving a total test set of n=27. In addition, images of unaffected controls (n=100) were collected from independent resources. A severity scale was created based on holistic image analysis, using the proprietary FDNA technology.

RESULTS: FDNA technology demonstrated an ability to able to discriminate between unaffected controls and the affected cohort. Additionally, FDNA demonstrates the ability to recognize a spectrum of severity within cleft cases. Severity index ranged from 0.103 (representing the least severe) to 1.270 (representing the most severe), mean 0.69 (SD 0.29).

CONCLUSION: Current methods of preoperative morphologic evaluation of unilateral cleft lip are subjective and non-standardized, making a universal discussion of disease severity difficult. Additionally, standardized, objective measurements utilizing calipers are difficult to obtain in an awake child. FDNA technology provides the potential for development of a computer-generated cleft severity scale for a rapid, clinically practical, simple and standardized evaluation of preoperative severity.

Optimizing Measurements in Plastic Surgery through Holograms with Microsoft Hololens

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INTRODUCTION: Microsoft HoloLens (HoloLens)™ is a wearable computer headset that enables visualization and interaction with holograms. Using various laser sensors, HoloLens users can take measurements in their surrounding physical space using sterile hand gestures and voice commands. This tool can be applied to clinically and ideally suited to use in the operating room given the hands free nature of the device. In this study, we use typical breast and body measures to investigate the accuracy and reliability of measurements made with HoloLens.

METHODS: Using third-party software (HoloMeasure) with Microsoft HoloLens, holographic lines were projected and measured between the sternal notch to nipple, and areolar horizontal and vertical diameter. The same distances were then measured using a standardized ruler. The mean error of these measurements and the user variability was then calculated. Users were then instructed to take a 9-question survey assessing comfort level, ease of use, and overall satisfaction. Survey responses were graded on a five-point Likert scale, and averages were calculated.

RESULTS: Using Microsoft HoloLens, our group successfully made precise measurements of breast and body parameters routinely used in plastic surgery. The mean error of distance measurements was 4.3% with a SD of 0.71 among the users. The average ease of the voice-activated controls was