3D Imaging Approaches to Analyzing Outcomes of Facial Reanimation Surgery

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Background

• Facial reanimation is the surgical correction of facial paralysis
• Facial paralysis can result from trauma, iatrogenic causes, malignancy, congenital syndromes, infection
• Facial paralysis is a life-altering condition that can result in functional, communicational, and aesthetic deficits
• Facial reanimation is considered the first line treatment for longstanding facial paralysis
• Facial reanimation encompasses several surgical techniques
  • A common technique uses a flap taken from the gracilis muscle of the leg and attaching it to the corner of the mouth and the zygomatic arch, using the masseter nerve as the nerve supply
• The goals of facial reanimation procedures are:
  • Restoration of movement
  • Restoration of facial symmetry at rest and in motion
• Both qualitative and quantitative assessment tools exist to evaluate the achievement of these goals
• Qualitative methods are not sufficient to measure outcomes objectively
• Quantitative methods are not standardized or validated, and no single method is widely utilized. For example:
  • 3D video
  • 3D imaging
• These technologies exist but we have not established one as standard of care, nor have we utilized them to their full potential
• It is therefore unclear whether 3D video is necessary or superior to 3D imaging
• It is also unclear whether 3D imaging or 3D video will replace the current standard of 2D photography and anthropometry
• We therefore present a novel application of a 3D imaging system as it relates to the analysis of outcomes of facial reanimation procedures

Methods

• The 3dMDface imaging system provides a 3D picture of the human face resulting in an accurate, photo realistic external surface image

• Once the 3D images are captured, they can be stored and analyzed using the 3dMD software program
• The following patient was chosen to demonstrate the suitability of the 3dMD system for measuring the outcomes of facial reanimation procedures

• This patient has Mobius syndrome, a congenital syndrome that results in bilateral facial paralysis
• This patient underwent a facial reanimation procedure to the left side of his face 9 months prior to the capture of the following images. The right side of his face has yet to be treated
• The variables we have chosen to measure as most relevant to the outcomes of facial reanimation surgery are:
  • Smile elevation or excursion
  • Graft vector (amplitude and angle)
  • Midface volume

We present a series of images of a patient with Mobius syndrome, a disorder that results in bilateral facial paralysis. At the time these images were captured, the patient had undergone the previously described facial reanimation procedure to the left side of his face.

Discussion

• 3D imaging and video approaches have obvious advantages over traditional 2D imaging approaches in regards to the assessment of outcomes of facial reanimation procedures
• Only 3D analysis can objectively and accurately document the complex movements of the human face
• Replacement of antiquated 2D photography and manual anthropometry is necessary
• It is unclear which mode of 3D imaging will do so
• Additionally, it is possible that some 3D imaging technology is superfluous and need not be used to evaluate outcomes of facial reanimation surgery
• 3D video has the capability to capture 3D motion, measure trajectories, angles, velocity, amplitudes, and sound. However, these systems lack the resolution and sophistication of available 3D imaging technology
• The 3dMDface system is an ideal system to assess the outcomes of facial reanimation surgery because it provides a high-resolution, photorealistic image. Its integrated software is well-equipped to measure the outcomes of facial reanimation surgery, including distances, e.g. smile elevation, angles, graft vectors, and midface volume
• The precision, accuracy, and reproducibility of the 3DMD system have been independently validated
• The 3DMDface system is not able to provide information on velocity or sound; however, these data points are of no particular interest to clinicians seeking only to evaluate the results of facial reanimation procedures
• The 3DMDface camera system is therefore an excellent and reliable means of assessing the outcomes of facial reanimation surgery

References

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