Monitoring Facial Nerve Function with Digital Analysis: a Non-contact EMG Equivalent


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Introduction: Digital Image Skin Correlation (DISC) is an inexpensive imaging technique that can provide physicians with both diagnostic and prognostic data for management and treatment of acoustic neuroma’s (vestibular schwannomas, VS), and other incidents affecting the facial nerves. DISC is non-contact and non-invasive and yet provides information similar to that obtained via electromyography regarding facial muscular enervation. Hence it can be used for early detection of pathologies, such as VS, as well as in cosmetic applications, such as botulism (BTX-A) injections.

Materials and Methods: The technique is simple and easily implemented anywhere, even in the patients home, using an iphone camera and sending the images to the physician from processing. Two sequential images of slight facial motion are obtained, mounted on a head support that we developed. Two studies were conducted to demonstrate the clinical application of DISC. The first involved the detection of VS and monitoring post surgical patient recovery. Two sequential digital images of slight facial motion (smile) were obtained from 29 patients with VS (with and without surgery) and 14 healthy volunteers. The images were processed with DISC to produce spatially resolved vector maps of the muscular displacement. Comparing the patients’ “normal” functional side (non-tumor involvement) to the “affected” side (tumor involvement) the locus and impact on facial enervation was quantified.

A second, 12 months, two stage, double blind, study was conducted to determine the usefulness of DISC in tracking paralysis and predicting the locus of botulism injections. 10 Caucasian women ages 30 to 60, were recruited and injected in two stages with 25 U of BTX-A in the glabellar region. One group was injected using standard protocol, according to “surgeons experience”, where the location of the muscle was determined by physical examination and injections were performed symmetrically. The second group used a DISC guided method: baseline images were taken prior to injection and the locus of maximum tension was determined from the vector images (figure 1 right). Tension was defined as the region where maximal changes occurred in the gradient to the vector. Guided region did not employ symmetry arguments and identified each injection locus separately. In all cases, pictures were taken in follow-up visits at days 3 and 7 and then at weeks 2,3,4, 8, 10, 12, and 24.

Results and Discussion: Comparing the patients’ “normal” functional side (non-tumor involvement) to the “affected” side (tumor involvement) we found that .non-surgical VS patients had facial asymmetry that was five times larger than the control group, (P< 0.0001). The side with the tumor is red, exhibiting hyperkinesis, relative to the normal side. Patients who underwent traditional surgical or gamma knife resection of the VS, had asymmetries that were 10 and 15 fold higher, respectively, than the control group (P< 0.0003), where the affected side was now hypokinetic. In the case of the BTX study, the results (survival curve) clearly show that DISC is an effective method to track paralysis, and in most cases agrees with FLO-11 analysis. The results following DISC guided injections were far more effective than those from empirically determined injections. The paralysis was deeper and lasted 24 weeks vs 8 weeks.

Translational Impact: DISC has been shown to be effective in early screening and detection of VS, at a significantly lower cost than MRI, the current method. DISC is effective in tracking paralysis following BTX injection, and using DISC as a guide for the injection site, allows for a significant decrease in dosing, which minimizes off target effects.

Conflict of Interest: None