

A novel eyelid motion monitor

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Abstract

Background Eyelid motion analysis can provide important information about ophthalmic, neurologic, and systemic diseases. Routine assessment of eyelid function is currently based mainly on clinical examination estimating Levator Function and static palpebral fissure measurements. Most clinical tools developed to date are cumbersome expensive and difficult to operate. Currently there is no widely available, affordable device providing user friendly precision based evaluation of eyelid kinematics. Our goal is to develop a novel device for evaluation of eyelid kinematics providing rapid defined diagnosis of diseases involving eyelid movement.

Methods A real-time prototype eyelid motion monitoring system was designed based on magnetic field sensors detecting movement of a tiny magnet located on the upper eyelid. Motion is recorded and analyzed using specially developed hardware and software, respectively, enabling both real-time and off-line data presentation. The Eyelid Motion Monitor correlates between blinking characteristics of eyelid movement and the output voltages produced by the system. Blink detection is defined as peak in voltage, caused by eyelid closure or opening. The device was tested on 20 healthy volunteers with normal clinical blinking patterns.

Results The Eyelid Motion Monitor succeeded in detecting full blink motion. The system easily extracts different parameters of eyelid kinetics.

Conclusions An inexpensive prototype novel device was developed for monitoring and analyzing eyelid motion characteristics, including the inter-blink interval, eye closing/opening duration and entire blink duration. The device should allow early objective non-invasive diagnosis and follow-up of disease progression. It could be of great potential value in many ophthalmic, neurologic, and systemic diseases.

Keywords Eyelid motion · Blink detection · Monitor device · Magnetic sensor

Introduction

Ophthalmologists, neurologists, and general physicians examine the eyelids and their movements to assess and monitor many ocular and systemic diseases including Ptosis, Thyroid eye disease, Myasthenia Gravis, neurologic diseases such as third and seventh cranial nerve palsy and Parkinson's Disease [1–5]. A user friendly easily available monitor could potentially allow easier recognizable diagnosis and monitoring of disease such as blepharospasm, which is often missed in its early stage causing great suffering to the patient.

It could also be used potentially as a monitoring device to follow progression or regression of a disease such as thyroid-associated ophthalmopathy. Routine clinical measurement of eyelid status and movement is assessed using static metrics measuring levator and orbicularis muscle function. Many different techniques have been used to measure the time course of blinks, using coils, camera, electromyographic (EMG) recording, lever arm and photosensitive position detectors. High speed video recordings have also been used, which record the eyelid motion during downward and upward eyelid saccade [6]. However, to the best of our knowledge there is no readily available clinical device that allows user friendly evaluation of the kinematics of

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