# Determination of corneal biomechanical properties in-vivo using a contact device

Submission date 25/06/2014	<b>Recruitment status</b> Stopped	<ul><li>Prospectively registered</li><li>Protocol</li></ul>
Registration date	Overall study status	Statistical analysis plan
23/07/2014	Stopped	Results
Last Edited	Condition category	Individual participant data
31/03/2016	Eye Diseases	Record updated in last year

# Plain English summary of protocol

Background and study aims

This is a research project that has two studies.

Study A

A Goldmann tonometer (GAT) is the standard method used to measure the internal pressure (intraocular pressure) of the eye by pressing the cornea (the transparent dome-shaped window covering the front of the eye) with a small flat piece. The aim of Study A is to develop a new technology to measure the biomechanical (structural and functional) properties of the cornea. Characterising these properties are vital for treating conditions (e.g. diseases or injury) that effect the corneas ability to maintain its shape and its ability to focus light, and therefore effect an persons ability to see. Corneal biomedical properties also affect how some diseases (for example keratoconus, where the shape of the cornea alters to resemble a cone) are treated, the accuracy of intraocular pressure (IOP) measurements, outcome of eye surgery procedures and the design of contact lenses. Since the new device will come into contact with the eye, anaesthetic must be used before measurements are taken. Here, we want to find out how reliable the new device is and how comfortable it is to use. It is similar to a GAT tonometer, but is operated by a computer and uses a curved contact tip. The device will press against the cornea and move it inward and backward by about half of a millimetre. This will be done 3 times using different loading rates.

# Study B

The aim of this study is to compare corneal stiffness and hysteresis (elastic and viscoelastic) measurements of the new device compare to those taken by another device called the Ocular Response Analyzer (ORA). The stiffness measurements will also be compared to that taken by a new non-contact device called the Corvis ST. The study will also consider the stability of the measurements when the device and the eye are not accurately aligned.

# Who can participate?

The study population will be healthy volunteers and participants with raised intraocular pressure, with or without ocular hypotensive therapy. Patients will be screened against the inclusion and exclusion criteria for the study.

What does the study involve?

Participants recruited to study A will undertake the following assessments:

- 1. General Medical and Ophthalmic History
- 2. Visual Acuity Check (standard check of your vision on a letter chart)
- 3. Biomicroscopy, Ophthalmoscopy, Gonioscopy (standard check of the health of the eye)
- 4. Corneal stiffness measurements with the device under study using three different loading rates.
- 5. Biomicroscopy
- 6. A short questionnaire about comfort during the measurements

Participants recruited to study B will undertake the following assessments:

- 1. General Medical and Ophthalmic History
- 2. Visual Acuity Check (standard check of your vision on a letter chart)
- 3. Biomicroscopy, Ophthalmoscopy, Gonioscopy (standard check of the health of the eye)
- 4. Eye Pressure measurements with Goldmann applanation tonometer and dynamic contour tonometer. (These are the standard clinical methods of checking the eye pressure during a routine visit to the optometrist or eye doctor. We will need to instil one drop of a mild topical anaesthetic, which will wear off after approximately 20 minutes. You are advised to refrain from rubbing your eye until this time.).
- 5. Corneal Hysteresis (CH) and Corneal Resistance Factor (CRF) will be measured by the Ocular Response Analyzer (ORA).
- 6. Corneal force-deformation response measurements using the device.
- 7. The ophthalmic examination is repeated to search for any adverse effects caused by using the prototype.

What are the possible benefits and risks of participating?

Participants will volunteer to participate in this study which aims to derive the stress-strain behaviour of corneal tissue from the in-vivo stiffness measurements. Quantifying corneal mechanical properties is also important when these properties impact on the treatment of diseases such as keratoconus, accuracy of IOP measurements, improving the outcome of refractive surgery procedures and design of contact lenses.

Where is the study run from?

- 1. Ninewells Hospital (UK)
- 2. Moorfields Hospital (UK)
- 3. Aberdeen Royal Infirmary (UK)

The study is managed by the Liverpool Clinical Trials Unit (UK)

When is the study starting and how long is it expected to run for? July 2014 to February 2015

Who is funding the study? Engineering and Physical Sciences Research Council (UK)

Who is the main contact? Mr M Bickerstaff oasis@liv.ac.uk

# Contact information

**Type(s)**Scientific

Contact name

#### Prof Ahmed Elsheikh

#### Contact details

University of Liverpool School of Engineering Brownlow Hill Liverpool Liverpool United Kingdom L69 3GH

# Additional identifiers

EudraCT/CTIS number 2014-002712-16

IRAS number

ClinicalTrials.gov number

Secondary identifying numbers UoL000983

# Study information

#### Scientific Title

Determination of corneal biomechanical properties in-vivo using a contact device: a single-arm, observational study

# Acronym

DetCorBio

# Study objectives

This is an observational study to determine the corneal biomedical properities of patients with high IOP using a novel contact device. The device applies indentation to the participants cornea and monitors the corneal deformation and load to measure the overall stiffness of the cornea. A computer is used to control the device and to store the measurements.

The cornea is a load-bearing tissue whose primary function is to focus light on the retina. The mechanical properties of the cornea are important in maintaining this function under the effect of actions such as intraocular pressure (IOP), eyelid movement and external impacts. Characterising the mechanical properties of the cornea is of critical clinical importance when action is to be taken to remedy deterioration in mechanical performance, caused for instance by disease or injury, and leading to corneal failure to maintain its shape and focus light. Quantifying corneal mechanical properties is also important when these properties impact on the treatment of diseases such as keratoconus, accuracy of IOP measurements, outcome of refractive surgery procedures and design of contact lenses

# Ethics approval required

Old ethics approval format

# Ethics approval(s)

Not provided at registration

# Study design

Single-arm study of a non-CE-marked medical device

# Primary study design

Observational

# Secondary study design

Other

# Study setting(s)

Other

# Study type(s)

Diagnostic

#### Participant information sheet

Not available in web format, please use the contact details below to request a patient information sheet

# Health condition(s) or problem(s) studied

Increased intraocular pressure of eye

#### Interventions

The device applies indentation to the participants cornea and monitor the corneal deformation and load to measure the overall stiffness of the cornea. A computer is used to control the device and to store the measurements.

# **Intervention Type**

Device

#### Phase

Not Applicable

# Primary outcome measure

Study B

- 1. The correlation between the force-displacement measurements made by the device and:
- 1.1. The overall stiffness as estimated mathematically based on the corneas thickness, topography and age
- 1.2.The differences in IOP readings made by two devices; namely the Goldmann Applanation Tonometer or GAT (which is known to be affected by corneal stiffness), and the Dynamic Contour Tonometer or DCT (which is known to be much less affected by corneal stiffness than GAT),
- 1.3. Corneal Resistance Factor, CRF (a stiffness-related parameter) as provided by the Ocular Response Analyzer (ORA).
- 1.4. The stiffness estimate provided by Corvis ST; a recently-released and not yet fully validated, non-contact device.
- 2. The correlation between the tissue hysteresis (difference in stress-strain behaviour under

loading and unloading conditions) measured by the new device and the Corneal Hysteresis (CH) parameter provided by the Ocular Response Analyzer (ORA)

3. Estimation of tissue viscoelasticity

# Secondary outcome measures

Study A

- 1. The reliability and repeatability of the device output
- 2. Comfort of use and tolerance of the new device
- 3. Assessment of general operation of device

#### Overall study start date

01/07/2014

# Completion date

01/02/2015

# Reason abandoned (if study stopped)

Lack of funding/sponsorship

# Eligibility

# Key inclusion criteria

- 1. At least 18 years of age
- 2. Normal findings in the medical history unless the investigator considers an abnormality to be clinically irrelevant
- 3. Normal ophthalmic findings, other than high IOP
- 4. Astigmatism <2D
- 5. Potential to complete the study and comply with appropriate instructions
- 6. Signature on the informed consent form

# Participant type(s)

**Patient** 

# Age group

Adult

# Lower age limit

18 Years

#### Sex

Both

# Target number of participants

70

# Key exclusion criteria

- 1. Corneal pathology or previous intra- or extra-ocular surgery, including refractive surgery (e.g., radial keratotomy, photorefractive keratotomy, LASIK, intracorneal ring), retinal surgery (e.g., buckle, photocoagulation), or implantation of a primary or secondary intraocular lens
- 2. Contact lens wearing within 3 days (rigid contact lenses) or 1 day (soft contact lenses) prior to

# study day

- 3. Inability to fully understand the informed consent
- 4. Participants who are diabetic

# Date of first enrolment

01/07/2014

# Date of final enrolment

01/02/2015

# Locations

# Countries of recruitment

England

**United Kingdom** 

# Study participating centre University of Liverpool

Liverpool United Kingdom

L69 3GH

# Sponsor information

# Organisation

University of Liverpool (UK)

# Sponsor details

University of Liverpool / Liverpool Joint Research Office 2nd Floor Block D Waterhouse Building 3 Brownlow Street Liverpool

England

United Kingdom

L69 3GL

# Sponsor type

University/education

# **ROR**

https://ror.org/04xs57h96

# Funder(s)

# Funder type

Research organisation

#### Funder Name

Engineering and Physical Sciences Research Council

# Alternative Name(s)

EPSRC Engineering & Physical Sciences Research Council, UKRI Engineering and Physical Sciences Research Council, Engineering and Physical Sciences Research Council - UKRI, Engineering & Physical Sciences Research Council, The Engineering and Physical Sciences Research Council (EPSRC), EPSRC

# **Funding Body Type**

Government organisation

# **Funding Body Subtype**

National government

#### Location

**United Kingdom** 

# **Results and Publications**

# Publication and dissemination plan

Not provided at time of registration

Intention to publish date

Individual participant data (IPD) sharing plan

IPD sharing plan summary