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Programa de Doctorado en Óptica, Optometría y Visión

ESCUELA DE DOCTORADO
UNIVERSIDAD COMPLUTENSE DE MADRID

FACULTAD DE ÓPTICA Y OPTOMETRÍA
UNIVERSIDAD COMPLUTENSE DE MADRID

Índice

PRÓLOGO

Hemos llegado a la octava edición de nuestro congreso, el 8º PhDay- FOO, organizado por y para los doctorandos de la Facultad de Óptica y Optometría de la Universidad Complutense de Madrid. Una iniciativa enriquecedora en la que estos jóvenes científicos podrán presentar sus investigaciones al resto de sus compañeros predoctorales y a toda la comunidad universitaria que desee disfrutar de este evento.

A través de varias sesiones de presentaciones orales y en formato póster, nuestros doctorandos mostrarán la gran diversidad y riqueza de las líneas de investigación incluidas en nuestro programa de doctorado. Se pretende promover el desarrollo de las carreras científicas de los doctorandos, contribuyendo a mejorar sus habilidades de comunicación y facilitando la difusión de su trabajo. Además, el PhDay constituye un excelente foro para intercambiar nuevas ideas y establecer relaciones y colaboraciones entre grupos de investigación.

Los estudiantes que se han incorporado recientemente al programa no deben faltar a esta jornada al tratarse de una estupenda toma de contacto con la que será su labor académica-investigadora en los próximos años hasta desembocar en la presentación de su tesis doctoral. Igualmente, los doctorandos más veteranos, gracias a su mayor experiencia podrán apreciar el gran trabajo que hay detrás de cada presentación.

Además de los propios estudiantes de doctorado, este evento es especialmente interesante para los Estudiantes de Máster por ser ellos la cantera de futuros doctorandos del multidisciplinar Programa de Doctorado en Óptica, Optometría y Visión. Si eres un estudiante de Máster, en pocos meses te encontrarás con la opción de proseguir tu trayectoria como universitario hasta alcanzar el máximo nivel de estudios y ser Doctor, y esta jornada PhDay-FOO te puede ayudar a tomar esta decisión.

Profesores, estudiantes de últimos años de Grado, PAS de la Facultad de Óptica y Optometría son también bienvenidos a este congreso para profundizar en las diversas líneas de investigación vinculadas a nuestro Programa de Doctorado de la mano de sus protagonistas.

Desde el Equipo Decanal de la Facultad de Óptica y Optometría y en particular, como Vicedecana de Posgrado e Investigación y Coordinadora del Programa de Doctorado, quiero agradecer la buena acogida que esta iniciativa ha tenido entre los doctorandos en las diversas ediciones y en especial, en esta 8ª edición. Igualmente, me gustaría agradecer al Comité Organizador (Alejandro Casillas, Clara Lim y Gonzalo Valdés) toda su dedicación, ilusión y profesionalidad. Sin ellos sería imposible el desarrollo de este evento centrado en la difusión científica y el intercambio de experiencias entre los doctorandos.

Mar Martín-Fontecha Corrales

Coordinadora del programa de doctorado en Óptica, Optometría y Visión
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AGRADECIMIENTOS

El Comité Organizador quiera agradecer tanto a la Escuela de Doctorado como a la Facultad de Óptica y Optometría de la Universidad Complutense de Madrid, la oportunidad de contribuir a la organización de la 8ª Edición del PhDay FOO. Ello ha permitido la adquisición de nuevas competencias relacionadas con el desarrollo de eventos de difusión científica.

Queremos dar las gracias también a todos los compañeros que han participado, ya sea, como ponentes o como asistentes en esta nueva edición del PhDay, ya que sin su colaboración y sus aportaciones todo esto no sería posible.

En último lugar, nos gustaría reconocer el esfuerzo del comité científico que ha permite que todos los trabajos sean valorados de forma objetiva, justa y transparente, dedicando todo su tiempo a evaluar y poder otorgar así los merecidos premios a los participantes.

COLABORADORES INSTITUCIONALES

COMITÉ ORGANIZADOR

Alejandro Casillas Rubio

Graduado en Óptica y Optometría y Máster en Tecnologías Ópticas y de la imagen por la Universidad Complutense de Madrid.

Clara Lim

Graduada en Ciencia e Ingeniería de Materiales por la Escuela de Minas de Nancy (Francia).

Gonzalo Valdés Soria

Graduado en Óptica y Optometría por la Universitat de València. Máster en Optometría y Visión por la Universidad Complutense de Madrid.

COMITÉ CIENTÍFICO

José Antonio Gómez Pedrero

Doctor en Ciencias Físicas por la Universidad Complutense de Madrid en 1999. Ha sido profesor Asociado y Profesor Titular de Escuela Universitaria y en la actualidad es Profesor Titular de Universidad del Departamento de Óptica de la Universidad Complutense, estando adscrito a la Facultad de Óptica y Optometría.

Su área de investigación es la Óptica Aplicada con especialización en el diseño y puesta a punto de nuevas Técnicas Ópticas de Medida, el diseño y caracterización de Lentes Oftálmicas, el desarrollo de nuevos algoritmos de Procesado de Imágenes y de diseño e integración de Sistemas Ópticos, incluyendo sistemas fuera del visible (infrarrojo y óptica de THz). Es autor de 62 publicaciones en revistas indexadas en JCR con revisión por pares, de 2 libros científicos y de 17 publicaciones con revisión editorial. Desde octubre de 2024 es *Topical Editor* de la revista *Applied Optics*. Ha participado en 16 proyectos de investigación (2 como IP) competitivos de los cuales 2 son europeos y 11 son nacionales, autonómicos o universitarios. También ha participado como miembro del equipo investigador en 6 contratos con empresas al amparo del Art. 83 de la LOU. Tiene en su haber la dirección de 3 tesis doctorales, 7 trabajos fin de master y 4 trabajos fin de grado. Ha sido director entre 2010 y 2014 de la Sección Departamental del Departamento de Óptica en la Facultad de Óptica y Optometría y secretario de dicha Sección entre 2009 y 2010. En la actualidad, es miembro de la Comisión de Máster y Doctorado de la Facultad de Óptica y Optometría

Clara Llorens Quintana

Doctora en Ingeniería Biomédica por Wroclaw University of Science and Technology (Polonia) y en Óptica Optometría y Visión por la Universidad Complutense de Madrid. Actualmente lleva a cabo un proyecto de investigación subvencionado por el Instituto de Salud Carlos III bajo el programa "Sello de excelencia ISCIII-HEALTH" en la UCM en el grupo "Clinical and Experimental Eye Research Group". Su actividad investigadora se centra en el procesado de imagen y análisis de datos para desarrollar herramientas de diagnóstico clínico.

Alba Martín Gil

Es Óptico-Optometrista, Máster (2008) en Óptica, Optometría y Visión y en 2016 obtuvo el título de Doctor con la tesis titulada "Mecanismos celulares activados por receptores P2Y2 en los procesos ciliares: Implicaciones en la hipertensión ocular y el glaucoma" con la calificación Sobresaliente "Cum Laude", por la cual obtuvo el premio extraordinario de doctorado de la UCM del curso 2015-2016.

Ha sido profesora en la Universidad de Sevilla y en la actualidad es Profesora Permanente Laboral en la Universidad Complutense de Madrid, donde imparte docencia tanto en el Grado en Óptica y Optometría como en el Máster en Optometría y Visión, del cual es coordinada. Además, ha dirigido y dirige tesis doctorales en la Facultad de Óptica y Optometría. Respecto a su faceta investigadora, forma parte del grupo de investigación Bioquímica del Ojo (Ocupharm-092077). Su actividad investigadora ha estado enfocada en el estudio de la implicación del sistema purinérgico y melatoninérgico en la fisiopatología del glaucoma y la fisiología y fisiopatología de la superficie ocular. Es co-autora de 25 artículos científicos indexados y de una patente de invención, además ha participado en numerosos proyectos de investigación, y en la actualidad es co-IP de un Proyecto del Ministerio de Innovación y Ciencias, centrado en el estudio de la aparición y progresión de la miopía.

Sonia Melle Hernández

Doctora en Ciencias Físicas (2002) y Profesora Titular de Universidad del Departamento de Óptica en la Facultad de Óptica y Optometría de la Universidad Complutense de Madrid (desde 2011).

En la actualidad su actividad investigadora se desarrolla en el Laboratorio de Fotoluminiscencia en Nanosistemas (PhotoLumiNano Lab, UCM) y se centra en mejorar las propiedades luminiscentes de nanopartículas de upconversion excitadas en el infrarrojo cercano para el desarrollo de aplicaciones biomédicas y biosensores. Es autora de más de 70 publicaciones en revistas indexadas JCR de alto índice de impacto que cuentan con más de 3700 citas. Ha dirigido 3 proyectos de investigación y ha participado en 28 proyectos competitivos europeos (2), nacionales (9) y autonómicos (17). Ha dirigido 3 tesis doctorales, 2 trabajos fin de máster y 7 trabajos fin de grado. Ha sido directora de la Sección Departamental del Departamento de Óptica en la Facultad de Óptica y Optometría entre 2021 y 2023. Su docencia se centra en las asignaturas de Física, Óptica Física y Óptica Biomédica; cuenta con 3 evaluaciones docentes muy positivas y ha participado en 9 proyectos de innovación docente.

Elena Salobrar García Martín

Doctora en Ciencias de la Visión, especializada en geriatría, enfermedades neurodegenerativas y el uso de la retina y la visión como biomarcador en patologías del sistema nervioso central. Su tesis doctoral obtuvo el "Premio Extraordinario de Doctorado en Medicina" de la UCM, el "Premio de Doctorado 2020 en Ciencias Médicas Básicas", de la Real Academia Nacional de Medicina de España, y el "Primer Premio de Tesis Doctoral Santiago Grisolía".

Es profesora de la Universidad Complutense de Madrid (UCM) y óptico-optometrista de la clínica de oftalmología de la Facultad de Medicina. Participa en la docencia de la UCM de los grados de Medicina y en el de Óptica y Optometría. A nivel posgrado, imparte docencia en el máster de Investigación en Ciencias de la Visión (máster interuniversitario), en el máster de Optometría Hospitalaria y en el máster de Óptica, Optometría y Visión y en el University Master's in Pharmacology Research en la Universidad Autónoma de Madrid.Ha participado en más de 200 congresos nacionales e internacionales. Es coautora de 51 artículos en revistas de alto impacto y 14 capítulos de libro. Es referee de diferentes revistas científicas y miembro del consejo editorial de dos. Pertenece a seis sociedades científicas.

Leire Virto Ruiz

Licenciada en Biología por la Universidad de Salamanca, Doctora por la Universidad Complutense de Madrid (UCM) y Premio Extraordinario de Doctorado.

Actualmente es profesora del Departamento de Anatomía y Embriología en la Facultad de Óptica y Optometría de la UCM. Pertenece al grupo de investigación UCM ETEP, calificado como excelente, y al grupo de investigación Endocrinología de Enfermedades Metabólicas del hospital Clínico San Carlos. Ha sido miembro de la Agencia Andaluza del Conocimiento como evaluadora experta para la renovación de la acreditación de programas de doctorado y como evaluadora para la renovación de la acreditación de másteres y grados en la UCM.

PONENCIA INVITADA

Analizando la imagen del futuro: desafíos y oportunidades del postdoctorado

En esta charla la Dra. Clara Llorens Quintana nos hablará de su experiencia como investigadora durante el doctorado y postdoctorado.

Explicará el principal propósito de su línea de investigación que se centra en el análisis y procesado de imágenes y datos para producir herramientas diagnósticas y de cómo ésta se ha enriquecido tras haber trabajado en diferentes laboratorios internacionales.

Hará un repaso de las opciones postdoctorales en el ámbito de la academia y de las ventajas de empezar una carrera global con colaboraciones con instituciones extranjeras y ampliando el carácter traslacional y multidisciplinar de los proyectos de investigación.

PROGRAMA CIENTÍFICO

8ª Edición PhDAY- FACULTAD DE ÓPTICA Y OPTOMETRÍA 2024

11 de Octubre de 2024

PROGRAMA CIENTÍFICO 8ª Edición PhDAY- FACULTAD DE ÓPTICA Y OPTOMETRÍA 2024	
9:00-9:15 h. INAGURACIÓN	
Decano FOO: José Miguel Ezquerro Rodríguez Vicedecana de Posgrado e Investigación. Coordinadora de Doctorado: Mar Martín-Fontecha	Salón de Actos
9:15-9:45 h. CONFERENCIA INVITADA	
Leire Virto Ruiz. Presentación del proyecto de la preincubadora Facultad de Óptica y Optometría	Salón de Actos
9:45-11:15 h. COMUNICACIONES ORALES. PRIMERA SESIÓN	
Coordinan: José Antonio Gómez Pedrero Alba Martín Gil Leire Virto Ruiz Gonzalo Valdés Soria	Salón de Actos
11:15-11:45 h. PAUSA PARA CAFÉ Y SESIÓN DE PÓSTERES	
Coordinan: Sonia Melle Hernández Clara Llorens Quintana Elena Salobrar García Martín	Hall FOO
11:45-13:15 h. COMUNICACIONES ORALES. SEGUNDA SESIÓN	
Coordinan: Clara Llorens Quintana José Antonio Gómez Pedrero Leire Virto Ruiz Clara Lim	Salón de Actos
Coordinan: Alba Martín Gil Sonia Melle Hernández Elena Salobrar García Martín Alejandro Casillas Rubio	Aula 16
13:15-13:50 h. CONFERENCIA INVITADA	
Clara Llorens Quintana. Analizando la imagen del futuro: desafíos y oportunidades del postdoctorado	Salón de Actos
14:00 h. Entrega de Premios y Clausura	

DESGLOSE DEL PROGRAMA

9:00-9:15 h. Inauguración PhDAY 2024

SALÓN DE ACTOS

Decano de la Facultad de Óptica y Optometría: José Miguel Ezquerro

Vicedecana de Posgrado e Investigación. Coordinadora de Doctorado en Óptica, Optometría y Visión: Mar Martín-Fontecha Corrales

9:15-9:45 h. Comunicaciones orales. Primera sesión

"Presentación proyecto preincubadora Facultad de Óptica y Optometría"

Dra. Leire Virto Ruiz

9:45-11:00 h. Comunicaciones orales. Primera sesión

SALÓN DE ACTOS

Coordinan: José Antonio Gómez Pedrero, Alba Martín Gil, Leire Virto Ruiz y Gonzalo Valdés Soria

- Advance Optical Technologies Applied to the Analysis and Restoration of Historical Tapestries. **Bárbara Sánchez Cancela**
- Optical Quality in Decentration of Intraocular Lenses: A Systematic Review. **Celia Villanueva Gómez Chacón**
- Influence of Sleep Habits on Myopia Onset in Spanish Children. **Ana Isabel González Abad**
- Sports Visual Analysis in UEFA Referees. **Carlos Ramos Athane**
- The MCL-PRO-CAT: A Computer-Adaptive Testing Tool for Assessing Multifocal Contact Lens Performance in Presbyopic Individuals. **Elsa Albero Ros** *(online)*

**Ponencias online Salón de Actos:* https://meet.google.com/hgc-jecp-qid

11:00-11:45 h. Sesión de Pósteres y café

Hall FOO

Coordinan: Sonia Melle Hernández, Clara Llorens Quintana y Elena Salobrar García Martín

- Macular Thicknesses of Choroid Layer Measured by Automatic Segmentation with Artificial Intelligence in Non-Pathological High Myopia. **David Blanco Darriba**

- Myopia Control with Ophthalmic Lens. **Beatriz de Corcuera Terrero**
- Race and Sex-Related Differences in Ocular Dimensions among Africans and Europeans. **Mame Diatou Toure Sarr**
- Adverse Effects of Tamoxifen on the Ocular Surface. A Pilot Study. **Dayan Flores Cervantes**
- Effects of Prolonged Use of Video Games with Short and Medium Wavelength Selective Absorbance lenses on Pupillary Changes Under Scotopic Illumination. **Carmen Martín Aranda**
- Influence of Red Background Intensity on the Dark Adaptation Curve Using RapiDA V1 Adaptometer. **Belén Martínez Álvarez**
- Validation of In Vitro Measurement of Soft Contact Lenses Central Thickness and Comparison Between Two Optical Coherence Tomography. **María Romaguera Planells**
- Development of an Ex Vivo Porcine Corneal Healing Model: a pilot study. **Laura Ximena Sierra Buitrago**

11:45-13:15 h. Comunicaciones orales. Segunda sesión

SALÓN DE ACTOS

Coordinan: Alba Martín Gil, Sonia Melle Hernández, Leire Virto Ruiz y Clara Lim

- Molecular and Clinical Characterization of the Ocular Surface in Glaucoma Patients. **Sandra Carolina Durán Cristiano** *(online)*
- Characterization of the Meibomian Glands in Patients with Allergic Conjunctivitis and its Relationship with Histaminase. **Jimmy Fernando Reyes Domínguez** *(online)*
- Advances in Research: Effect of the Elasticity Module of Soft Contact Lenses on the Morphology and Function of the Meibomian Glands. **Jorge Giovanni Vargas Velasco** *(online)*
- COQUN Combo modulates inflammatory and neurodegenerative responses in a mouse model of glaucoma. **José Antonio Matamoros Felipe** *(online)*
- Breakup of the Tear Film Before and After Therapy with Antihistamines in Ages Between 5 and 15 Years with Keratograph in Patients who Attend the Pediatric Optometry Clinic of the University of La Salle in Bogotá Colombia. **Guiomar Said Malaver** *(online)*

**Ponencias online Salón de Actos:* https://meet.google.com/hgc-jecp-qid

AULA 16

Coordinan: Clara Llorens, José Antonio Gómez Pedrero, Elena Salobrar García Martín y Alejandro Casillas Rubio

- Characterizing the Effect of Stray Light on the Spectral Response Function of a High-Resolution Chlorophyll Fluorescence Spectrometer Using the Slanted-Edge Method. **Óscar Gutiérrez de la Cámara Ara**
- Central Nervous System Regeneration: Towards Axonal Guidance Using Biofunctionalized Silk Fibroin Fibers as Scaffold. **Cristina Castro Domínguez**
- Characterization and modeling of the response of construction materials to solar radiation. **Pablo Alonso Rodríguez**
- Improvement of Visual Abilities in People with Acquired Brain Injury. **Carla Otero Currás**
- Cone-mediated dark adaptation (DA) using a smartphone application (MOBILE DA). **Beatriz Sánchez Gavilán**

13:15-13:50 h. Conferencia Invitada Entrega de Premios y Clausura

SALÓN DE ACTOS

"Analizando la imagen del futuro: desafíos y oportunidades del postdoctorado".

Dra. Clara Llorens Quintana

14:00 h. Entrega de Premios y Clausura

PONENCIAS ORALES

Elsa Albero Ros
Pablo Alonso Rodríguez
Cristina Castro Domínguez
Sandra Carolina Durán Cristiano
Ana Isabel González Abad
Óscar Gutiérrez de la Cámara Ara
José Antonio Matamoros Felipe
Carla Otero Currás
Carlos Ramos Athane
Jimmy Fernando Reyes Domínguez
Ángela María Sáez Gutiérrez
Guiomar Said Malaver
Bárbara Sánchez Cancela
Beatriz Sánchez Gavilán
Jorge Giovanni Vargas Velasco
Celia Villanueva Gómez Chacón

The MCL-PRO-CAT: A Computer-Adaptive Testing Tool for Assessing Multifocal Contact Lens Performance in Presbyopic Individuals

Elsa Albero-Ros[1,2], Amalia Lorente-Velázquez[2], Mariano González-Pérez[2]*

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Purpose: Presbyopia, an age-related condition that reduces the ability to focus on nearby objects, is commonly treated with multifocal contact lenses (MCL)[1]. However, significant dissatisfaction exists among wearers[2], and no reliable instrument currently measures the patient's perspective of MCL performance[3]. To address this gap, this study aims to develop a valid and reliable computer-adaptive testing (CAT) patient reported outcomes (PRO) instrument to assess MCL performance in presbyopic individuals with high precision. The self-administered tool will initially be available online in Spanish and English, providing a robust method to evaluate MCL performance from the patient's viewpoint.

Methods: The instrument was developed in four main phases: first, item-bank creation and domain identification; second, item response theory calibration and implementation of computer adaptive testing; third, cross-cultural adaptation from Spanish to English; and fourth, validation and repeatability assessment.

Results: The final item consisted of 108 items assessing 6 key domains relevant to MCL performance: activity limitation, convenience, emotional well-being, general symptoms, ocular symptoms and visual symptoms. The final instrument distinguished between 16 levels of MCL performance, presenting an average of 10.61 ± 1.00 items per patient and had an average completion time of 3:04 ± 1:24 minutes. Convergent validity was supported by a correlation of 0.73 with the CLDEQ-8 instrument. The repeatability assessment showed an intraclass correlation coefficient (ICC) of 0.86 and LoA of ±0.9 after 3 days, and an ICC of 0.83 and LoA of ±0.43 after 3 minutes. A total of 1,416 presbyopic patients participated in the development process.

Conclusions: The MCL-PRO-CAT demonstrated high reliability, precision, and efficiency in assessing MCL performance, with strong evidence of convergent validity. The tool's consistency over time, as shown by repeatability assessments, along with successful cross-cultural adaptation, makes it a valuable resource for both clinical and research environments.

Keywords: Multifocal Contact Lenses, Patient Reported Outcomes; Computer Adaptive Testing.

[1] Pérez-Prados R, Piñero DP, Pérez-Cambrodí RJ, Madrid-Costa D. Soft multifocal simultaneous image contact lenses: a review. Clin Exp Optom 2016;100(2):107–27. Available from: http://dx.doi.org/10.1111/cxo.12488

[2] Morgan PB, Efron N, Papas E, Barnett M, Carnt N, Dutta D, et al. BCLA CLEAR Presbyopia: Management with contact lenses and spectacles. Cont Lens Anterior Eye 2024;47(4):102158. Available from: http://dx.doi.org/10.1016/j.clae.2024.102158

[3] Wolffsohn JS, Berkow D, Chan KY, Chaurasiya SK, Fadel D, Haddad M, et al. BCLA CLEAR presbyopia: Evaluation and diagnosis. Cont Lens Anterior Eye 2024;47(4):102156. Available from: http://dx.doi.org/10.1016/j.clae.2024.102156

Characterization and Modelling of the Response of Construction Materials to Solar Radiation

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Purpose:

The construction sector is increasingly prioritizing the development of materials that can optimize solar radiation management to improve energy efficiency and reduce environmental impact. Although significant progress has been made, there is still a need for more comprehensive studies on how innovative technologies, such as thermochromic, cool, super-cool, and phosphorescent materials, respond to varying environmental conditions and optimize building performance. This research aims to address this by characterizing and modeling these materials to assess their effects on energy demand, carbon footprint, and overall building habitability.

Methods:

A key focus will be the measurement of optical properties such as reflectance and emissivity across a range of environmental factors, including temperature and humidity variations. The influence of surface roughness on the optical behavior of these materials will also be studied.

The optical properties of these materials will be assessed using portable devices, such as handheld emissometers and spectrophotometers, which are suitable for conducting in-field measurements. These measurements will be compared with those from high-precision instruments which cannot leave the laboratory but will evaluate the accuracy and reliability of portable equipment. The results will contribute to the development of numerical models that simulate the behavior of these innovative materials. These models will be used to optimize solar radiation management in construction materials with the aim of improving the habitability and sustainability of urban environments.

Keywords:

Solar radiation management, Optical properties characterization, Energy efficiency in buildings.

References:

[1] Barreira E, Almeida RMSF, Simões ML. Emissivity of building materials for infrared measurements. Sensors. 2021;21(6):1961. doi:10.3390/s21061961

[2] Caron S, Herding L, Binyamin Y, Baidossi M, Vinetsky Y, Morales Sabio Á, et al. Laboratory intercomparison of solar absorptance and thermal emittance measurements at room temperature. Sol Energy Mater Sol Cells. 2022;238:111579. doi:10.1016/j.solmat.2022.111579

[3] Albatici R, Passerini F, Tonelli AM, Gialanella S. Assessment of the thermal emissivity value of building materials using an infrared thermovision technique emissometer. *Energy and Buildings*. 2013 Nov;66:33-40

Central Nervous System Regeneration: Towards Axonal Guidance Using Biofunctionalized Silk Fibroin Fibers as Scaffold

Cristina Castro-Domínguez [1], Atocha Guedan-Duran [1], José Pérez-Rigueiro [2] and Fivos Panetsos [1,3].

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Purpose: following an injury, the limited regenerative capacity of the central nervous system poses challenges for recovery [1]. Biomaterials, such as biofunctionalized silk fibroin fibers, provide a potential solution. In this study, we have demonstrated the effective guidance of neuronal axon growth by these fibers. Furthermore, the biofunctionalization of these fibers with adhesion peptides enhances their guiding capabilities. This implies that these fibers may find application as implants in spinal cord injuries, enhancing treatment prospects by facilitating the reconnection of damaged end.

Methods:

- Extraction and purification of silk fibroin (SF) and fiber fabrication: *Bombyx mori* cocoons were degummed and dissolved to extract the protein. The solution was dialyzed to remove residues, and then concentrated through reverse dialysis [2]. With the dope, silk fibroin fibers were manufactured using the straining flow spinning (SFS) technique, which mimics the natural spinning process of the silkworm [3].

- Biofunctionalization of SF fibers: the fibers were biofunctionalized with IKVAV (laminin), HADVI (N cadherin) and FRM (NCAM) peptide using crosslinkers (EDC – NHS).

- **Cell cultures:** Human neuroblastoma SH-SY5Y cells, differentiated into neurons using a protocol based on retinoic acid (RA) and brain growth neurotrophic factor (BDNF) for 11 days, were used as a model to study axonal guidance on fibers. The guidance studies were further complemented using primary cortical neurons extracted from E14 mouse embryos.

- **Determination of axonal guidance:** axonal alignment was quantified using the "guidance factor" (φ_G), which measures the degree of alignment by counting axon intersections with grid lines on culture images [4].

- **Mesoporous silica nanoparticles (MSNs) fabrication:** were synthesized by dissolving cetyltrimethylammonium bromide (CTAB) in water to form micelles, followed by the addition of tetraethyl orthosilicate (TEOS). The mixture was stirred to allow silica condensation around the micelles and the resulting solid was recovered.
- **Statistical procedures:** a significance level of $p < 0.05$ was chosen. GradPad Prism software was used for all statistical tests.

Results:

- **Biofunctionalization of FS fibres by EDC/NHS crosslinking technique:** analysis of variance (ANOVA) showed significant differences ($p<0.0001$) between the control fibres and the fibres biofunctionalized with the fluorescent peptides IKVAVK-FITC HADVI-FITC and FRM-FITC.
- **Determination of φ_G:** SH-SY5Y cells were used to evaluate φ_G as a quantitative measure of axonal guidance on both polystyrene plates and SFS fibers over 6, 11, and 18 days. φ_G values close to 1, indicate random growth. In contrast, φ_G values exceeding 1, indicate significant directional axonal growth.
- **Axonal guidance in primary culture neurons:** The study also cultured mouse cortical cells on nonfunctionalized and biofunctionalized SFS fibers, demonstrating that φ_G was close to 1 for cells on polystyrene (isotropic growth) but greater than 1 for cells on fibers (directional growth). Additionally, biofunctionalization influenced axonal alignment.
- **MSN fabrication and immobilization:** The results of the MSN synthesis yielded nanoparticles with the desired pore size. Additionally, we successfully immobilized the MSNs onto fibers, demonstrating effective attachment.

Conclusions:

- Biofunctionalization of the fibers is possible through the EDC/NHS.
- Neurons adhere and elongate following the fibres as a guide.
- Immobilization of MSN could serve as an effective drug delivery system.

Keywords: spinal cord injury, regeneration, biomaterials

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Molecular and Clinical Characterization of the Ocular Surface in Glaucoma Patients

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Introduction: Ocular surface disease is commonly associated with glaucoma medication, leading to symptoms such as foreign body sensation, dryness, and damage to the conjunctiva and cornea (1). Recent studies have revealed alterations in the transcriptomic profiles of glaucoma patients, regardless of whether they have dry eye (2).

Purpose: This study aims to investigate the clinical and molecular characteristics of primary open-angle glaucoma (POAG).

Methods: We will conduct a prospective observational cross-sectional study with both descriptive and correlational components. The study will include healthy individuals and patients with POAG who are undergoing treatment with anti-glaucoma eye drops. We will evaluate various ocular parameters, including: ferning test, fluorescein staining, keratograph analysis: including non-invasive keratograph tear break-up time (NIKBUT), measurement of lacrimal meniscus height, bulbar redness, meibography, OSDI questionnaire for ocular symptoms. Additionally, we will analyze conjunctival impression cytology to examine morphological changes and perform transcriptome analyses.

Preliminary results: We evaluated 56 participants (21 with POAG and 35 controls) with mean ages of 61.14 ± 7.60 years and 55.14 ± 6.24 years, respectively. Significant differences were observed in OSDI-reported ocular symptoms (p=0.001): 57.14% of POAG patients reported moderate to severe symptoms, while 71.42% of controls reported normal to mild symptoms.

Meibography revealed significant differences (p=0.003), with meibomian gland loss ranging from 0% to >33% in healthy subjects and 33% to 100% in POAG subjects. Notably, morphometric changes in meibomian glands were significant. NIKBUT did not significantly differ between the healthy and glaucoma groups (4.29 ± 1.24 seconds vs. 5.23 ± 2.52 seconds; p=0.413). Topical anti-glaucoma medications predominantly included prostaglandin analogs, often combined with beta-blockers, with benzalkonium chloride as a common preservative.

Conclusion: Our study demonstrates that patients with primary open-angle glaucoma (POAG) exhibit greater meibomian gland loss and more pronounced ocular symptoms compared to healthy individuals.

Keywords: glaucoma, ocular surface, conjuntiva, antiglaucoma drugs, transcriptome.

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Influence of Sleep Habits on Myopia Onset in Spanish Children

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Purpose: Previous studies have demonstrated that circadian rhythms are important for normal ocular growth and alterations to the cycles would result in changes in refraction (1,2). This study aims to analyze the association between sleep habits and myopia in Spanish children.

Methods: An epidemiological and cross-sectional study has been carried out in children between 5 and 7 years old. All the children participated in the "School campaign in favour of children's visual health" by the Alain Afflelou Foundation. The data was collected through the Alain Afflelou opticians in different Spanish Autonomous Communities. Children's parents read the information sheet and signed the informed consent form before the start of data collection. The children underwent an optometric examination to determine the refractive error and parents filled out the "Children's Sleep Habits Questionnaire". Children were classified as myopic if Spherical Equivalent (SE) ≤ 0.50. Furthermore, "Good sleep" was defined according to the sleeping hours recommended by the "Spanish Association of Pediatrics" and the "National Sleep Foundation" (3). The statistical analysis was carried out using Altair Analytics Workbench Version 5.23.1.2.106-GA-release (Troy. Michigan)

Results: A total of 5,490 children were examined of which 1,801 were excluded for not meeting the inclusion criteria. 47.8% of 5-year-old children did not sleep the hours recommended by the association and foundation. In the case of children aged 6 and 7 years, 21.6% and 24.9% had poor sleep, respectively. 24.5 % of myopic children had poor sleep compared to 21.3% of non-myopic children**.** There were no significant differences (p=0.777). No statistically significant differences were found in sleep quality (p=0.532), wake-up time (p=0.526) and bedtime (p=0.2564) between myopic and non-myopic children.

Conclusions: The quantity and quality of sleep, wake-up time and bedtime do not appear to influence myopia onset.

Keywords: myopia; children; sleep

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Characterizing the Effect of Stray Light on the Spectral Response Function of a High-Resolution Chlorophyll Fluorescence Spectrometer Using the Slanted-Edge Method

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Purpose: Characterizing the impact of stray light on remote sensing spectrometers used for estimating solar-induced chlorophyll fluorescence (SIF) is critical, as stray light can be misinterpreted as fluorescence [(1)]. A spectral slanted-edge method has been developed to characterize the Spectral Response Function (SRF) of a high-spectral-resolution Chlorophyll Fluorescence Spectrometer (CFL) [(2)]. This method uses a spectrally square input beam to measure the SRF twice for each spectral pixel, once for the rising slanted edge and once for the falling slanted edge.

Methods: The Headwall Hyperspec® CFL airborne imager spectrometer consists of 2,160 spectral bands with a step size of 0.05 nanometers, covering the range from 670 to 780 nm. The factory-specified SRF exhibits a Full Width at Half Maximum (FWHM) ranging from 0.1 to 0.2 nm. The instrument features 1,600 spatial across-track pixels within a 23-degree Field of View. The CFL's high spectral resolution is similar to that of a monochromator, where the beam dispersed by the grating is cut by two sharp knife edges at the output slit, producing distinct rising and falling edges. By adjusting the slit and synchronizing the spectral modulation of the turntable-mounted dispersion grating of the monochromator with the frame acquisition time of the CFL, an image of a white strip on a black background with a slight slope was recorded, where the along-track pixels were organized into rows and the spectral bands into columns. The columns in the resulting image carry spectral information, and the processed edge is linked to the line spread function, representing the SRF of the across-track pixel, as measured by the ISO 12233:2023 algorithms [(3)].

The experimental setup was aligned at the nadir spatial pixel, and the CFL integration time was set to 20 milliseconds, mimicking real remote sensing conditions. To study the behavior of the SRF as a function of intensity levels from neighboring illuminated pixels through the output slit, adjustments were

made by opening or closing the light source slit and recording the digital number from the CFL at high levels of the combined edge function, which forms a square function.

Results: The FWHM increased with higher edge function levels, leading to a loss of spectral resolution and indicating a greater influence of stray light. Figure 1 illustrates this effect by presenting SRFs at various points in the 16-bit radiometric range for spectral pixel 425 and across-track pixel 800 at nadir.

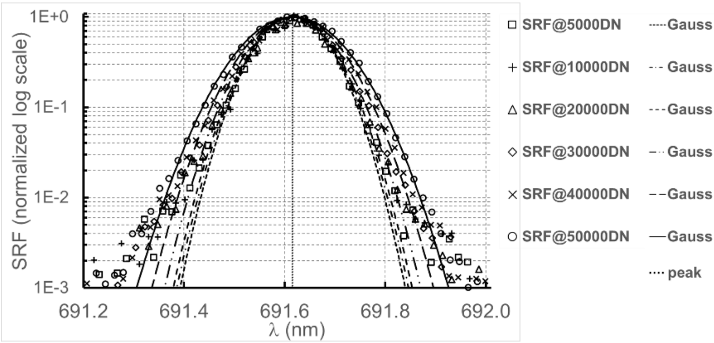

Figure 1. SRFs obtained at several points in the 16-bit radiometric range of the CFL for spectral pixel number 425 and across-track pixel number 800 at nadir.

Conclusions: The Spectral Slanted-Edge Method provides a robust means to estimate the influence of spectral stray light on SRF measurements in the CFL. This approach could improve the accuracy of SIF retrievals in remote sensing applications.

Keywords: SRF, stray light, SIF

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COQUN Combo Modulates Inflammatory and Neurodegenerative Responses in a Mouse Model of Glaucoma

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Purpose: Glaucoma is a neurodegenerative disease characterized by the progressive loss of retinal ganglion cells (RGCs). Elevated intraocular pressure (IOP) is a primary risk factor, and conventional treatments aim to reduce it. However, neurodegeneration persists even with controlled IOP [1]. Therefore, this study explores the therapeutic potential of Coenzyme Q10 (CoQ10) and citicoline, known for their antioxidant, anti-inflammatory, and neuroprotective properties [2]. We investigate the neuroprotective and anti-inflammatory effects of a combination of citicoline and CoQ10 (COQUN Combo) in an experimental mouse model of ocular hypertension (OHT).

Methods: 46 male Swiss albino mice were divided into four groups: vehicle control, COQUN Combo control, laser with vehicle, and laser with COQUN Combo. COQUN Combo was administered daily with gelatin starting 15 days before and continuing 3 to 7 days post-laser induction of OHT. OHT was induced in the left eye by laser photocoagulation of the limbal and episcleral veins, analyzing hypertensive eyes and their contralateral eyes. IOP was measured at various time points post-laser (1, 2, 3, 5, and 7 days post-induction). At 3 days post-laser, retinal whole-mounts were processed with: 1) Anti-Iba-1 to quantify: Number of Iba-1+ cells (Iba1-cn) in outer segments (OS), outer plexiform layer (OPL), and inner plexiform layer (IPL); Retinal area occupied by Iba-1+ cells (Iba1-RA) in the nerve fiber layer-ganglion cell layer (NFL-GCL); Cell body area (Iba1-cba) of Iba-1+ cells in OPL, IPL, and NFL-GCL; and arbor area (Iba1-aa) of Iba-1+ cells in OPL and IPL. 2) Anti-P2RY12

to differentiate activated microglia. 3) Anti-GFAP to quantify the retinal area occupied by GFAP+ cells (GFAP-RA) in NFL-GCL. At 7 days post-laser, retinal whole-mounts were processed with: 1) Anti-Brn3a to quantify the number of Brn3a+ RGCs; and 2) Anti-melanopsin to quantify the number of melanopsin+ RGCs.

Results: Both vehicle and COQUN Combo hypertensive eyes exhibited a significant increase in IOP at 24 hours post-laser, with a lower increase in the COQUN Combo group ($p < 0.0001$). At 3 days post-induction, inflammatory markers (Iba1-cn, Iba1-RA, Iba1-cba, Iba1-aa, and GFAP-RA) were significantly elevated in OHT eyes and their contralateral, but these changes were much less pronounced in the COQUN Combo-treated groups. P2RY12 expression was downregulated in OHT eyes, with a much less pronounced reduction in the COQUN Combo group. At 7 days post-induction, the number of Brn3a+ RGCs was significantly reduced in vehicle OHT eyes compared to controls, while COQUN Combo-treated OHT eyes maintained similar RGC counts to controls. The number of melanopsin+ RGCs remained consistent across all groups.

Conclusions: COQUN Combo protects against the loss of RGCs and reduces the inflammatory process related to OHT. Therefore, this drug shows promise as a neuroprotective and anti-inflammatory treatment for glaucomatous pathology.

Keywords: glaucoma, citicoline, coenzyme Q10

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Improvement of Visual Abilities in People with Acquired Brain Injury

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Purpose: There are research gaps regarding the effectiveness of visual therapy (VT) using virtual reality (VR) to treat oculomotor dysfunctions in people with acquired brain injury (ABI) [1,2,3].

A descriptive, comparative, and cross-sectional study will be conducted to analyze visual functions before and after VT in this population. In this way, long-term improvements in visual abilities in people with ABI will be described.

Methods: This study, under a contract pursuant to Article 60 of the LOSU of the Complutense University of Madrid (UCM), continues a pilot involving 27 individuals with ABI. The aim is to expand the sample size to obtain more robust and generalizable results.

The study will include the participation of the maximum number of individuals with ABI, both men and women of all ages, who have signed the informed consent (IC). The only exclusion criterion will be the inability of the patient to cooperate. Participants will be recruited through neuro-ophthalmology consultations at the Gregorio Marañón Hospital and from various foundations in the Madrid region, such as the "Federación Española de Daño Cerebral (FEDACE)".

In mid-September, visual tests will begin at the Faculty of Optics and Optometry. First, participants will complete two questionnaires: one on visual symptoms (BIVSS) and another on daily activities related to peripheral vision and mobility (ADRVPM). Next, a medical history will be taken, followed by the corresponding visual tests. The following parameters will be measured: objective refraction, visual acuity (VA), subjective refraction, interpupillary distance (IPD), and deviations using the cover test (CT). Additionally, near point of convergence (NPC), vergence, accommodative flexibility, stereopsis, and ocular motility will be evaluated, the latter using an artificial intelligence (AI) instrument called DIVE. Visual and auditory reaction times will also be measured using LUMMIC lights. Finally, tests such as visual field (VF), Hess-

Lancaster screen, and phorias will be performed using Dicopt Pro, a VR device.

Subsequently, the population will be divided into three subgroups to carry out Dicopt VT, consisting of 15 minutes of daily treatment. The first group of individuals with ABI will undergo therapy once a week for 12 weeks. The second group will do it twice a week for 6 weeks. The third group, serving as the control, will not receive any treatment.

The VT will be performed using a headset for a mobile phone and a controller. The 12 sessions will focus on games designed to train oculomotor skills, vergence, and binocular vision. Visual assessments will be conducted midway and at the end of the sessions, using the same battery of initial tests to monitor progress and compare the evolution between the groups. Additionally, after each session, ocular motility, reaction times, accommodative flexibility, and phorias will be measured.

The results will be analyzed using SPSS v28, in collaboration with the UCM/UPM computing center, employing descriptive and comparative statistics.

Results: The results presented in the pilot study, obtained from a smaller sample, indicated significant improvements in visual function. Individuals with ABI increased their near fusional vergence range from 12.00△ to 16.00△ [4.00, 41.00] ($p=0.007$), reduced their visual reaction times from 927.00 ms [550.00, 2230.00] to 890.00 ms [575.00, 2200.00], fixation stability during prolonged tasks improved from 0.98 [0.11, 1.84] to 0.85 log grad^2 [0.15, 1.75] ($p=0.002$), and they achieved a higher percentage of points seen in the visual field (67.50% [0.00, 100.00] vs. 81.00% [8.00, 96.00]).

Conclusions: VR-supported visual therapy is an effective tool for visual rehabilitation in patients with ABI. Future research is recommended to thoroughly optimize the protocols.

Keywords: acquired brain injury, visual therapy and virtual reality.

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Sports Visual Analysis in UEFA Referees

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Purpose: To analyze the visual skills of UEFA referees is crucial to understanding their performance and decision-making during matches. Compare the differences between types of arbitrators. [1,2]

Methods: A retrospective observational study has been carried out on UEFA winter concentrations. In this next phase, the following variables of the sports visual examination have been evaluated with the COI-vision software: dynamic visual acuity, visualization, saccadic time, visual memory and minimum perceptual time, in addition to the variables of the initial study. The statistical analysis was carried out with the SPSS program. The results of the continuous variables have been presented by their mean and standard deviation. In the case of categorical variables, the results have been presented by their percentages and frequencies.

Results: The mean dynamic visual acuity measured under binocular conditions was 0.77 ± 0.17 Snellen unit. The visualization obtained an average of 8.7 ± 1.8 points, with 8 points being its minimum expected value. The saccadic time was 1089.85 ± 212.93 ms. Visual memory presented a mean value of 9.87 ± 2.56 points, with 9.5 points being the minimum expected value. The minimum perceptual time had a mean value of 10.08 ± 2.72 points, which is equivalent to 0.04ms for 6 digits. Below is the comparative table between the different referees.

Type of referee

	Referee		Assistant	
	Media	Deviation	Media	Deviation
Visual acuity	1,11	,17	1,05	,19
Saccadic Time	1097,10	211,34	1077,50	215,34
Visual Memory	9,87	2,91	9,86	1,87
Minimum Perceptual Time	10,08	2,71	10,08	2,74

Conclusions: This study has shown that visual skills, such as dynamic visual acuity, visualization, saccadic time, visual memory, and minimum perceptual time are critical components in the performance of elite referees. The referees, both principal and assistants, displayed superior visual skills, supporting their ability to make quick and accurate decisions on the field of play.

Keywords: elite; referee; skills

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Characterization of the Meibomian Glands in Patients with Allergic Conjunctivitis and its relationship with Histaminase

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Purpose: The dysfunction of the meibomian glands generates an affectation in the lubrication and wetting of the ocular surface, resulting in inflammatory responses, which must be treated effectively and immediately. To determine the morphology and function of the meibomian glands in patients with allergic conjunctivitis and its relationship with the concentration of histaminase found on the ocular surface.

A descriptive, prospective, cross-sectional study is proposed in a population of patients diagnosed with allergic conjunctivitis [1] and attending consultations at the Optometry Clinic of the University of La Salle, who will be evaluated for the morphology of the Meibomian glands in addition to tear evaluation using the Oculus Keratograph 5.

Methods: All participants will sign a written informed consent after explaining the research and two questionnaires will be applied: Visual Function Questionnaire (VFQ-25) and The Ocular Surface Disease Index (OSDI).

The evaluation of patients will be adjusted to the management of two teams:

1. Oculus Keratograph 5, where aspects such as: Meniscometry, NIKBUT, thickness will be analyzed using the TF Scan, R Scan and Meibo Scan modules. of the lipid layer and dynamics of the tear film, ocular redness and morphology of the meibomian glands.

2. I-Profiler (Zeiss aberrometer), to perform the analysis and quantification of the type of aberrations that may occur on the ocular surface of patients diagnosed with allergic conjunctivitis according to Zernike polynomials [2].

Finally, the patients will undergo a non-invasive evaluation of the concentration in the tear film of histaminase and determine its relationship with the alterations or damage of the ocular surface in allergic conjunctivitis [3]. The technique to use is an enzyme-linked immunosorbent assay test (ELISA).

The project will follow the principles of the Declaration of Helsinki, resolution 8430 of the Ministry of Health that regulates research in humans in Colombia and will also be subject to evaluation and approval by the ethics committee of the Faculty of Health Sciences of the La Salle University.

Results: At PhDay 2024, I am interested in presenting partial progress of the data found in 40 patients evaluated in the I-Profiler and the Oculus Keratograph 5. Analysis and statistics of the entire database are still pending.

Conclusions: Information pending at the end of the investigation.

Keywords: Allergic conjunctivitis, ocular surface, tear film.

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Breakup of the Tear Film Before and After Therapy with Antihistamines in Ages Between 5 and 15 Years with Keratograph in Patients who Attend the Pediatric Optometry Clinic of the University of La Salle in Bogotá Colombia

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Purpose: Antihistamine treatment causes significant changes in the samples tested, allowing differentiation of test results before and after treatment. This study aims to classify the findings according to the evolution of the applied samples and to evaluate the impact of antihistamine treatment on these samples.

Methods: A prospective cross-sectional study is proposed, in a population of 35 people, aged 5 to 15 years, attending the Pediatric Optometry Clinic of the Universidad de La Salle, randomly selected; with untreated allergic conjunctivitis at the start of the research, who will be evaluated for tear film breakup before and after treatment with antihistamines; for this purpose, the Oculus Keratograph will be used. Keratograph taken before the use of the first dose of antihistamines. the variables to be considered are tear redness, tear break-up time and stability, upper eyelid meibography, lower eyelid meibography and tear meniscus.

Results: At the moment, the data are variable when making the comparison, between the symptoms and the signs, there is no relationship in 6 cases out of 10. There was a great variability in the results compared to what the literature has shown us in the physiology of the anterior segment in the ages between 5 and 15 years.

Conclusions:

It is relevant to specify that one of the most frequent reasons for consultation in pediatrics is that children rub their eyes constantly and when diagnosed with allergic conjunctivitis they have various types of how and how to use antihistamines. The knowledge of the mechanisms and foundations becomes highly competent for the daily and common practice of the optometrist to be very clear in directing the most assertive treatment in pediatrics with Allergic conjunctivitis.

Keywords: Allergic conjunctivitis, tear stability, antihistamines,

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Advance Optical Technologies Applied to the Analysis and Restoration of Historical Tapestries

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Purpose: Current methods for assessing material loss in historic tapestries are limited. We have developed an innovative system for preliminary tests simulating authentic tapestries to improve accuracy in evaluating the deterioration. We aim to measure spectral reflectance point by point of both sides of the tapestry, and chromatic coordinates will be calculated to optimize color reproduction and minimize photochemical damage.

Methods: The experimental optical setup was designed to analyze fabric deterioration in historical tapestries due to a material loss. It detects variations in light propagation based on inferred density (d), as radiation transmission changes with density. A qualitative color – coding system visualizes these density variations: red for low density (higher transmission), green for medium density, and dark blue for maximum density (lower transmission).

One the system has identified the areas of interest; a calibration method will be developed to quantitatively measure the thread densities in different areas of the tapestry. This system will allow for distinguishing between areas with high, low and medium thread densities.

It is also anticipated that the spectral reflectance will be measured point by point on both the front and back of the tapestry. Chromatic coordinates for each point will be calculated, and the optimal spectral distribution will be determined to reproduce the original color and minimize photochemical damage. [1]

Results: Measurements were taken on actual historical tapestry with the help of the Royal Tapestry Factory of Madrid. The restorers provided us with images of the tapestry under study, highlighting the areas of greatest interest

(zig – zag lines in Figure 1. Left.). This allowed us to compare our results with those of the experts in the field. Our qualitative analysis confirmed that the regions identified by our system as having higher radiation transmission (red color) aligned with the areas marked by the restorers with blue zig - zag lines.

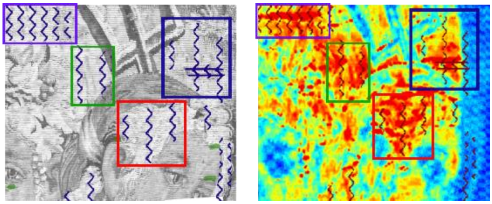

Figure 1. Left: Reference image provided by the restorers showing areas of interest (to be restored). Right: Image with color - coded representation overlaid with the restorers' pattern.

Conclusions: The experimental system automatically detects areas of wear, even in regions with no visible changes in the fabric. This is confirmed by comparing the expert pattern with the false – color image, demonstrating its usefulness in identifying areas of restoration.

Further work will focus on transitioning from a qualitative color – coding system to a qualitative approach. Additionally, we will measure spectral reflectance and chromatic coordinates to optimize real color reproduction.

Keywords: Tapestry, transmission, reflectance.

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Cone-Mediated Dark Adaptation (DA) Using a Smartphone Application (MOBILE DA)

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Purpose: Dark adaptation (DA) refers to the slow recovery of visual sensitivity in darkness after a bleach. How our eyes adapt to darkness can be a key indicator of retinal health which can be altered in the presence of certain diseases, such as age-related macular degeneration (AMD). There is evidence of the role of dark adaptation (DA) as a functional biomarker in age-related macular degeneration (AMD). In this study we determine the repeatability of smartphone application (MOBILE DA) to evaluate the cone-mediated dark adaptation (DA) in healthy young adults.

Methods: Testing was done by placing a Samsung Galaxy S8 smartphone in front of the subject sitting in a dark room (40 cm from the test eye). In two different sessions 1 week apart, the cone-mediated dark adaptation was measured in 20 healthy subjects aged 23 ± 5 with good visual acuity (VA). Cone-mediated DA recovery threshold was measured after a bleach for 5 min with the MOBILE-DA App in a smartphone. Two bleach conditions were tested: 40 seconds and 20 seconds. Threshold recovery functions were fitted to an exponential decay model to determine the time constant (τ, seconds) of cone sensitivity recovery and final cone threshold (Y_f). Repeatability was estimated by the Bland-Altman method, whereby the mean difference (MD) and the 95% limits agreement were determinate as the coefficient of repeatability (COR).

Results: Mean time constant (τ) values with a bleach of 40 seconds were $4{,}58 \pm 21{,}75$ and with 20 seconds were 5,94±46,3. Mean differences in measurements between session 1 and 2 were not significant. Repeatability was better for a 40s of bleach (COR = 42,63) vs 20s of bleach (COR=90,75).

Similar repeatability was observed between Lo for 40 s of bleach (COR = 0,79) vs 20 s of bleach (COR = 2,14).

Conclusions: The smartphone app (MOBILE_DA) offer repeatable for cone-mediated dark adaptation measurements.

Keywords: Dark adaptation; age-related macular degeneration; visual function.

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Advances in Research: Effect of the Elasticity Module of Soft Contact Lenses on the Morphology and Function of the Meibomian Glands

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Purpose:
To present the data found and the characterization of the patients studied in the research on the effect of the elasticity modulus of soft contact lenses on the morphology and function of the Meibomian glands.

The objective of this study was to characterize the morphology and function of the Meibomian glands in participating patients, before and after the adaptation of silicone hydrogel soft contact lenses with different elasticity modules in patients between 18 and 40 years old who attend the Optometry Clinic of the University of La Salle.

Secondary objectives:

- Characterize the tear film (meniscus height, lipid layer NIKBUT and film dynamics) in participating patients, before and after fitting soft silicone hydrogel contact lenses with two different modules of elasticity.

- Compare conjunctival redness in participating patients, before and after wearing silicone hydrogel soft contact lenses with different modulus of elasticity.

Materials and methods:
A descriptive observational study was proposed in a population of people over 18 years of age and up to 40 years of age, called young adults.
The sample was 42 patients who met the inclusion criteria and signed the informed consent.

The refraction of the patients was between +1.00 and -4.00 of spherical power and up to -2.75 of cylindrical power, in order to preserve the symmetry in the thickness of the contact lenses to maintain the elasticity module, this is because, with greater thickness, the module will increase. (1)

• In the first part, measurements were made to 42 patients with the defined protocol (TF Scan: Meniscus height, NIKBUT, dynamic video of the film, lipid layer video (interferometry), R Scan: Ocular redness, MEIBO SCAN: GM Morphology) with the Keratograph 5M.
• The second part consisted of completing the Ocular Surface Disease Index questionnaire. (2, 3)

Expected results: The data obtained will allow us to determine the effect of the elasticity modulus of soft contact lenses on the morphology and function of the Meibomian glands. The results will contribute to improving the practice of eye and visual health professionals and will provide data to the contact lens manufacturing industry.

Conclusions: Once the statistical analysis is completed, conclusions can be drawn about the effect of the elasticity modulus of soft contact lenses on the morphology and function of the Meibomian glands.

Keywords: Preliminary study, Feasibility study. Tear film. Meibomiam glands. Keratograph.

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Optical Quality in Decentration of Intraocular Lenses: A Systematic Review

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Purpose: The decentration of an intraocular lens can be a complication following cataract surgery caused by certain risk factors, which leads to a decrease in optical quality.

A systematic review was performed to assess the literature on how intraocular lens decentration impacts optical performance and quality, depending on the lens' optical design.

Methods: This systematic review is based on articles searched in the databases of PubMed, Web of Sciences, Scopus and MDPI platforms.

The research question was defined using the PIO framework (Patient/Population, Intervention, Outcome). The search was limited to the following inclusion criteria: English publications which were published in peer-reviewed journals with no date restriction, measurements in vitro of the optical quality on optical bench, measurements of decentered intraocular lens on optical bench and reporting through-focus modulation transfer function (MTF) obtained by the measure on optical bench. Following this review process, 91 manuscripts were selected.

Results: The spherical aberration in normal eyes is +0.27±0.02 µm.(1) For these reason, the aspherical conventional lens have negative SA to compensate the corneal SA of the human cornea, improving the optical quality versus spherical IOLs.(2)

In cases of decentration in monofocal IOLs, when comparing spherical, aspherical aberration-correcting, aspherical partially aberration-correcting and aberration-free IOLs the studies showed that the aspherical designs, depending on their SA correction, increased third-order asymmetric aberrations more rapidly than spherical IOLs.(3-6)

Regarding extended depth of focus (EDoF) IOLs, it was reported that IOLs with positive SA with a periphery aberration-free were more robust to decentration in small apertures than aberration-correcting IOLs.(7) And that IOLs which a X-Wave technology™ are more robust that IOLs with pure refractive optics principle.(8)

Finally, concerning multifocal IOLs (MIOLs), the studies showed that refractive MIOLs were more affected by decentration at far distance than diffractive MIOLs.(9) And in the group of diffractive MIOLs the decreasing in MTF depended on the design of the diffraction structure.(10)

Conclusions:

- Well-aligned optical and visual axes are required for achieving good optical intraocular lens performance.
- The analysis of the optical performance of the IOLs in such cases is crucial for selecting the most suitable IOL for each patient's eye.

Keywords: intraocular lens, decentration, optical quality

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PONENCIAS EN FORMATO PÓSTER

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Macular Thicknesses of Choroid Layer Measured by Automatic Segmentation with Artificial Intelligence in Non-Pathological High Myopia

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Purpose: *To evaluate the thickness changes in choroid between simple myopes and high myopes without associated pathology using optical coherence tomography (OCT) and from an automatic segmentation system based on artificial intelligence.*

Introduction*:* The increase in axial length (AL) in myopic eyes generates a series of structural changes in the retina and choroid. This increase in AL implies a decrease in the thickness of the choroid and sclera. These changes in choroidal thickness in turn imply a decrease in perfusion, implying that this AL growth may be due to chorioretinal ischaemia factors. Optical coherence tomography (OCT) segmentation of retinal and choroidal layers is necessary for the assessment of possible structural and pathological changes at the macular level. In particular, accurate measurement of the choroid is an important step in the assessment and monitoring of structural changes involving a decrease in this layer such as the progressive development of myopia. Therefore, automation of the choroid can improve choroidal delineation and avoid possible manual measurement errors due to the subjective nature of this method.

Methods*:* This observational case-control study included a total of 45 eyes of 45 subjects comprised of n = 22 eyes with simple myopia (axial length between 24.00mm and 25.50mm; spherical equivalent between -0.50D and -4.50D) and n = 23 eyes with magna myopia without associated pathological findings (axial length greater than or equal to 26.00mm; spherical equivalent

less than or equal to -6.00D). Images were obtained from Spectralis® HRA/OCT2 OCT (Heidelberg Engineering Inc. Heidelberg, Germany) and the coriocapillaris complex + stromal choroid (CC+CS) was analysed sectorially from the Early Treatment Diabetic Retinopathy Study (ETDRS) 1, 3, 6 mm grid by automatic segmentation by artificial intelligence-based software (Discovery® 4.1, RetinAI, Suize).

Results*:* Subjects with high myopia without associated pathology showed a greater mean thinning in the CC+CS complex ($p<0.001$). Specifically, the external region at the nasal level were the segmentation values with the greatest thinning. In turn, AL and the CC+CS complex showed a negative correlation at $r_{CC+CS} = -0.667$, $p \leq 0.001$).

Conclusion*:* There is a greater choroidal thinning in magna myopia without ocular pathology than in simple myopia. The increase in axial length in myopia magna without associated pathology may be the determining factor in the presence of these changes. Automatic segmentation using artificial intelligence may be a useful tool in the characterisation and analysis of these layers.

Keywords: myopia, choroid, optical coherence tomography

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Adverse Effects of Tamoxifen on the Ocular Surface. A Pilot Study

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Introduction: Breast cancer is the most common neoplasm among women and has the highest mortality rate worldwide [1]. Selective estrogen receptor modulators (SERM) act against breast cancer by occupying estrogen receptors. Tamoxifen (TMX) is used as hormone therapy in premenopausal and postmenopausal hormone receptor-positive breast cancer patients. In addition, it is the only SERM approved by the Food and Drug Administration (FDA) as adjuvant therapy in patients with early-stage disease and as a prophylactic agent in all stages of breast cancer [2].

Purpose: The aim of this study is to determine the ocular effects caused by the use of tamoxifen as a treatment for breast cancer.

Methods: This is an observational, prospective and longitudinal pilot study. The sample consisted of 47 patients: 22 belonged to the tamoxifen group, their age range was (50.41 ± 5.71) years. The control group consisted of 25 patients with a mean age range of (41.88 ± 9.42) years.
Photopic visual acuity, both monocular and binocular (for distance and near vision), was measured using the ETDRS test. The OSDI test was used to subjectively assess dry eye symptoms between the two groups.

Results: The best-corrected visual acuity for distance was (-0.06 ± 0.06) LogMAR in the study group, while in the control group it was (-0.09 ± 0.07) LogMAR. Regarding refractive status, a higher percentage of women were myopic (40.9%). A smaller proportion had astigmatism (12.8%), and three patients were hypermetropic (7.3%), but there was a larger group of presbyopes (32.7%).

On the first measure, the OSDI test results for both the tamoxifen group and the control group showed little difference in terms of symptomatology half the time in windy, dry or low humidity settings (28%), differing only in air-conditioned or heated settings (36% in the tamoxifen group versus 16% in the control group).

On the next measure, the tamoxifen group, half or almost all of the time experienced more dry eye symptoms in windy, dry or low humidity locations (36%), while at the same time experiencing discomfort in air-conditioned or heated locations (28%). The control group, on the other hand, experienced fewer symptoms in dry or low humidity (12%) and air-conditioned or heated places (8%).

Conclusions:

The sample has a higher percentage of myopes in this first study, and corrected distance visual acuity does not seem to be affected in either group.

Tamoxifen may cause alterations in the ocular surface over time compared to the control group.

As this is a pilot study, these data will be used to calculate the sample size needed for future studies.

Keywords: Breast cancer, tamoxifen, dry eye.

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Myopia Control with Ophthalmic Lens

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Purpose: Myopia control using ophthalmic lenses has emerged as a solution to slow the increase of this refractive error in a non-invasive way. Currently, there is extensive scientific evidence that this treatment method is effective, especially in the Asian population, from which the largest amount of data is available unlike the data we have from the European population.[1–3]

A 2-year prospective, multicenter, randomized controlled, double-blind clinical study will be conducted to investigate the efficacy of a new ophthalmic lens design for controlling myopia progression.

Methods: The clinical study will be conducted in various ophthalmic clinics located in Spain and Portugal, with the base clinic for this doctoral thesis being the IMO Miranza clinic in Madrid.

The inclusion criteria will be as follows:

Age between 6-13 years at the time of the recruitment.

Caucasian ethnicity.

Decimal visual acuity monocular/binocular with correction ≥ 1,00.

Spherical equivalent between -0,75D y -5,00D.

Astigmatism < 1,50D.

Anisometropia < 1,00D.

Change of at least -0,50D in one year.

Exclusion criteria:

Presence of ocular pathology or history of ocular and systemic anomalies.

Strabismus or binocular vision problems.

History of ocular surgery.

Previous use of any myopia control method.

Presence of contraindications for the use of drugs for cycloplegia/corneal anesthesia.

Visits will be scheduled at the ophthalmic clinic for follow-up and data collection. An initial screening visit will be conducted and three months after the use of the glasses, followed by semi-annual check-ups from the date of delivery of the glasses. The children assigned to the study group will wear ZEISS Myocare lenses, while those included in the control group will wear conventional ZEISS ClearView single-vision lenses. Both types of lenses are made from the same material and surface treatments.

Results:

The results of the clinical study are currently being worked on.

Conclusions: Due to the implementation of a new lens design, clinical research on its effectiveness is necessary, and it is also important to study the European population to gather more scientific evidence for this specific group.

Keywords: Myopia, ophthalmic lenses, progression.

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Effects of Prolonged Use of Video Games with Short and Medium Wavelength Selective Absorbance Lenses on Pupillary Changes under Scotopic Illumination

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Purpose: The modification of the pupil diameter is an involuntary action performed by the sympathetic (dilation) and parasympathetic (constriction) vegetative system. Recent studies such as that of Schilling T. et al. in 2023 [1] and not so recent studies such as that of Lei S. et al. in 2016 [2] show that exposure to short wavelength light leads to a decrease in pupillary diameter. The aim of this study is to assess, by measuring pupil diameter, whether visual fatigue caused by four hours of play has an impact on the autonomic nervous system after the use of short and medium wavelength selective absorbance lenses.

Methods: First, users were randomly provided with the short and medium wavelength selective absorbance lenses Clare and Intensitive. In addition, they were also provided with a third anti-reflective lens without a filter. The selective absorbance lenses have the following characteristics: The Intensitive selective absorbance lens has a visible spectrum tramitance of 77%, the Clare selective absorbance filter lens has a visible spectrum tramitance of 96% and the anti-reflective lens without selective absorbance filter has a visible spectrum tramitance of 100%. The Power Refractor II device was then used to assess pupil size in scotopic light conditions. The user was dark-adapted for 3 minutes. Subsequently, the user was placed one metre away from the device. This device has a red fixation point and the user has to look at it for 10 seconds while the device performs the measurement. Measurements were performed on three different days on 29 video gamers, with a mean age of 25.10±4.98 years, before and after playing any video game for four hours with each of the three lenses.

Results: The statistical method applied in the comparison of the measurements before and after the game was the paired t-test. The Duncan's test was used for the comparison between lenses. For the three lenses, similar

mean values were obtained before and after the game, between 5mm and 8mm. After four hours of play, mean pupil diameter values are very similar to the initial values and this occurs independently of the interposition of any of the three lenses. The results obtained show no significant differences (p-value>0.05) as the mean pupil diameter values achieved after playing are very similar to the initial values with any of the three lenses. When comparing the three lenses with the Duncan's test, no significant differences were found, so the three lenses behaved in a similar way for the measurement of this variable.

Conclusions: With the use of absorbance-selective lenses, a balance of the vegetative system can be achieved by preventing pupillary diameters from being altered after ocular exposure to short and medium wavelength light.

Keywords: Videogamer; pupil diameter; scotopic illumination.

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Influence of Red Background Intensity on the Dark Adaptation Curve Using RapiDA V1 Adaptometer

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Purpose: Dark adaptation (DA) is a measure of the eye's ability to adjust its sensitivity in scotopic conditions after being exposed to a bright light. Research has proved that ageing and retinal diseases such as AMD show impaired DA. However, has not been studied in clinics because of the prolonged testing time and patient discomfort. Introducing a red background, which is blind to the rods, should be reduce testing time by increasing the cone threshold and shorten Alpha point, while the recovery of the rods (S2) is not affected.(1)
The aim of this study is to analyze the influence of different red background intensities (18, 21, 24, 27 and 30 dB) on the parameters of DA curve: CT, S2 and Alpha, using RapiDA V1, an instrument that measures DA in real time.

Methodology: The sample consisted of two healthy adult subjects of 26 years old, both students of The University of Manchester. The measurements were carried out in the laboratory 4.012 of the Cary's Bannister building. It was necessary to adapt to darkness for 2 minutes to be able to perform the test with the adaptometer. The test was completed in total darkness. The subjects wore their usual optical correction and was performed monocularly, taking the right eye.
Ten tests were performed for each subject. On one hand, each subject realized five tests with different red backgrounds intensities (18, 21, 24, 27 and 30 dB) applying a flash of 36 dB. On the other hand, each subject realized five tests with different red backgrounds intensities (18, 21, 24, 27 and 30 dB) applying a flash of 40 dB. Following the bleach (min 20%), the participant, while looking at a fixation point, had to press a button when a green arc-shaped stimulus located at 8º on the temporal retina. When the participant responded, the instrument itself automatically attenuated the stimulus and

then increased it until it was detected again. At the same time, a graphical readout appeared which could be analyzed by the examiner.

To determine whether there was a correlation between the variables, the Pearson correlation coefficient (R) was calculated.

Results: *Table1* shows the Pearson correlation coefficient (R) and p-value of the parameters of DA: CT, S2 y Alpha and the different red backgrounds intensities applying a 36 dB flash and 40 dB flash, respectively. As can be seen, in contradiction to the literature, there wasn´t an association between the intensity of red background and the parameters of DA. It was expected that the alpha point would be of shorter duration and that the CT would be at a high threshold with an increasing intensity level of background (dB). The reasons for these would be related to the alignment of the eye in the eyepiece and the fact that fixation cannot be easily controlled, which will be improved in the new version of RapiDA.(1,2)

Table 1. the Pearson correlation coefficient (R) and p-value of the parameters of DA: CT, S2 y Alpha and the different red backgrounds intensities, applying a flash of 36 dB (n=2) and a flash of 40 dB.

	Flash 36 dB		**Flash 40 dB**	
	R	**p-value**	**R**	**p-value**
CT	0,33	0,59	0,00	0,99
S2	0,08	0,90	0,60	0,29
Alpha	0,62	0,26	0,50	0,39

Conclusions:

1. The parameters of DA: CT, S2 and Alpha were independent of red background intensity.
2. It is convenient to increase the sample for greater reliability.

Keywords: Dark adaptation, RapiDA, background intensities.

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Validation of In Vitro Measurement of Soft Contact Lenses Central Thickness and Comparison Between Two Optical Coherence Tomography

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Purpose: The inspection of contact lenses involves geometric metrology, such as measuring central thickness (CT), using ISO-standardized techniques (e.g., mechanical thickness gauges and, optical projection techniques) [1]. A potential method that could provide this functionality is optical coherence tomography (OCT), which proved effective in measuring soft and rigid lenses [2]. This study aimed to validate the in vitro measurement of the CT of different soft contact lenses using two OCT systems and to compare the results obtained from each system.

Methods: A total of 120 lenses, divided into 8 groups based on contact lens materials (Etafilcon A, Balafilcon A, Nesofilcon A, Delefilcon A, Lehfilcon A, Stenfilcon A, Comfilcon A, and Lotrafilcon A), were used. Each group comprised 15 lenses, which were categorized into 5 powers (+6.00D, +3.00D, -0.50D, -3.00D, and -6.00D), with 3 lenses per power. The lenses were stabilized in 1 milliliter of Phosphate-Buffered Saline (PBS) for 24 hours in 24-well plates. Each lens was placed on a circular support with a base curve of 8 mm, featuring white markings to indicate the center and diameter of each lens, ensuring optimal centering. The lens was positioned on the support and measured with the OCT 5 seconds after placement. Each measurement was performed by 3 different masked examiners under the same environmental conditions. The CT measurements were quantified using a caliper and the refractive index of each material. The two OCT systems used in this study were the DRI Triton swept-source (Topcon Corporation; Tokyo, Japan) and the iVue-100 spectral domain (Optovue Inc.; Fremont, California, USA). The technique validation was performed by measuring the inter-observer repeatability (Sw) of the different materials with each OCT device.

Results: The inter-observer repeatability (Sw) for all materials measured with both OCT systems was ≤ 5 µm, being the best repeatability observed for Etafilcon A (Sw = 2.39 µm) using the Triton system. Comfilcon A and Lotrafilcon A materials showed the lowest difference in the comparison between the measurements of both instruments (fig. 1).

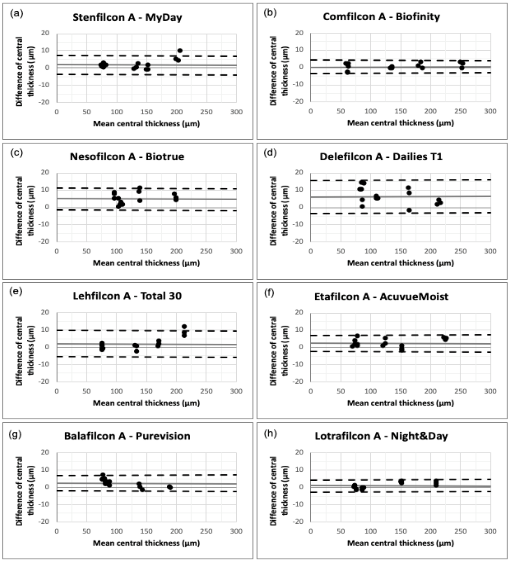

Figure 1. Bland-Altman plots for central thickness (µm) to assess the agreement between the OCT systems (diff. iVue-100 - Triton) for each material (a to h). The middle line represents the mean difference, while the two dashed side lines show its 95% limits of agreement.

Conclusions: Both OCT systems demonstrated repeatability in measuring the central lens thickness. However, differences between the two OCT systems appear to exceed the repeatability of each system individually.

Keywords: central thickness, material, soft contact lenses

References:

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Race and Sex-Related Differences in Ocular Dimensions among Africans and Europeans

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Purpose: Studies examining the relationship between ocular biometry and sex have yielded varied and often contradictory results. Some research suggests significant differences between men and women in certain ocular measurements, such as corneal size, corneal thickness, axial length of the eyeball, and lens diameter. However, other studies have found these differences to be minimal or nonsignificant. The objective of this study was to compare biometric measurements in populations of different races.

Methods: The sample consisted of two ethnic groups: 88 Caucasians (CAU), comprising 26 men and 62 women, and 129 Africans (AFR), consisting of 50 men and 79 women. The following variables were analyzed: axial length (AL), corneal diameter (WTW), curvature (K) and astigmatism (ASTC), refractive errors (RX), corneal and anterior chamber depth (ACD). All participants signed informed consent. Ocular biometry assessment was performed using the Zeiss IOL MASTER 500 (Carl Zeiss Meditec Inc., Dublin, California). The assessment of refractive status was performed with the Nidek HandyRef-K portable autokeratorefractometer, with three measurements by the same. The spherical equivalent (SE) was defined as the spherical value plus half the cylindrical value.

Results: The p-value in AL between Caucasian men and women was 0,2772, Africans showed p-valor 0,2670. However, when comparing males of different ethnic groups, a p-value of 0,0216 was obtained, and 0,0233 for females. WTW showed no differences in its comparison between the different sexes of the same ethnic group, but a p-value of 0,0004 was found when comparing CAU males to AFR males, and the same was found for females, with a p-value

of 0,0001. KM showed no statistically significant differences in any of the comparisons. The ASTC variable did not show significant differences among Caucasians, but did in Africans, showing a p-value of 0,0195. When comparing the ASTC of Caucasian and African men, a p-value lower than 0,0001 was obtained, and the same p-value was obtained in women. In the RX variable, no significant differences were found between the different sexes of the same racial group, but differences were found between white and black men, obtaining a p-value of 0,0032, the same thing happens for the female participants, who obtained a p-value of 0,0007. The last variable compared was the ACD, showing no significant differences between the different sexes of the same racial group, but when comparing men and women of the two racial groups, a p-value lower than 0,0001 was obtained in both cases.

Conclusions: this study have found significant differences across almost all the variables. This highlights the need for targeted interventions and further research to address ocular health inequalities within African communities.

Development of an *Ex Vivo* Porcine Corneal Healing Model. A Pilot Study

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Purpose:
To establish an *ex vivo* porcine corneal healing model and evaluate its functionality and viability.

Corneal wound healing is crucial for maintaining corneal integrity and visual function [1]. This complex process involves cellular interactions, growth factors, and molecular signalling [2]. Due to ethical and logistical challenges, preclinical models that accurately mimic human corneal healing are limited. Porcine corneas, with their anatomical and physiological similarities to human corneas, offer a promising alternative. This study aims to develop and validate an *ex vivo* porcine corneal healing model, providing a reproducible platform for studying wound healing dynamics and future therapeutic investigations.

Methods:
Porcine eyes were obtained from a local slaughterhouse, using male pigs aged 10 months and weighing 130-155 kg.

The eyeballs were extracted postmortem and preserved in 1x phosphate-buffered saline (PBS) at 4°C during transport. Upon arrival, the eyeballs were cleaned, and all surrounding tissue was removed. The eyes underwent two washes with a povidone-iodine solution, rinsed with PBS. *Ex vivo* corneas preparation for the beginning of the experimental procedure took less than 6 hours from the eye collection. In a laminar flow hood, a transverse incision was made through the sclera, leaving a 4-5 mm margin from the limbus to isolate the anterior segment. Anterior segments were filled with 1% agar-agar : minimum essential medium eagle (MEM), and it allowed to harden prior to being preserved on a 6-well plate. Culture medium was added up to submerge the corneal buttons, and the plates were incubated at 37°C, 5% CO_2, and 95%

humidity for tissue preservation and cellular activity. Two hours after *ex vivo* corneas preparation, corneal injuries were produced using a 3 mm Whatman filter paper disc soaked in n-heptanol that was applied to the centre of the cornea for 30 seconds, followed by a PBS wash.

Wounds were stained every day for six days with 5 µL of diluted 2% sodium fluorescein to visualize the wound margins and quantity the healing area.

Results:

The corneal buttons #1 and #2 exhibited evidence of corneal edema and reduced transparency. However, the corneal button #3 demonstrated the most well-defined and circular wound, with complete epithelial regeneration by day four, and hence it was the only quantitatively analysed wound.

The dimensions of the wound were measured over a six-day period, with a starting measurement of 9.16 mm^2. By day 1, the area had decreased to 8.94 mm^2, but then increased slightly to 9.68 mm^2 on day 2 due to early inflammation. Finally, on day 3 it decreased to 7.74 mm^2. The corneal button #3 had fully healed by day 4, while the other buttons continued to show corneal edema.

Measurements up to day 6 confirmed complete wound closure in corneal button #3, demonstrating a typical healing progression with initial inflammation, followed by shrinkage and full recovery.

Conclusions:

1. The *ex vivo* porcine corneal model can function as a replica of the wound healing dynamics observed *in vivo.*
2. Corneal button #3 demonstrated complete epithelial regeneration by day four, indicative of effective healing.
3. The initial inflammatory response resulted in a transient increase in wound size, followed by shrinkage and closure by day 4.
4. This model serves as a reliable platform for the study of corneal healing and the evaluation of therapeutic interventions.

Keywords: porcine cornea, *ex vivo* model, corneal healing.

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