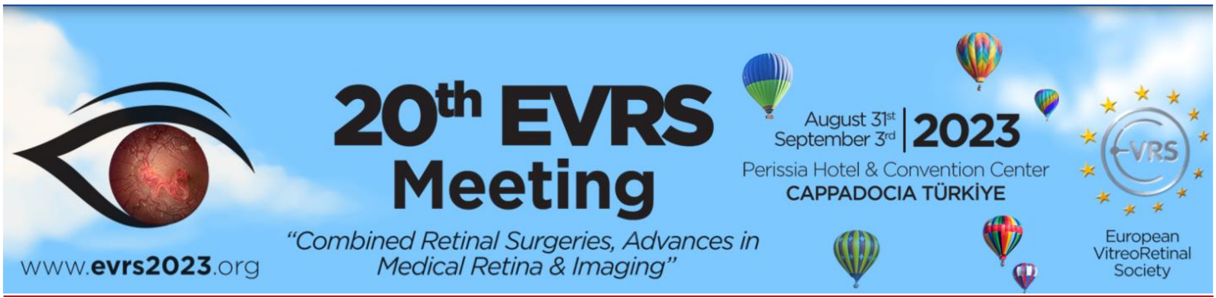

SESSION: Innovations on Surgical Instrumentation / Artificial Intelligence
DATE: September 1, 2023
HALL: HALL 1
TIME: 14.00-15.05
Moderators: Levent Akduman, Linda Lam

Developing an artificial intelligence model to detect epiretinal membranes in OCT by using a machine learning platform without typing code

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Purpose: To develop a method by using an auto machine learning platform without coding to detect epiretinal membrane in OCT
Materials-Methods: Anonymased 60 OCT (Xephilio OCTA-1, Canon, Netherlands) images of patients who have an epiretinal membrane and, 60 OCT images of patients who don't have the disease, were used for the training set. For testing a total of 40 images were used and half of them were having and the other half don't have the disease. The segmentation process is applied to the training images with Weka trainable image segmentation in the ImageJ program. The images used for testing were selected from different OCT devices. Then all images are uploaded to the Vertex AI AutoML application of the Google Cloud platform.The images were labelled and after that, training and testing processes of the platform were performed. The models were evaluated by the same platform.
Results: Precision recall curves and confusion matrix were calculated.The precision value which shows the percentage of correct predictions and the recall value, which shows the ground truth items that were successfully predicted by the model were calculated by the same platform. The results that were given by the platform were 100% for precision recall values and true positives, and true negatives.
Discussion: Models for recognition of the retinal images by using artificial intelligence, the popular technology of our century, can be built by ophthalmologists. As we are the primary occupational group for these images, the preparation of the models by us is more valuable and can be accomplished without using codes. Our training group was containing images of primary and secondary epiretinal membranes. The test group

was prepared from images of different devices of our clinic. For the power of our model, it may need testing with different images from different clinics.

Digital Ophthalmology

Linda Anne Lam
USC Keck School of Medicine/USC Roski Eye Institute

Will discuss current applications of Artificial Intelligence in Ophthalmology, with emphasis on retinal applications particularly in Macular Degeneration and Diabetic Retinopathy.

A Novel Mobile Application for Communication between Parents, Pediatricians and Ophthalmologists for Retinopathy of Prematurity Screening Providing Artificial Intelligence Assisted Retinopathy of Prematurity Diagnosis

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Aim: to raise awareness of ROP among parents, pediatricians and ophthalmologists, keep them in communication for early diagnosis and treatment.
Methods: A mobile application and web platform running on devices with Android and iOS operating systems were developed. Parents, pediatricians and ophthalmologist are users. These users are presented with different screens where they can perform different functions. Appointment module infrastructure was designed according to the patient data. Ophthalmologist can view the appointments on the agenda, reach patients through their appointments, view past visits of patients, and define notifications for patients. In addition, ophthalmologist can upload the fundus photo of the patient to the web platform, and save the artificial intelligence assisted analysis result of the photo, see the patient's past visit by entering the appointment date (Fig 1,2). Parents could enter the application after logging in and view the upcoming, past and current appointments, notifications, announcements on the main screen and the notes written by the doctor over the appointments.
Results: We performed a demo registration with one of our patient who was at a NICU clinic of an other hospital in our city by the help of a neonatologist. She upload the application and helped the parents register to the web platform. System gave an appointment and it was approved by the ophthalmologist. After the ROP examination, the fundus photo of the infant was uploaded to the web platform and it was analysed with the help of AI and gave the risk percent for being ROP (Fig 3).
Conclusion: This pilot study and live demo encouraged us to use this mobile application and web platform in routine ROP screening. So, we look forward to using

this mobile application in routine ROP screening programs after obtaining necessary permissions and authorizations from government agencies due to personal data protection law.

The use of artificial intelligence in the retina;Where and how?

Özlem Candan
Ankara Education and Training Hospital

Aim: The aim of this study was to determine the application of artificial intelligence (AI) in retina and retinal diseases, based on a systematic assessment of the literature
Materials-Methods: PUBMED/MEDLINE database was searched from inception to January 2023 using a computer-based search. The key search terms included (((Deep Learning[Title/Abstract]) OR (Machine Learning[Title/Abstract])) AND (retina[Title/Abstract])) OR (((Deep Learning[Text Word]) OR (Machine Learning[Text Word])) AND (retina[Text Word])).
Results: A total of 708 publications, between 2004-2023 years, were identified. 507 studies were in opthalmology, 452 of which were focused on retina and retinal disease. The studies between 2004 and 2015 were mostly about scaling up retinal images to higher resolutions, artifact removal and making definitive diagnosis, but, the studies conducted after 2016 were also adressed on treatment planning, differential diagnosis and forecasting disease progression and visual outcomes. The most popular topics were the detection and grading of diabetic retinopathy from fundus photographs or OCT images, diagnosis and classification of dry and neovascular age-related macular degeneration, layer segmentation of retina in OCT and OCTA images and the detection of retinal abnormalities in color fundus photographs and OCT images, respectively.
Conclusion: AI, machine learning and deep learning have demonstrated high performance in screening,classification and diagnosis of retinal diseases and will likely play a important role in future clinical ophthalmology practice. However, there is a requirement to create artificial intelligence-specific guidelines for standardization of design, terminology and the measurements of outcomes for upcoming studies.

Tips in dealing with surgical challenges of myopic macular holes with AXL more than 32 mm

Khahid Sabti
Kuwait specialized eye center, Kuwait

Dealing with Myopic macular holes in very long eyes of AXL more than 32mm is quite challenging. In most of these cases it is very difficult or even impossible to peel ILM due to relative instruments short shaft to perform membrane peel. We are demonstrating a practical and simple surgical technique to overcome this surgical challenge. This novel surgical technique was used successfully in 8 cases in which all membrane peel was successful with closure of all holes.

Comparative study of commonly used intraocular forceps

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Purpose:
To establish the subtle differences in performance, accuracy, precision, and safety of three commonly used intraocular forceps tip designs and compare their effectivity and safety margins.
Method:
Internal limiting membrane pinch peeling procedure was modelled using a purpose-built robotic system with a biomimetic membrane resembling retinal layers. Perforation pressure through excessive denting, dent versus lift curve, maximum lift and safety ranges for 27-gauge Eckardt End-Gripping, 27-gauge Katalyst stiff Dex and a 27 gauge Ultrapeel forceps were compared.
Result
Perforation pressure through excessive denting was 15.85, 15.48 and 16.01 mg for Eckart, Katalyst and Ultra-peel forceps. Dent versus lift curve showed an initial positive then a plateau and finally a negative correlation. Maximum lift was 15.29, 8.43 and 11.13 mg for Eckart, Katalyst and Ultra-peel. The minimum dent to achieve the maximum lift was 1.10, 10.42 and 0.97mg for Eckart, Katalyst and ultra-peel. The safety range was 14.75, 5.06 and 15.04 mg for Eckart, Katalyst and ultra peel.
Conclusion
Forceps tip design has significant influence on its overall performance and safety. Manufacturers should be encouraged to provide detailed and objective data in relation to the performance of their designs to enhance safety and ensure appropriate usage. Currently no objective data is being provided by any forceps manufacturers.

Application of Single-Molecule Localization Microscopy in Ophthalmology

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Immunohistochemistry has been a conventional method used to image tissues in ophthalmology research. However, it has its limitations in terms of resolution. With the introduction of super-resolution microscopy techniques, including single-molecule localization microscopy (SMLM), higher resolution images can now be obtained. SMLM, which uses the technology that won Eric Betzig and others the 2014 Nobel Prize, has the highest resolution among super-resolution techniques.

In this study, we developed a high-power laser illumination system for SMLM (figure 1.) and used it to image müller and RPE cells. Our results showed that the high-resolution images obtained through SMLM technology allowed us to observe the qualitative and quantitative changes in cellular structures such as microfilaments, intermediate filaments, microtubules (30nm, figure 2), mitochondria (figure 3), and various types of collagen (I, II, III, IV and IV) after exposure to different cytokines such as TGF-alpha, VEGF A, VEGF B, and PlGF.

Our findings suggest that SMLM has enormous potential in ophthalmology research. The high-resolution images of cellular structures provide better insights into the mechanisms of various eye diseases, aiding in the development of new treatments. Additionally, the precise colocalization of different biomarkers (GS, GFAP, CLALBP and Alpha-SMA) using SMLM can help in studying the trans-differentiation of muller cells in epiretinal membrane.

The study highlights the importance of SMLM technology in ophthalmology research and the potential for improving our understanding and treatment of eye diseases. By observing the changes in cellular structures and their response to different cytokines, we can identify potential targets for drug development. This technology can aid in the development of personalized medicine and improve the outcomes of patients with eye diseases.

Impact of Three-Dimensional Heads-Up Display on Ergonomics, Surgical Performance and Teaching in VitreoRetinal Surgery in a Tertiary Eye Care Center

Yassine Malek, Shamil Louaya
Ophthalmology Department Agadir Military Hospital, Souss Massa University Hospital, Ibn Zhor University, Agadir, Morocco

Purpose: To assess the impact of three dimensional head's up display on surgical performance, ergonomics and teaching in Vitreoretinal Surgery

Settings: Ophthalmology Department, Oued Eddahab Agadir Military Hospital, Agadir, Morocco.

Methods: A combination of a retrospective comparative study between cases operated with three dimensional head's up display system (3D HUD) (N=24) (NGENUITY; Alcon Inc., Fort Worth, Texas, USA) and Standard operating Microscope (SOM) (N=35) (Lumera 700, Zeiss Meditech, Germany), and a questionnaire was done. Rates of anatomical success, duration of surgery, peroperative complications and Postoperative best corrected visual acuity were compared in both groups. Questionnaire consisted in evaluating subjective satisfaction of Surgeons, Assistants and trainees, regarding ergonomics, quality of image, depth of field, simplicity, teaching, and overall satisfaction on a scale of 1 to 10.

Results: In the comparative study, both groups were comparable in terms of Demographic Data. Final Anatomical success, in terms of Retinal Reattachment, Macular Hole closure, rebleeding were comparable in both groups. Surgery Duration was significantly longer in 3D HUD group for Rhegmatogenous retinal detachment (p=0,04), Tractional Retinal Detachment (p=0,01). Rates of complications were significantly higher in 3D HUD group with 3 retinal touches (p=0,001). In the questionnaire, All the surgeons, assistants and trainees satisfaction scores were higher in the 3D HUD Group.

Discussion: This study demonstrates the comparable efficacy of 3D HUD and SOM for various VitreoRetinal Surgeries in term of anatomical success. However, many surgeries remain longer in 3D HUD, and rate of peroperative complications Higher, probably due to a learning curve. Overall satisfaction regarding ergonomics, quality of viewing, teaching and learning are in favor of 3D HUD.

Conclusion: 3D HUD remains a remarkable tool for teaching, and improving Ergonomics in VitreoRetinal Surgery. However a certain learning curve is necessary.

Modified MACULR BUCKLE, the ultimate solution

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Alexandria University,Harvard associate.

Purpose. To report the anatomic and visual results of a new sutureless illuminated macular buckle designed for patients with macular hole retinal detachment related to high myopia (MMHRD). Design. Prospective nonrandomized comparative interventional trial. Methods. Twenty myopic eyes of 20 patients (mean age, 51.4 years; range, 35–65 years) presenting with MMHRD with a posterior staphyloma, in whom the new buckle was used, were evaluated. The buckle used was assembled from a 5 mm wide sponge and a 7 mm wide silicone tire; it was fixed utilizing the sterile topical adhesive Histoacryl Blue (B Braun, TS1050044FP) which polymerizes in seconds upon being exposed to water-containing substances. The primary outcomes measured included aided visual acuity (BCVA) and optical coherence tomography (OCT) findings. The mean follow-up period was 6 months. Results. Postoperatively, the MH closure was identified by OCT in 8 (40%) eyes. The mean BCVA increased from 0.11 to 0.21 ($p < 0\ 005$). The axial length of the eyes included decreased from 30.5 mm preoperatively to 29.8 mm ($p = 0\ 002$) postoperatively. Conclusion. Preparation of the new sutureless macular buckle is simple and easy. Illumination of the terminal part of the buckle ensures proper placement. Histoacryl Blue is effective in fixing the buckle in its place for at least 6 months with no reported intra- or postoperative complications.

Myopia Support Device (Titanium Macular Buckle): Outcomes of the First Three Cases

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Objective: To present the outcomes of the first three cases of the Akduman myopia support device (titanium macular buckle) in patients with pathologic myopia.

Methods: To date, three patients have received the Akduman myopia support device (Figure 1). In the first case, the device was used in a combined vitrectomy and macular buckle surgery to close a recurrent myopic macular hole. The surgery involved a combination of vitrectomy and macular buckle. In the second case, the buckle was placed and no vitrectomy was done to treat a myopic posterior pole detachment with maculoschisis. In the third case, a combined vitrectomy and macular buckle was performed to repair a posterior pole retinal detachment.

Results: The macular hole was successfully closed in the first case and remained closed 15 months after surgery. The buckle was removed at two months. In the second case (Figure 2), follow-up was 6 months: the posterior pole retinal detachment and maculoschisis were resolved. In the third case, which involved persistent posterior pole detachment and maculoschisis with an inner retinal hole, the detachment and the maculoschisis were completely resolved at 1 month when the buckle was used in combination with vitrectomy.

Conclusion: The Akduman myopia support device effectively addresses primary posterior pole pathology requiring surgical repair, with or without vitrectomy, based on the pathophysiology of the macular problem as previously described in the myopic traction maculopathy (MTM) classification by Parolini et al. The device's easier placement procedure, concave natural design that supports the posterior pole, and stability with no dislocation after placement are advantageous aspects. Macular buckles can be a valuable addition to surgical procedures with vitrectomy or as a standalone procedure for repairing macular pathology in myopic degeneration

MTM-Stop device: Outcomes of the first 15 years of study on macula buckling

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Eyecare Clinic

Background
Myopic traction maculopathy (MTM) has been thoroughly studied and divided in 12 stages in the MTM staging system. It has been observed that, while stages with full thickness macular holes (FTMH) such as stages “c” need to be treated with vitrectomy and ILM flap, stages with severe schisis and macular detachment benefits more from a macular buckle
The aim of the study is to report long term results on 265 eyes operated with macular buckle and followed up for 15 years
METHODS
Two hundred and 65 eyes affected by MTM were operated with macular buckle with or without combined vitrectomy
The follow up was ranged between 1 and 15 years
The following parameters were studied: improvement of anatomical result and vision, improvement in microperimetry, change in axial length and refraction, complications
RESULTS
The anatomical partial or complete was 98%
Improvement of vision of at least 3 lines was observed in 85% of eyes. In 25% vision had a limited improvement or remained stable due to preoperative atrophy
Macular buckle did not induce further sign of atrophy progression when compared with the contralateral eye in a period of 15 years
CONCLUSIOIN
Macular buckle offers an efficient, safe and long lasting resolution of MTM
Macular buckle should be chosen as first line of treatment for macular schisis and detachment secondary to MTM

Keywords: Myopic traction maculopathy, MTM, FTMH