Free Papers

13:30 - 15:00 Sunday, 4th September, 2022

13:30 - 13:38

21 Smartphone Annotation Tool for faster and accurate Image - labelling for Diabetic - Retinopathy and Common Retinal disorders

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Abstract

Purpose: Deep Learning (DL) and Artificial Intelligence (AI) have become widespread due to the advanced technologies and availability of digital data. Supervised learning algorithms developed for an annotation tool with a customizable feature set. We evaluated viability of having an in house annotation tool which works on a smartphone.

Methods: We developed a smartphone-based grading system to help in grading multiple retinal fundi. We designed the flow of user interface (UI) keeping in view feedback from experts. Quantitative and qualitative analysis of change in speed of a grader over time and feature usage statistics was done. The dataset size was approximately 200,000 images with adjudicated labels by a minimum of 3 doctors. Results for an AI model trained on the images graded using this tool and its validation over some public datasets.

Results: We created a DL model and analysed its performance for a binary referrable DR Classification task, whether a retinal image has Referrable DR or not. A total of 32 doctors used the tool for minimum of 2000 images each. Data analytics suggested significant portability and flexibility of the tool. Grader variability for images was in favour of agreement on images annotated. Mean of 89.11% was seen in agreement.

Conclusions: Our aim was to make Annotation of Medical imaging easier and to minimize time taken for annotations without quality degradation. The user feedback and feature usage statistics confirm our hypotheses of incorporation of brightness and contrast variations, green channels and zooming add-ons in correlation to certain disease types.

13:38 - 13:46

5 The safety and feasibility of the tele-screening for retinopathy of prematurity during the COVID-19 pandemic

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Abstract

Purpose: To evaluate the use of remote reading of digital retinal photographs in the diagnosis of severe (treatment-warranted) retinopathy of prematurity (ROP) during longitudinal screening for ROP in NICUs not accessing bedside ophthalmology exam during the COVID19 pandemic in northeast Iran.

Methods: According to ROP standard timelines, infants were examined longitudinally, over a series of examinations, by digital photography using the RetCam-120 Digital Retinal Camera (Massie Research Laboratories Inc., Dublin, CA) from July 2020 to April 2021. Images were transferred in a web-based route to ROP reading center in a tertiary ophthalmology hospital to be interpreted by trained vitreoretinal surgeons. Treatment-warranted ROP was defined as the presence of plus disease or the presence of any stage 3 ROP. Treatment with intravitreal bevacizumab was done in NICU. All patients were examined bedside after discharge from NICU at the referral ROP center.

Results: A total number of 523 exams was done for 213 patients (1-13, median 2). The mean birth age of the patients was 30 weeks (24-40) and the mean birth weight was 1351 grams (680-3500). Severe (treatment-warranted) ROP was diagnosed in 18 eyes (10 patients) during admission in NICU. Intravitreal injection of bevacizumab was performed in NICU. In the final bedside clinical exam in the referral ophthalmic center, no case of advanced ROP was recognized. Tele-screening had a 100% sensitivity in diagnosing treatment-needed ROP.

Conclusions: This pilot study showed that longitudinal remote reading of digital photographs using the RetCam-120 system has excellent sensitivity in detecting treatment-warranted ROP.

13:46 - 13:54

61 Rural Teleophthalmology Camp Model for Eye Care during COVID-19.

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Abstract

Purpose: Due to Severe Acute Respiratory Syndrome (SARS) Coronavirus 2 (COVID-19) pandemic, the eye camp activities have been re-structured since March 2020. As a result, only a limited number of patients are being screened on a daily basis. We describe the process of conducting eye camps during COVID-19 using teleophthalmology mobile vans to determine the major causes of blindness.

Methods: Patients underwent comprehensive eye examination, vision testing, refraction, slit lamp examination and fundus photography at Thiruvallur and Kanchipuram districts of Tamilnadu, India, from March 2021 to May 2022 as per the COVID-19 Guidelines for eye camp activities prescribed by the Government of India. Social distancing was enforced to minimize risk of exposure with hand hygiene, appropriate personal protective equipment (PPE) like gloves, masks and shields, and rigorous sterilization of equipment after every patient. Ophthalmologists at base hospital had teleconsultation with patients at campsite using internet connectivity (256- 512 Kbps).

Results: 218 camps were conducted across Tamilnadu. 21046 patients underwent ophthalmic evaluation. Of which, 916 patients had teleconsultation; 11917 had refractive error and was identified as the commonest cause of avoidable blindness; 4365 patients had cataract; 310 had retinal disease, and an additional 359 had diabetic retinopathy. 9705 patients were prescribed low-cost spectacles, and those with cataract or retinal diseases were referred to the base hospital for further evaluation and intervention.

Conclusions: A mobile teleophthalmology unit conducting eye camps is a very effective tool especially during COVID-19 to prevent blindness in rural villages.

13:54 - 14:02

33 Is glaucoma training essential for remote screening of glaucoma based on fundus photographs?

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Abstract

Purpose: To determine if there is difference in optic disc assessment between glaucoma specialists and non-glaucoma trained ophthalmologists.

Methods: Three fellowship trained glaucoma specialists and two non-glaucoma trained ophthalmologists were provided via internet, 1201 fundus photographs. Each investigator, using ImageJ software, manually annotated the disc and cup margins. Disc area, cup area, rim area, cup height, cup width, disc height, disc width, average cup-disc ratio (ACDR), vertical cup-disc ratio (VCDR) and horizontal cup-disc ratio (HCDR), were measured in pixels from each photograph. Intraclass correlation coefficient (ICC) was used to analyze the agreement between all five ophthalmologists, the glaucoma trained and non-glaucoma trained groups. ICC estimates were calculated on average-measures, absolute-agreement, 2-way random-effects model.

Results: All five ophthalmologists annotated all 1201 photographs. The disc parameters- disc area, height and width showed excellent reliability between all five ophthalmologists, the glaucoma specialists and non-glaucoma trained groups with ICC values more than 0.9. In assessing the rim area, the glaucoma specialists had excellent reliability of ICC 0.901 whereas the non-glaucoma trained ophthalmologists had good reliability with ICC of 0.849. In measuring the ACDR, VCDR and HCDR, the glaucoma specialists showed good reliability with ICC of 0.808, 0.788 and 0.761 respectively whereas the non-glaucoma trained ophthalmologists showed moderate reliability with ICC values of 0.610, 0.697, and 0.453 respectively.

Conclusions: Fundus photographs can be evaluated reliably by both glaucoma trained and non-glaucoma trained ophthalmologists for optic disc parameters implicated in glaucoma. Training in glaucoma may give an edge in assessment of the cup and rim.

14:02 - 14:10

46 Pretreatment with frequent topical betamethasone in Ahmed glaucoma valve implantation

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Abstract

Purpose: To evaluate the efficacy of pretreatment with topical betamethasone in Ahmed glaucoma valve (AGV) implantation.

Methods: We randomly assigned patients undergoing AGV to 2 arms of the study. The case group received AGV implantation with preoperative betamethasone eye drops, and the control group did not receive preoperative betamethasone. Follow-up examinations were performed on postoperative day 1, at least weekly for 4 weeks, and then every 1 to 3 months. Our main outcome measure was the rate of success, defined as intraocular pressure (IOP) <15 mm Hg and IOP 18 mm Hg. Results: We analyzed 62 eyes divided to case (n = 33) and control (n = 29) groups. The success rate was significantly higher in the intervention group than in the control group at 12 months postoperatively when considering either IOP >< 15 or IOP < 18 mm Hg.

Results: We analyzed 62 eyes divided to case (n = 33) and control (n = 29) groups. The success rate was significantly higher in the intervention group than in the control group at 12 months postoperatively when considering either IOP < 15 or IOP < 18 mm Hg as success ($p < 0.001$) and also at 6 months when considering IOP < 18 mm Hg as success ($p < 0.041$). The reduction in the number of anti-glaucoma medications used postoperatively was significantly higher in the betamethasone group at follow-up at 1 and 3 months and 1 year.

Conclusions: Pretreatment with topical betamethasone in AGV implantations increases the success rate and reduces the need for medications.

14:10 - 14:18

63 Automated Glaucoma Screening tool integrated offline on a smartphone-based fundus camera

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Abstract

Purpose: The study aimed to evaluate the performance of a novel, automated screening tool for referable glaucoma using an offline AI deployed on a smartphone-based fundus camera.

Methods: This cross-sectional study was conducted in 6 satellite vision centers(VC) of a tertiary eye hospital. On 299 subjects, two disc-centered fundus images of sufficient quality were taken with validated portable fundus camera by minimally trained ophthalmic assistants. The images were analyzed independently by an 'offline AI' and 'VC doctors through teleophthalmology' (masked to diagnosis) and graded as normal, glaucoma or disc suspect based on pre-defined criteria. Additionally, 58(19%) subjects deemed referable by either AI or VC doctor were referred to glaucoma specialist at tertiary eye hospital. The AI output was compared against VC doctor (image grading) and specialist diagnosis (glaucoma workup).

Results: Sensitivity of the offline AI to detect confirmed glaucoma was 91.30%(95%CI 71.96- 98.93) and specificity 92.14%(95%CI 88.35-95.01) when compared to VC teleophthalmology doctors. Combining glaucoma and suspects as referable, sensitivity and specificity of the AI algorithm was 73.17%(95%CI 62.24–82.36) and 98.6(95%CI 96 - 99.7). For the 70 subjects referred to the base hospital, sensitivity of AI to pick up glaucoma was 91.3%(95%CI 79.21-97.58) for the specialist vs 97.83%(95% CI 88.47-99.94) for the VC doctor.

Conclusions: The AI showed robust performance in detecting glaucoma with minimal over referral of normal cases. The AI can potentially be used as a clinical decision support tool to improve the diagnostic consistency of VC doctors for glaucoma.

14:18 - 14:26

60 Evaluating a Novel Bayesian Diagnostic Algorithm for Red Eye Complaints in Primary Care Settings

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Abstract

Purpose: Diagnoses of red eye pose significant challenges to primary care providers, causing suboptimal triaging and unnecessary tests. Current diagnostic aids are static flowcharts which do not provide dynamic, stepwise workups. The research team created a novel artificial intelligence (AI)-based diagnostic algorithm which employs a Bayesian feedback process to recreate itself continuously at each step of decision-making. Its diagnostic accuracy for red eye complaints was tested against that of primary care physicians and ophthalmologists.

Methods: Seventy-two patients with red eye were prospectively assessed by a primary care provider (‘referrer’), who completed a questionnaire about ocular symptoms/findings (without requiring slit lamp examination). An ophthalmologist then attributed an independent “gold standard diagnosis”. The algorithm employed questionnaire data to produce a differential diagnosis.

Results: Referrer diagnostic accuracy was 34.7%, while the algorithm’s top diagnosis was correct in 69.4% of cases, increasing to 90.3% with its top 2 diagnoses included and 94.4% with the top 3. The algorithm’s sensitivity for urgent cases (angle-closure glaucoma, endophthalmitis, iritis, and corneal ulcer) (n= 24) using the top diagnosis was 83.3% (95% CI: 62%-95%), with specificity of 95.8.0% (95% CI: 86%-99%).

Conclusions: A referrer diagnostic accuracy of 34.7% demonstrates that 'red eye' presents diagnostic challenges for primary care providers. A novel AI algorithm successfully improved diagnostic accuracy to a range of 69.4%-94.4% and is highly specific for urgent cases. It can be used as an adjunct to clinical judgement in these settings to optimize referrals and patient care.

14:26 - 14:34

59 Artificial Intelligence–Based Risk Assessment Model for Chronic Ocular Graft-Versus-Host Disease

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Abstract

Purpose: To develop an artificial intelligence (AI) model for identifying patients with high risk of chronic ocular graft-versus-host disease (coGVHD).

Methods: A total of 326 patients after allogeneic hematopoietic stem cell transplantation (HSCT) visited to the cornea clinic of our hospital and the hematology clinic of Nanfang Hospital from October 2019 to February 2022 were enrolled in this prospective, cross-sectional study. All participants completed the medical history collection, the ocular surface disease index (OSDI) questionnaire and underwent ophthalmic examinations. The models were trained and tested by 146 coGVHD cases and 124 non-coGVHD controls. The validation was performed with 33 coGVHD cases and 23 non-coGVHD controls. The AI models were established using the LightGBM. Three models were trained: 1) medical history factors including age, demographic data, transplant data, systemic GVHD; 2) OSDI questionnaire; 3) hybrid factors combining medical history and OSDI. Model performances were assessed by the area under the receiver operating characteristic curve (AUC).

Results: In the testing dataset, the AUC was 0.766 (95%CI: 0.551-0.953) for medical history factors, 0.926 (0.775-1.0) for OSDI, and 0.962 (0.876-1.0) for hybrid factors. In the validation, the model of hybrid factors showed high discrimination (AUC=0.991, 95%CI: 0.968-1.0). Furthermore, oral chronic GVHD, number of chronic GVHD involved organs, and donor age were identified as the top three most relevant factors to coGVHD diagnosis.

Conclusions: The AI model based on medical history and OSDI can accurately discriminate coGVHD patients and have the potential to serve as a complementary screening instrument for transplant physicians or patients’self-testing.

14:34 - 14:42

30 Profile of age-related macular degeneration in Bhutan: a 3-year national study

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Abstract

Purpose: To determine the severity of age-related macular degeneration (AMD) at first presentation among the Bhutanese patients attending national vitreoretinal (VR) clinics to inform national health policy on the potential benefits of a screening program.

Methods: A retrospective cross-sectional study was conducted on all new AMD cases in Bhutan over 3 years. Demographic data, clinical details and diagnostic procedures performed (fundus photography, OCT and fluorescent angiography) were recorded and clinical staging were performed. If a patient presented with asymmetrical AMD, the eye with more severe AMD was considered, and if both the eyes had the same severity one eye was chosen randomly.

Results: Of 521 new AMD patients aged 71.9 ± 11.3 years, 306 (58.7%) were males (p=0.005). At their first presentation, 234 patients (44.9%) already had late-stage AMD. Importantly, 69 patients (29.5%), that is half of total neovascular AMD (nAMD) patients, had disciform scar (DS) which were beyond treatment, and 7 (3.0%) had geographic atrophy (GA). Fourteen of nineteen polypoidal choroidal vasculopathy (PCV) patients were younger than 50 years.

Conclusions: Half of nAMD cases presented as DS not amenable to the treatment. Many potentially treatable nAMD patients had already lost central vision and were legally blind. Young people with PCV losing vision early in life with longer morbidity-affected life and socio-economic burden was concerning. Incorporating a screening program and telemedicine services for AMD with effective health education, and maintaining a national AMD Registry, would potentially lower AMD-related blindness and visual impairment, and improve quality of life with visual rehabilitation.

14:42 - 14:50

3 A study of efficacy of injection ranibizumab in retinal vein occlusive disorders.

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Abstract

Purpose: To investigate anatomical and functional response following administration of injection ranibizumab (Intravitreal) in retinal vein occlusive disorders.

Methods: This is a hospital based, prospective, interventional, clinical study on efficacy of injection ranibizumab in retinal vein occlusive disorders. Depending on the inclusion criteria, exclusion criteria and regularity of follow up, 100 eyes of newly diagnosed patients of retinal vein occlusion were selected. The BCVA (best corrected visual acuity), fundus examination and 3D-OCT (optical coherence tomography) were recorded in 3 months follow up.

Results: In this study, mean age group in BRVO (branch retinal vein occlusion) is 59.24 years, in CRVO (central retinal vein occlusion) is 58.14 years with 54 males and 46 females. Reduction of CMT (central macular thickness) over 2nd month to 3rd month is significant (0.009 and 0.048) in both BRVO and CRVO. Improvement in mean BCVA over 1st month to 2nd month is significant (0.0015 and 0.01) in both BRVO and CRVO, over 2nd month to 3rd month is significant (0.0003 and 0.0042)in both BRVO and CRVO.

Conclusions: Ranibizumab is an efficient and safe therapy in the management of macular edema secondary to retinal vein occlusive disorders. There is rapid decrease of macular thickness and significant improvement in visual acuity.

14:50 - 14:58

64 Tackling a global public health challenge with an ultra-low-cost, portable, lightweight, high-performance wavefront auto refractometer

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Abstract

Purpose: Uncorrected refractive errors are a major public health concern. Most autorefractors are bulky, expensive and have limited adoption in low-resource settings. The aim of the study was to validate the performance of a simple, portable autorefractor (PA) against subjective refraction (SR) and open field autorefractor (OFA).

Methods: Refractive error was assessed without cycloplegia on consecutive adults (BCVA 20/20) in a prospective study over five months. Subjects underwent objective retinoscopy, and subjective refraction measurements using the PA and OFA. Agreement between the PA and the other methods was evaluated using Bland-Altman analysis.

Results: On 132 subjects (30.53 ± 9.36 years), the mean paired differences (95% limits of agreement) between the PA and SR were –0.0862 (-0.1975 to 0.0252), 0.0607 (-0.0291 to 0.1505) and 0.0308 (-0.0820 to 0.1435) and that between PA and OFA was -0.1326 (-0.2512 to -0.0140), -0.0002 (-0.1055 to 0.1051) and -0.1276 (-0.2438 to -0.0114) for spherical equivalent (M), J0, and J45 (astigmatic components of power vectors), respectively. The study device (PA) agreed within 0.5 D of SR and OFA in 84.1% and 78% of eyes respectively for spherical equivalent power.

Conclusions: The study found strong agreement between the measurements obtained with the portable auto refractometer against subjective refraction and open-field autorefractor.