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Analyzing Skull Base Imaging Using Machine Learning to Predict the Risk of Spontaneous CSF Leak

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Comparison of Multiple IOL Power Calculation Formulas Using Keratometric Data From a Scheimpflug Camera vs. Swept-Source OCT
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Mentor: Ronald R. Krueger
Program: Ophthalmology
Type: Original Research

Background: IOL calculation formulas can use multiple different metrics to run their calculations before cataract surgery. The purpose of this study was to analyze the accuracy of multiple intraocular lens power calculation formulas using the IOL Master 700 keratometry (K) and total K (TK) measurements metrics and the Pentacam K and equivalent K readings (EKR).

Methods: This was a retrospective analysis of consecutive patients submitted to phacoemulsification. Inclusion criteria were patients with good quality scans from both devices on the same day, visual acuity of 20/40 or better at the 1-month postoperative visit, and no surgical complications. Patients with previous surgery, other ophthalmic disorders, and history of eye trauma were excluded. Initial screening identified 45 out of 59 eligible patients. Only one eye per patient was included. Assessment compared the keratometric data among devices and each formula's mean absolute error (MAE) using different keratometric input and patients within 0.25 D, 0.50 D and 1.00 D of the predicted error. Postoperative refraction was assessed at one month postoperatively.

Results: Keratometric variables were normally distributed, and a repeated measures ANOVA was found to be statistically significant (p < 0.01). Post-hoc analysis showed a statistical difference between IOL Master K and TK (p < 0.01) and the IOL Master TK and Pentacam EKR (p < 0.01). Regarding the IOL formulas calculation, the EVO IOL Master K performed best (± 0.50 D = 96%, MAE = 0.24 D), followed by the Pearl DGS TK (± 0.50 D = 93%, MAE = 0.21 D) and the Pearl IOL Master K (± 0.50 D = 93%, MAE = 0.26 D).

Conclusion: Formula choice should take into consideration which keratometric values are being used. Also, using Pentacam K, especially the EKR, did not improve any formula accuracy. Future analysis will include optimization of A-constants, assessment other IOL types, and stratification of subjects by groups of interest. ■

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Association Between Mortality and Early Post-operative Ambulation After Distal Femur Fracture Fixation in Elderly Patients
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Type: Original Research

Background: There has been an increased interest regarding the impact of ambulation on outcomes in elderly patients who sustain lower extremity fractures. This study sought to evaluate the effect of early postoperative ambulation on postoperative mortality in elderly patients who sustained distal femur (DF) fractures.

Methods: This is a retrospective review of patients ≥65 years of age who underwent open reduction internal fixation (ORIF) of a DF fracture. Subjects were divided into all-comer and isolated injury cohorts. Both cohorts underwent statistical analysis to evaluate associations between both the modified 5-factor frailty index (mFI-5) and postoperative ambulation with regard to mortality at 30-days and 1-year.

Results: Patients who ambulated within the first three postoperative days had an odds ratio of 3.41 of survival at one year compared to those who did not, independent of whether they had 1 or >1 fracture (p=0.028, 95% CI 1.144-10.143); this was statistically significant in both the all-comer (p=0.037) and isolated...
Analyzing Skull Base Imaging Using Machine Learning to Predict the Risk of Spontaneous CSF Leak

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Background: Elevated intracranial pressure (EIP) and idiopathic intracranial hypertension (IIH) are associated with erosion of the skull base, which may lead to spontaneous CSF leak or encephalocele. Prior research has identified expansion of the foramen ovale (FO) as a radiologic marker associated IIH, spontaneous CSF leak, and encephalocele. We hypothesized that a convolutional neural network (CNN) could be trained to identify and measure the FO to identify patients at high risk of IIH or spontaneous CSF leak.

Methods: CT studies from 295 normal patients were manually segmented using 3D Slicer to train a CNN using the U-Net architecture for image segmentation. We evaluated the accuracy compared to manual measurements of the FO in a dataset of 264 patients with IIH, CSF leak, or encephalocele that were obtained by 2 observers using digital calipers.

Results: The CNN performed estimations of the FO area that were different by a mean of 0.4 to 0.5 mm² (1.8 to 2.2% of the foramen area) from the manually segmented foramen measurements of the same imaging studies. This compared favorably with the manual measurements of the FO in the dataset of 264 patients, which had an intraclass correlation coefficient between the 2 observers of 0.85 (95% CI 0.81-0.88).

Conclusion: Automated segmentation using a CNN is an accurate and efficient method for measurement of the FO. Early identification of patients at high risk of recurrent CSF leak after surgical repair due to EIP using non-invasive methods could improve management by identifying patients in need of additional workup and treatment.

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Medications Affecting Hearing in Patients Undergoing Radiotherapy for Vestibular Schwannoma

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Background: Patients with Vestibular schwannoma (VS) undergoing definitive radiotherapy (RT) for the purpose of hearing preservation commonly experience hearing loss due to effects from both tumor and treatment; however, there is limited data evaluating the associated role of concurrent medications in hearing preservation during RT.

Methods: The baseline and post-treatment audiograms of consecutive patients who underwent definitive RT for VS between 2004 and 2018 were evaluated for hearing decline. We performed chi-squared analyses of the frequency of various clinicopathologic factors and t-tests evaluating the degree of hearing loss with the same factors. Patients without available audiograms were excluded.

Results: From 2004 to 2018, a total of 94 patients with concurrent medications listed were evaluable with both baseline and post-RT audiograms available for review. The most recent post-RT audiograms were recorded at a median of 35.7 months following RT which showed a mean increase in pure tone average (PTA) of 21.1 dB. A subset of 36 patients (38.3%) reported use of over-the-counter (OTC) analgesics (including acetaminophen and NSAIDs) during radiotherapy. The mean increase in PTA was significantly higher for patients taking OTC analgesics (25.7 dB vs 18.2 dB, p=0.030). OTC analgesic use remains a significant factor associated with PTA increase with multivariate analysis, and so does conventionally fractionated RT (CFRT). Patients taking OTC analgesics were more likely to be female than male (63.9% vs 36.1%, p=0.050) and more commonly received single fraction stereotactic radiosurgery (SRS) than CFRT (25.0% vs 3.4%, p=0.006). No other evaluated clinicopathologic factor was associated with hearing loss.

Conclusions: We found OTC analgesic use during definitive RT to be associated with greater hearing loss over the treatment course. This suggests the otoxic effects of analgesics may be additive to the ototoxic effects of radiotherapy. These results warrant further investigation.

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