▪ 437 / 2257

Intraocular pressure measurement using near infrared spectroscopy

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Purpose Despite advanced modern technology measurement of intraocular pressure is still a challenge. All systems in use depend on a indirect principle of measurement, influenced by tissue parameters. A new non invasive system to measure the intraocular pressure based on near infrared spectroscopy might overcome these limitations, by offering a real direct, non contact and non invasive intraocular pressure reading. It is based on the specific molecule absorption of near infrared radiation which is characteristically for individual molecule configurations. This principle is now being used in the human eye by measuring water molecule oscillation in the anterior chamber to assess the intraocular pressure transcorneally.

Methods 226 eyes from 113 patients were included in this study. Due to the impairment of existing pressure measuring devices, three different measuring techniques as reference methods for average calculation.were used. Following standard Goldmann applanation tonometry, corneal thickness was evaluated and Goldmann readings were adjusted according to Shah. In addition, Dynamic contour tonometry (Pascal Tonometer; SMT Swiss Mircotechnology AG, Zurich, Switzerland) was performed.

Results Intraocular pressure readings ranged between 8 and 52mmHg (mean: 17.2±5.8mmHg).Mean discrepancy between near infrared spectroscopy´s pressure values and mean of standard techniques was 4.43±3.04mmHg (Coefficient of correlation: r^2=0.95, RMSECV=2.2)

Conclusion Near infrared spectroscopy showed to be applicable in a real life environment for intraocular pressure measurement. Considering the lack of an objective intraocular pressure measuring device, results of this study suggest a high correlation between near infrared spectroscopy and standard devices.

▪ 438

Finite element model of the cornea for applanation tonometry

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Purpose Intraocular pressure (IOP) measurement is an important parameter in the diagnosis and monitoring of glaucoma. To estimate the IOP with Goldmann applanation tonometry (GAT), a pressure is applied on the cornea to form an applanated circular area of certain size. For normal human corneas the applanating and intraocular pressures are assumed tobe equal. However, recently it has been shown that applanating pressure is not always equal to true IOP, and depends on corneal thickness, curvature and rigidity. Furthermore, different refractive surgeries modify the corneal dimensions and structures thus affecting the accuracy of routine IOP measurement by GAT.

Methods An axisymmetric finite element model of cornea was developed to investigate the dependence of the true IOP on the applanating pressure and corneal biomechanical properties. Cornea was considered as varying in the thickness composite shell, exhibiting orthotropic material behaviour. Parameter nonlinear numerical analysis was performed as internal and applanating pressures were combined to model the applanation tonometry.

Results The effects of variation in each corneal variable on IOP readings was studied. The model shows that GAT is significantlyinfluenced by cornea biomechanical properties, thickness and curvature.

Conclusion The results show a good correlation with different published data, demonstrating that magnitude of error in Goldmann tonometry reading may be clinically significant in some patients.

▪ 439

Effects of physical exercise on intraocular pressure after the instillation of latanoprost eye drops

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Purpose To study the behavior of intraocular pressure (IOP) after the instillation of latanoprost eye drops and the performance of a physical aerobic exercise.

Methods 20 healthy individuals were included. The initial IOP was measured at 21:00h of the previous night, followed by the instillation of one drop of latanoprost 0.005% in their right eye. 12 hours later (on the peak of the latanoprost effect), the IOP of both eyes was measured again. The individuals performed a physical aerobic exercise of moderate intensity on a bicycle ergometer for about 10 minutes (at 60-80 watts) and the IOP was measured again.

Results The mean IOP of the right eyes before the latanoprost instillation was (mean±SD) 14.08±1.78mmHg and after 12 hours 11.10±1.79mmHg (statistically significant difference, P<0.001). After the completion of the physical exercise the mean IOP of the right eyes was 9.25±1.90 mmHg (P<0.001). As regards the left eyes, mean IOP before the latanoprost instillation on the fellow eye was 14.35±2.10mmHg and after 12 hours 14.25±1.66mmHg (not a statistically significant difference, P=0.733). Post exercise, mean IOP of the left eyes was 12.13±1.58mmHg (statistically significant difference, P<0.001). There was no statistically significant difference (P=0.094) between the two eyes, as regards the magnitude of the IOP reduction following the physical exercise.

Conclusion The instillation of latanoprost does not exclude the IOP reduction caused by physical exercise.

▪ 440

Differences in Central and Peripheral Tonometry with ICare® Rebound Tonometry as a Function of Age

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Purpose To evaluate the influence of age on the measurements and relationships among central and peripheral IOP readings taken with a rebound tonometer

Methods Three repeated measurements of intraocular pressure were taken with the ICare® rebound tonometer on the right eye of two-hundred and seventeen patients (88 males, 129 females), aged 18 to 85 years (mean ± SD, 45,9±19,8 years), at the center and 2 mm from the nasal and temporal limbus along the horizontal meridian. Three age groups were established as being less than 30 years old (n=75), from 31 to 60 years old (n=77) and above 60 years old (n=65)

Results There was a high correlation between central and peripheral IOP readings, with central reading being higher than peripheral ones, despite lack of statistical significance. The higher IOP values were found within the younger group for the central location. Subjects within the older group (above 60 years of age) presented significantly lower temporal IOP readings than the remaining two groups (p<0,001), while no significant differences were found among groups for central and nasal IOP readings (p=0,099 and p=0,225, respectively). There was a significant decrease in nasal and temporal IOP readings as the age increases (p=0,011 and p=0,006, respectively), what was not the case for central measurement (p=0,059)

Conclusion Peripheral rebound tonometry reflects a behavior as a function of age that central readings did not. Older patients have significantly lower values than the middle-aged and older patients in the temporal peripheral location. There is a trend towards a significant decrease in peripheral IOP as a function of age while central readings did not display such a trend