During our preliminary studies correlating frequent ocular tension measurements with other physiologic and biochemical parameters in man, we noted that intraocular tension was lowest in the early morning, generally around 3 A.M., in all subjects. This observation is at variance with most published data reporting lowest values during the afternoon. Short-term fluctuations in ocular tension were also observed in this study.

Eleven subjects, five normal subjects and six subjects with various types of glaucoma (juvenile glaucoma, steroid-induced glaucoma, unilateral traumatic glaucoma, pigmentary glaucoma, and chronic simple glaucoma) were examined. Each subject was placed at bed rest for a minimum of 24 hours during which time studies were conducted. Glaucoma subjects had their medications discontinued at least 24 hours prior to the start of the testing. Ocular tension was measured hourly or more frequently (every 20 minutes for several hours) using a calibrated MacKay-Marg electronic tonometer. All subjects were able to tolerate this repeated tonometry either with no anesthetic agent or with dilute (1:10 in sterile water) Ophthaine. No corneal damage was noted during or subsequent to the testing. The average of five good traces was recorded as the ocular tension. Other parameters measured in some but not all subjects included plasma samples taken every 20 minutes by venous catheter for assay of endogenous cortisol and growth hormone, and hourly blood pressure, pulse rate, rectal temperature, as well as polygraph recordings of electroencephalogram, EOG, and chin electromyogram done during nocturnal sleep hours (11 P.M. to 7 A.M.).

The lowest ocular tension was recorded in all eleven subjects during the early morning hours (2 to 4 A.M.). All six glaucoma subjects had a tension below 20 mm. Hg at this time regardless of the level of their ocular tension during the day. Unexpected was the finding of short-term fluctuations in ocular tension noted in both normal and glaucomatous eyes. Differences of from 5 to 9 mm. Hg were noted in one hour, and 3 to 4 mm. fluctuations were found over 20 minute sampling periods. In all instances both eyes showed fluctuations of intraocular tension in a similar direction at the same time. Fig. 1 is the diurnal record of a 42-year-old white male with unilateral glaucoma secondary to traumatic angle recession. His ocular tension has been difficult to control with any combination of medical therapy. His record shows that without therapy he attains a normal ocular tension in his diseased left eye early in the morning. His normal right eye also has its lowest ocular tension during the same hours. Fig. 2 is a composite of the diurnal traces of all eleven subjects; all had their lowest ocular

![Fig. 1.](https://iovs.arvojournals.org/pdfaccess.ashx?url=/data/journals/iovs/933603/)
tensions in the early morning. Fig. 3 is a composite of the ocular tensions in the 10 glaucomatous eyes (4 bilateral subjects, 2 unilateral subjects). The solid line represents the mean tension of the 10 eyes, while the dots represent the scatter. A single dot may represent values for several patients if they had identical tensions. Fig. 4 is a composite of the ocular tensions in the 10 normal eyes (5 bilateral subjects).

The present study is difficult to compare with previous reports as no other investigators have studied hourly ocular tensions for a full 24-hour period. Even those studies which have been performed "around the clock" were at intervals ranging from 2 to 6 hours, and generally no more frequent than every 3 to 4 hours. Langley and Swanljung1 in one of the most comprehensive studies to date recorded Schiötz tensions every two hours from 5 A.M. to 11 or 12 P.M. Consideration of their figures indicates that they did not detect the low early morning tensions as found in the present study because of the timing of their measurements. It is important to recognize that all of our subjects had a normal sleep-waking cycle in their daily lives; i.e., they routinely slept from approximately 11 P.M. to 7 A.M. Investigation of different sleep-wake times may demonstrate different temporal 24-hour patterns. Short-term
fluctuations in intraocular pressure, particularly in the early morning, have not received prior comment, and need to be evaluated more fully. If such fluctuations are common to all or most individuals, at all times of day, then the question of single ocular tension recordings and their significance must be reconsidered. The observation that intraocular tension drops to normal levels in the early morning even in severe glaucoma needs further confirmation in a larger group of patients. If this should prove the rule, then the question of appropriate nighttime medication for glaucoma subjects may need further study. The relationship between the diurnal fluctuations in intraocular tension and other physiologic parameters is presently under investigation as part of a larger study of the relation of sleep-waking cycles to clinical problems.

Recording of hourly intraocular tension measurements may prove of value in the study of aqueous dynamics in normal and glaucomatous eyes. The present study shows that such repeated measurements are feasible without damage to the eye.

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REFERENCES

Laser trabeculotomy in monkeys.† DAVID M. WORTHEN AND M. GARY WICKHAM.

The site of the greatest resistance to aqueous outflow in the monkey eye appears to be in the trabecular meshwork interior to Schlemm’s canal.†, ‡ Perfused human eyebank eyes behave the same way.§ The purpose of this study was to evaluate the effect of an argon laser on the trabecular meshwork in monkeys as seen at a microscopic level.

Four (4) Cebus and two (2) Macaca monkeys were tranquilized with Serynlan, then anesthetized with Nembutal. A Coherent Radiation Model 900 argon laser connected to a Zeiss photo slit lamp was used to deliver the argon laser beam. Treatments were done utilizing a 50 micron beam...