Gravity Does Not Affect Lens Position During Accommodation

Using the Lenstar LS 900 biometer, Lister et al.[1] measured the change in anterior chamber depth and lens thickness of 13 young (18–21 years old) and 10 older (50–63 years old) subjects in the upright position, and in the prone position before and during maximum voluntary and pilocarpine-stimulated accommodation. They concluded that the reduction in anterior chamber depth in the prone position during high levels of accommodation slackens the zonules sufficiently to allow the lens to move under the effect of gravity.

Based upon a careful assessment of the authors' measurements (and contrary to their conclusions), their experiment demonstrates that the reduction in anterior chamber depth in the young subjects, associated with a change from the upright to the prone position, is virtually identical under the baseline condition (no drug/minimal accommodation) and following maximum voluntary accommodation (no drug/maximum accommodation), see the Figure. When the young subjects (mean age 20.9 years), who have a mean accommodative amplitude of approximately 11 diopters,[2] were placed in the prone position while maximally voluntarily accommodating, their anterior chamber decreased approximately 40 μm more than when they were upright; however, when these young subjects were not accommodating (no drug/minimal accommodation) the anterior chamber also decreased approximately 40 μm in the prone position more than when they were upright. Furthermore, this small difference in anterior chamber depth of 40 μm is more likely due to the variability/repeatability of the measurement system,[3,4] rather than any movement of the lens due to gravity.

Evidence for this interpretation comes from comparing the reductions in anterior chamber depths when the unaccommodated (no drug/minimal accommodation) younger and older subjects were placed in the prone position. Movement due to gravity of the lens under these baseline conditions in either group depends upon the weight and equatorial diameter of the lens. The average weight and equatorial diameter of lenses in the younger and older groups were 178 and 230 mg, and 8.8 and 9.5 mm, respectively.[5–7] Since the older lenses were 52 mg heavier and their equatorial diameters were 70 μm larger than the younger lenses, the two parameters that affect movement of the lens by gravity favor much greater movement in the older eyes under these baseline conditions. The older lenses, due to their increased diameter, have reduced zonular tension and support, while they are approximately 30% heavier. The effect of gravity on lens position should be greatest in the older subjects, rather than in the younger subjects. The authors found the opposite with the prone minus upright anterior chamber depth of approximately 40 and 15 μm for the younger and older subjects, respectively.

Compared to unaccommodated young subjects, the anterior chamber depth was reduced an additional approximately 20 and 30 μm, respectively, between the prone and upright positions in the young subjects who received pilocarpine and did not voluntarily accommodate (drug/minimum accommodation) and when they received pilocarpine and maximally accommodated (drug/maximum accommodation), respectively. These minimal additional reductions in anterior chamber depth probably reflect drug-induced smaller pupil size[8] instead of an actual difference in anterior chamber depth due to movement of the lens.

The Lenstar LS900 routinely specifies pupil size and axial length, which does not significantly change with position.[9] The authors did not provide these parameters which may have offered an additional means for interpreting the accuracy of their measurements.

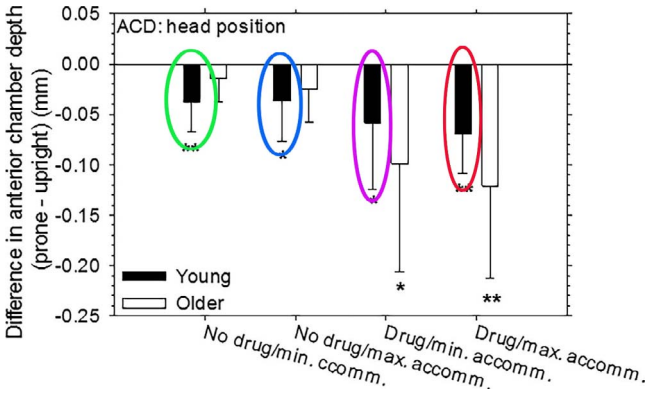

FIGURE. A reproduction of the authors' Figure 3C graph of the difference in anterior chamber depth (prone-upright). Note that for the young subjects there is essentially no difference between the prone and upright positions in anterior chamber depth during no drug minimum accommodation (circled in *green*) and no drug maximum accommodation (circled in *blue*). In the young subjects, following drug/minimal accommodation (circled in *purple*) and drug/maximum accommodation (circled in *red*) the anterior chamber reduction is approximately 20 and 30 μm greater than no drug/minimal accommodation (circled in *green*), respectively. These minimal differences probably reflect drug-induced smaller pupil size[8] and the variability in the measurement[3,4] rather than an actual difference in anterior chamber depth.

In summary, based upon an analysis of the available data presented by the authors, the small positional difference in anterior chamber depth most likely reflects the inherent variability of the measuring system as opposed to any movement of lens position associated with an effect of gravity. Within experimental error, during maximum accommodation in young subjects, anterior chamber depth is not altered with positional change from the upright to the prone position. This observation is consistent with the Schachar mechanism of accommodation.[10]

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