of the results of this study with those from earlier investigations.

Conflict of interest
The authors declare no conflict of interest.

References

1 Quaranta L, Konstas AGP, Rossetti L, Garcia-Feijoo J, O'Brien C, Nasr MB *et al.* Untreated 24-h intraocular pressures measured with Goldmann applanation tonometry vs nighttime supine pressures with Perkins applanation tonometry. *Eye* 2009. [Epub ahead of print 4 December 2009].
2 Whitty HPB. Trial results of a hand-held applanation apparatus. *Br J Ophthalmol* 1969; **53**: 664–669.
3 Baskett JS, Goen TM, Terry JE. A comparison of Perkins and Goldmann applanation tonometry. *J Am Optom Assoc* 1986; **57**: 832–834.
4 Wingert TA, Bassi CJ, McAlister WH, Galanis JC. Clinical evaluation of five portable tonometers. *J Am Optom Assoc* 1995; **66**: 670–674.
5 Wozniak K, Köller AU, Spörl E, Böhm AG, Pillunat LE. Intraocular pressure measurement during the day and night for glaucoma patients and normal controls using Goldmann and Perkins applanation tonometry. *Ophthalmologe* 2006; **103**: 1027–1031.
6 Brubaker RF. Flow of aqueous humor in humans. *Invest Ophthalmol Vis Sci* 1991; **32**: 3145–3166.
7 Liu JHK, Zhang X, Kripke DF, Weinreb RN. Twenty-four-hour intraocular pressure pattern associated with early glaucomatous changes. *Invest Ophthalmol Vis Sci* 2003; **44**: 1586–1590.

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Sir,
Response to Weinreb *et al*

We thank Drs Weinreb, Liu, and Medeiros for their time and effort to respond to our article 'Untreated 24-h intraocular pressures measured with Goldmann applanation tonometry *vs* nighttime supine pressures with Perkins applanation tonometry'. The authors raise good questions to which we respond below.

1. *A daytime Goldmann vs Perkins sitting pressure:* We agree that such a measurement would have provided more information. However, there were several issues that led us to our design:

   a. *Usual practice*: Most clinicians use Goldmann for daytime measurements and we wished to emulate clinical practice as much as possible during the study.
   b. *Study goal*: Even if we had compared daytime Goldman and Perkins pressure, the small mechanistic differences between the two tonometers would remain despite the fact that both use a similar applanation technique. Therefore, for the purpose of this study, we assumed the interchangeability of the two tonometers for assessing sitting and supine daytime pressures. As this was an unsupported study, this design allowed us to focus our resources on nighttime measurements, which is the main purpose of the study.

2. *The Perkins tonometer measurements for both nighttime sitting and supine measurements:* Again, we agree that this measurement would have provided more information. However, Goldmann applanation tonometry is the gold standard for measuring the intraocular pressure. Consequently, if we had used the Perkins only at night then we would have lost the opportunity to establish untreated sitting pressures during this time period measured by the gold standard. There was a trade off in design with either choice.

3. *The 10 : 00 inclusion criterion of 22 mm Hg and selection bias:* The authors' letter raises an interesting point that some glaucoma patients with low morning pressures could have been excluded from the study. We chose this level of pressure as an entry criterion for several reasons:

   a. A pressure level of 22–24 mm Hg is a commonly used inclusion criterion in clinical trials that helps excludes patients without disease or with normal-tension glaucoma.
   b. It provided an ability to recruit known patients from the authors' databases in a reasonably efficient manner.
   c. Patients with a low morning pressure would have required multiple measurements throughout the day to identify the time of their elevated pressure, which would have been an inconvenience to the patients and clinic staffs.

   We believe the number of glaucoma patients missed by our definition was few because most patients have their highest diurnal pressure in the morning.[1,2]

4. *The definition of day and night pressure cycles and the literature:* We appreciate this point again. Although studies differ in the results of untreated nighttime pressure curves, we chose a 12-h definition because in many, but not all, trials the late evening pressure (2200 hours) more closely relates to the mid-nighttime pressure (0200 hours) than the daytime curve (please see Table 1).[3–9] However, based on Table 1, no matter how evening pressures are defined for the purpose of analysis, such divisions do not necessarily always conform to physiological function.

The above observations highlight the general challenges mentioned in our paper that nighttime measurement of the intraocular pressure provide multiple problems that might be solved with future research.

1. *How should the nighttime intraocular pressure be measured*? Although Goldmann applanation tonometry is the gold standard in measuring the

Table 1 Pressure levels from untreated 24-h curve studies and various time intervals

Time interval (hours)	*Reference number*					
	4	5	6	7	8	9
1730–1800	26.3	26.7	28.1	21.4	20.5	20.2
2130–2200	24.8	24.9	26.4	20.7	18.0	19.5
0130–0200	24.8	24.3	25.3	21.2	24.2	21.0
0530–0600	27.1	27.7	28.8	25.1	25.0	22.5
0930–1000	27.7	28.9	29.5	26.4	19.8	20.5
1330–1400	27.2	26.9	28.3	22.3	20.0	20.5

pressure, it is obviously not perfect, and new and better tonometers, which provide more accurate and consistent readings, are needed for routine clinical practice. Further, what method should be used to most accurately measure nighttime pressures in a time period when the patient is asleep and recumbent?

2. *Are nighttime pressures important in evaluating glaucoma?* The literature differs with regard to the importance of pressures measured outside normal office hours, both with regard to peak pressure and long-term progression associated with pressure fluctuations.

3. *How could nighttime pressures be assessed in routine clinical practice?* It is difficult for clinicians to measure nighttime pressures to assess a patient's glaucoma. A recent study by Konstas *et al*[1] showed that if 2 mm Hg was added to the peak daytime pressure (measured at 1000, 1400, or 1800 hours), the value captured 98% of the 24-h peak pressures (Internal data, PRN). Consequently, it may be possible in routine practice in the future that most nighttime pressures could be assessed by assessing an appropriate series of daytime pressure points.

Again, we thank Drs Weinreb, Luis, and Medeiros for their comments about our paper. Their letter nicely highlights the need for further research regarding the best way to measure nighttime pressures, its influence on primary open-angle glaucoma, and the best way to assess these pressures in routine clinical practice.

Conflict of interest
The authors declare no conflict of interest.

References

1 Konstas AG, Mikropoulos D, Kaltsos K, Jenkins JN, Stewart WC. 24-hour intraocular pressure control obtained with evening versus morning dosed travoprost in primary open-angle glaucoma. *Ophthalmology* 2006; **113**: 446–450.
2 Konstas AG, Mantziris DA, Stewart WC. Diurnal intraocular pressure in untreated exfoliation and primary open-angle glaucoma. *Arch Ophthalmol* 1997; **115**: 182–185.
3 Hoyng PF. Verification of the biphasic response in intraocular pressure during treatment of glaucoma patients with 3% guanethidine and 0.5% adrenaline. *Doc Ophthalmol* 1981; **51**: 161–173.
4 Konstas AG, Pikilidou MI, Tsironi S, Mikropoulos D, Kozobolis VP, Sarafidis PA *et al*. 24-hour intraocular pressure and blood pressure levels with latanoprost/timolol fixed combination versus timolol. *Curr Eye Res* 2009; **34**: 369–377.
5 Konstas AG, Mikropoulos D, Haidich AB, Ntampos K, Stewart WC. 24-hour intraocular pressure control with the travoprost/timolol fixed combination compared with travoprost when both are dosed in the evening in primary open-angle glaucoma. *Br J Ophthalmol* 2008; **93**: 481–485.
6 Konstas AG, Tsironi S, Vakalis AN, Nasr MB, Stewart JA, Nelson LA *et al*. Intraocular pressure control over 24 hours using travoprost and timolol fixed combination administered in the morning or evening in primary open-angle and exfoliative glaucoma. *Acta Ophthalmol Scan* 2009; **87**: 71–76.
7 Quaranta L, Miglior S, Floriani I, Pizzolante T, Konstas AG. Effects of the timolol-dorzolamide fixed combination and latanoprost on circadian diastolic ocular perfusion pressure in glaucoma. *Invest Ophthalmol Vis Sci* 2008; **49**: 4226–4231.
8 Sit AJ, Weinreb RN, Crowston JG, Kripke DF, Liu JH. Sustained effect of travoprost on diurnal and nocturnal intraocular pressure. *Am J Ophthalmol* 2006; **141**: 1131–1133.
9 Liu JH, Zhang X, Kripke DF, Weinreb RN. Twenty-four-hour intraocular pressure pattern associated with early glaucomatous changes. *Invest Ophthalmol Vis Sci* 2003; **44**: 1586–1590.

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Sir,
Trends in the rate of trabeculectomy

In the late 1990s and early 2000s a dramatic decline in the rate of trabeculectomy was observed; for example, a UK study reported a reduction in admissions for trabeculectomy from a peak of 38.7 per 100 000 population in 1995 to 10.6 per 100 000 in 2004.[1–3] The decrease in surgery was attributed primarily to the introduction of new ocular hypotensive medications.