

PERKINS HAND-HELD APPLANATION TONOMETER*† A CLINICAL EVALUATION

BY

J. WALLACE AND H. G. LOVELL

M.R.C. Epidemiological Research Unit, South Wales

MANY ophthalmologists measure intra-ocular pressure with the Goldmann tonometer. It is neither portable nor capable of being used with the patient supine, which is disadvantageous in glaucoma screening programmes when it is often necessary to examine sick patients in their homes. An applanation tonometer, which is portable and can be used with the patient supine, sitting, or even standing, has been described by Perkins (1965). This paper reports the results of two field trials in which a prototype of the Perkins hand-held applanation tonometer was used. Measurements obtained with it are compared with measurements made on the same eyes using a Goldmann tonometer.

Material and Methods

The prototype instrument was similar to that first described by Perkins (1965) but incorporated a few modifications. In the instrument previously presented, four electric bulbs were used to illuminate the head of the prism, whereas in the version under discussion satisfactory illumination was achieved with only one bulb. A standard Haag-Streit applanation prism, as used in the Goldmann instrument, was utilized and the only other modification was to the adjustable forehead rest.

With the Perkins tonometer, the pressure is read directly from a scale calibrated in mm. Hg. The instrument can be operated from the mains electricity supply using a transformer or, alternatively, from a standard 6-volt power pack. It is held in precisely the same manner as an ophthalmoscope. The force of the prism is adjusted to 1 g. as in the Goldmann instrument, and after the forehead rest is applied the instrument is simply rotated until the prism makes contact with the centre of the cornea. The fluorescein "rings" are viewed through a +20 D lens and the pressure is adjusted *via* a knurled wheel acting on a spring. The end-point is reached as for the Goldmann tonometer.

The instrument was used during surveys in Jamaica and South Wales in late 1966 and early 1967. In both areas, intra-ocular pressures were also obtained with the Goldmann tonometer, the order in which the instruments were used being reversed for alternate patients. The comparative study was confined to left eyes; fundus photographs were being taken and it was felt that the epithelial changes resulting from repeated tonometry would impair their quality. The observer in both surveys was the same (J.W.).

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† Address for reprints: Dr. J. Wallace, Department of Ophthalmology, Cardiff Royal Infirmary, Cardiff.

Results

The distribution of the difference between the Perkins and Goldmann measurements on the same eye is shown for 174 Jamaicans in Fig. 1 and 232 residents of South Wales in Fig. 2. In the Jamaican data, the values obtained with the Perkins tonometer exceeded those obtained with the Goldmann instrument by an average of 0.34 mm. Hg, but the standard error of this mean difference was 0.20 so that it does not differ significantly from zero. In South Wales, however, the Goldmann readings were higher than those of the Perkins tonometer by an average of 0.56 mm. Hg, and, since the standard error of this mean difference was only 0.09, this was a very highly significant difference ($t = 5.9$). The variance of the difference between pairs of readings was 6.87 in Jamaica and 2.06 in South Wales and these two values are very significantly different.

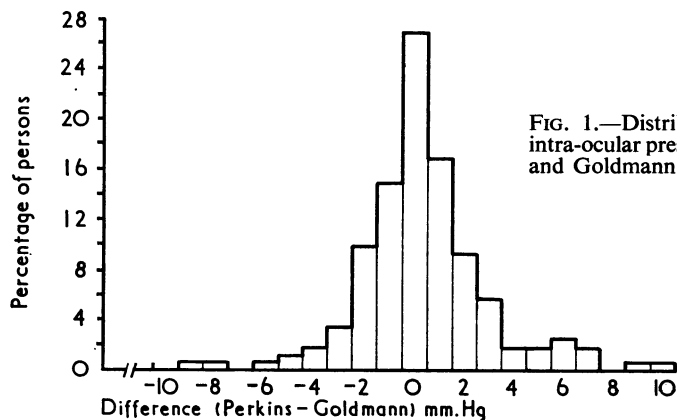


FIG. 1.—Distribution of differences between intra-ocular pressures obtained with the Perkins and Goldmann tonometers in Jamaica.

FIG. 2.—Distribution of differences between intra-ocular pressures obtained with the Perkins and Goldmann tonometers in South Wales.

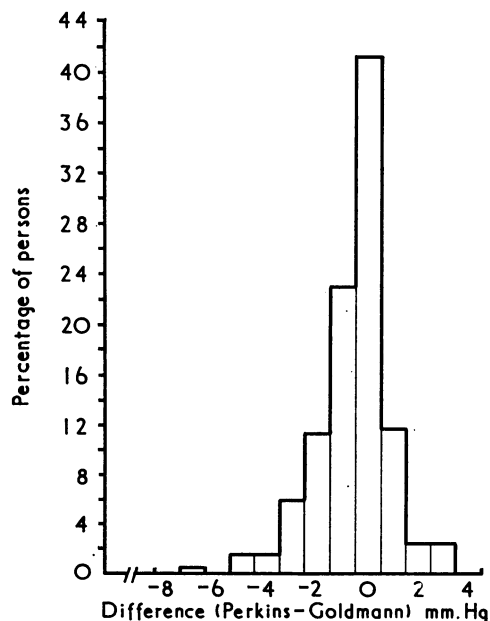


Fig. 3 gives the distribution of the pressures obtained with the Perkins tonometer in the first (Jamaican) survey. There was a remarkable amount of terminal digit preference at that time; the ratio of odd numbers to even numbers was only 61 : 113 which is very highly significant. However, the ratio in the later survey was 105 : 127, which is not significant.

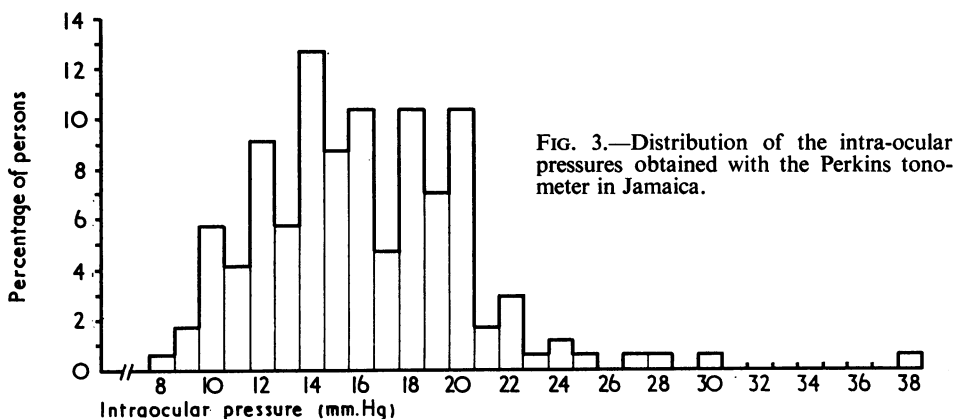


FIG. 3.—Distribution of the intra-ocular pressures obtained with the Perkins tonometer in Jamaica.

The correlation coefficient between a pair of measurements on the same subjects was 0.79 in Jamaica and 0.89 in South Wales. A scatter diagram showing the relationship between the results obtained by the two methods in the Jamaican survey is given in Fig. 4 (opposite) together with a line drawn at 45° to the axes. The sets of linear regression equations are:

$$P_J = 0.94 G_J + 1.32$$

$$G_J = 0.67 P_J + 5.03$$

$$P_W = 0.79 G_W + 3.80$$

$$G_W = 1.02 P_W + 0.18$$

where P = Perkins, G = Goldmann, J = Jamaica, and W = Wales.

Discussion

The Perkins tonometer was used in the present studies with a 6-volt power pack and was found to be fully portable. It was simple to use and it was particularly easy to centre the prism on the cornea. Some initial difficulty was experienced in handling the instrument because of its unfamiliarity, and this was reflected in a greater discrepancy between the two instruments in the early stages of the Jamaican study. The handling of the instrument improved rapidly with experience. During the examinations, the upper lid is held with the free hand and no difficulty with "squeezing" was encountered. On only two patients was it not possible to measure pressures. Both were of African origin and a combination of prominent frontal bones and deeply recessed orbits prevented the prism from making contact with the cornea when the forehead rest was in position. This difficulty was not encountered in South Wales and could be readily overcome by simple modifications to the forehead rest of the instrument.

It was expected that the experience of using the Perkins tonometer gained in the first survey would lead to results which were more comparable with the Goldmann measurements being obtained in the second. There was, however, a significant mean difference between the pairs of readings in the second survey and not in the first survey. This was not due to

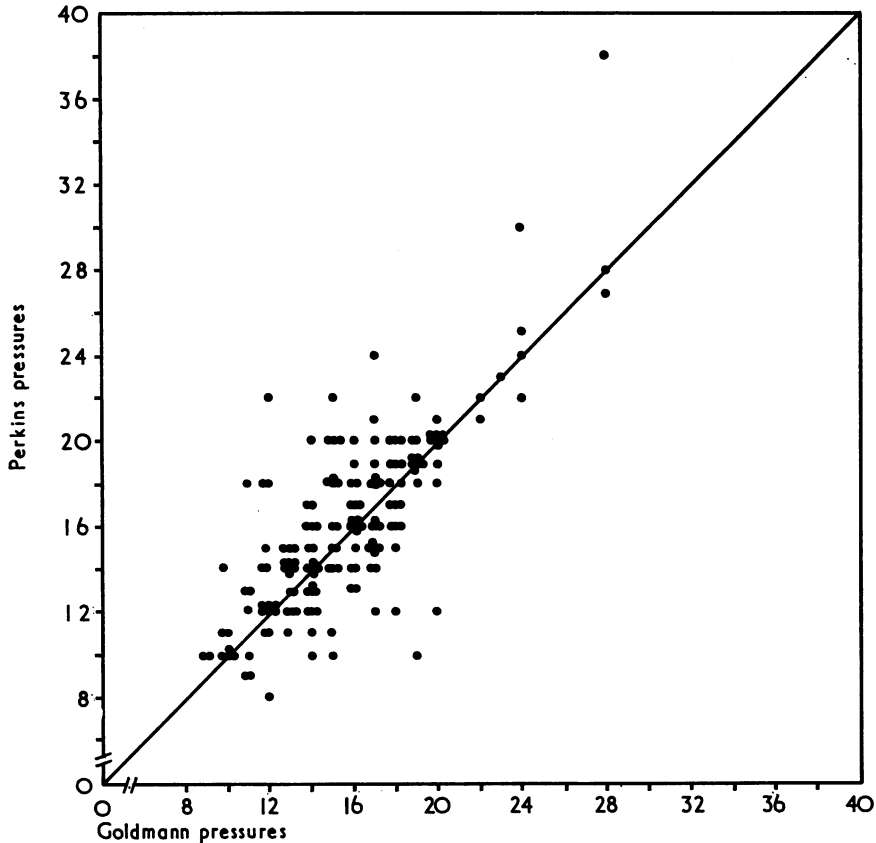


FIG. 4.—Relationship between intra-ocular pressures obtained with the Perkins and Goldmann tonometers in Jamaica.

deterioration of any part of the instrument, as recalibration after the surveys showed it to be still almost completely accurate. Paradoxically, the lack of large positive and negative differences in the second study, which may be indicative of improving agreement, increases the significance of the difference. It is noteworthy that, with added experience, came a higher correlation between the Perkins and Goldmann readings despite the increased mean difference.

A marked terminal digit preference was found in the readings obtained with the Perkins tonometer in Jamaica. The instrument was calibrated in even numbers, one division representing 2 mm. Hg. There is an appreciable gap between the levels of the reference mark and the "reading surface" of the knurled wheel from which the pressure is read. A parallax effect is therefore introduced and this largely accounts for the digit preference for even numbers. Such is not the case with the Goldmann tonometer and a simple modification to the Perkins instrument would remove this defect. The elimination of digit preference in the Welsh survey was due to more careful reading of the scale as a direct consequence of the results of the earlier survey.

In both countries, patients much preferred the Perkins to the Goldmann tonometer. With the Perkins instrument few were aware that contact with the eye had been made,

the majority being under the impression that the eye had been examined simply "with a blue light".

The advantages of the Perkins tonometer appear to be its simplicity of use, particularly the ease of centring the prism on the cornea, portability, acceptability to patients, and versatility in that the patient can be examined in the supine, sitting, or standing position. Its disadvantages appear to be that an initial learning phase is required even if the observer is experienced in handling a Goldmann tonometer, and that with some facial conformations measurements are unobtainable. Although the mean difference between the Perkins and Goldmann readings obtained in Wales was statistically significant, it was not so large as to be of great clinical importance and the, probably inexpensive, Perkins tonometer is likely to prove a useful alternative instrument.

Summary

Experience with the Perkins hand-held applanation tonometer in two ophthalmological surveys is described. There were some differences between results obtained with this instrument and others obtained with a standard Goldmann tonometer, mean differences being of the order of 0.5 mm. Hg, but the correlation between them was high. The Perkins tonometer appears to be a convenient, reliable, and portable alternative to the Goldmann instrument.

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REFERENCE

PERKINS, E. S. (1965). *Brit. J. Ophthalm.*, **49**, 591.