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ON THE VALUE OF THE
PRISOPTOMETER
IN DETERMINING THE DEGREE OF
MYOPIA.

BY H. CULBERTSON, M. D.,

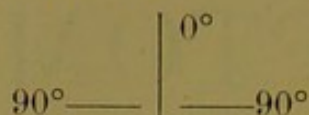
ASSISTANT SURGEON UNITED STATES ARMY, RETIRED.

THE "Prisoptometer" is an instrument invented by the writer to determine ametropia by the means of a prism. Essentially it is composed of a single prism of glass, of about 3° total refraction, the apex of which covers, and is secured over, the half of a central opening of 3. mm diameter, in a diaphragm of metal, which latter can be revolved at pleasure. The patient seated, looks through the central aperture at a *single* white circle, on a dark ground, placed at a distance from the observer, of from fifteen to twenty feet. This circle has a diameter according to the refraction of the prism, or proximity of the eye to the circle, of about 150 to 200 m.m. From the influence of the prism two images are seen. The prism being *fixed* at such a distance that the inner margins of the two images, the true and false circles, are tangent in the *emmetropic* eye. It follows that, in myopia the circles will appear to lap, and in hyperopia they will seem to be apart. It is only necessary to apply the proper lenses in front of the prism until the circles are tangent, and *these* will denote the glasses required to correct the ametropia. Astigmatism is detected in the same manner by revolving the *prism-disk*,

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so that thus the refraction of the eye can be determined quickly and accurately.

It should be stated that the scale of the instrument embraces a semi-circle, the verticle of which is 0° , and each quadrant, on the right and left, is divided into spaces of 10° each, running thus on either side from 0° to 90° .



This instrument has been accurately described in the "Cincinnati Lancet and Clinic," January 20, 1883, and as improved in the "Journal of the American Medical Association," January 5, 1884.

An article on the value of this instrument in determining the *total* and *manifest* hyperopia has appeared in the "New York Medical Journal," of March 22, 1884, p. 319.

The object of *this* paper is to decide what is the worth of this instrument in detecting myopia when the eye is, and is not, under the influence of mydriatics.

The maximum sum of dioptries of myopia shown in all the cases of the table, is greatest in those not subjected to mydriatics. Thus :

The sum of M, without mydriatics = D. 202.75.

" " " with " = D. 180.25.

" " " the difference, = D. 22.50 = 88.90 per cent.

This is a diversity in favor of the use of mydriatics to determine the absolute myopia present with the aid of the instrument, = 100.00 per cent. — 80.90 per cent. = 11.10 per cent.

In the oldest member of the table the patient's age was 57 years, and the myopia equaled D 3.0 without, and D 1.5 with mydriatics, a reduction of 50 per cent., and in favor of the employment of such agents to determine the actual degree of myopia at this age.

The youngest patient shown in the table is 12 years of age, and in this case the myopia shown, with and without mydriatics, was equal in degree.

For all the cases of the table, the mean age is 25. years ; and based upon half the sum of the dioptries of myopia shown when

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not under mydriatics ($\frac{20.2}{2} \cdot \frac{7.5}{2}$), and the sum of dioptries of the same form of ametropia in those subjected to these agents ($\frac{18.0}{2} \cdot \frac{2.5}{2}$), the age at 25 years reveals only 11.10 per cent. in favor of the use of mydriatics to determine the absolute myopia present at that age.

If the cases be classified in age—periods of five years, and the dioptries estimated, as shown in the table, in each class, both when the patients are, and are not under mydriatics, the following is the result :

| Age—Years. | Without mydriatics. | With mydriatics. | Per cent. |
|------------|---------------------|------------------|-----------|
| 12—15 | D 43.00 | D 41.50 | 96.51 |
| 16—20 | D 61.00 | D 59.50 | 96.72 |
| 21—25 | D 39.25 | D 33.00 | 84.07 |
| 26—30 | D 49.75 | D 40.00 | 80.40 |
| 31—35 | D 2.25 | D .25 | 11.11 |
| 40—45 | D 4.50 | D 4.50 | 100.00 |
| Over 45 | D 3.00 | D 1.50 | 50.00 |
| <hr/> | | | |
| Total 45 | D 202.75 | D 180.25 | |

Thus it is shown from 12 to 20 years, and from 40 to 45 years, the manifest closely approximates the absolute myopia, or is equal to it in the latter class.

The low degree of absolute myopia shown between 31—35 years = 11.11 per cent., is due, no doubt, to the limited number of cases (three), and cannot be relied upon as an accurate index of the myopia revealed by the instrument for this "age-period."

In the period "over 45 years" there are but two cases, and these, each aged 57 years. By reference to the formulæ in these examples, it will be seen that under the mydriatic the + D1c of hyperopic astigmatism disappeared in the right eye, and so also the + D 0.5c, H.A. in the left eye, leaving—D 0.75s in each eye, as the real degree of myopia. It would be more accurate to regard the astigmatism in these cases, as not hyperopic, but as simply denoting the presence of spherical myopia with less of this in a given meridian. Thus—D 1.75s— + D 1.0c = — D 0.75s in the R. E; and—D 1.25s — + D 0.5c = — D 0.75s in the left eye.

The same view in principle can be taken in cases 5, 8, 10, 11,

21, 22 and 23, it being remembered that accommodation—ciltasis—sometimes is, and again is not relaxed while being tested, and mydriatics not employed.

The "age-period," 21—25 years, reveals, through the instrument, 84.07 per cent., and that of 26—30 years 80.40 per cent. of absolute myopia, after the use of mydriatics. As 100 per cent. is the apparent myopia, without the influence of these paralyzing agents, the latter means develop at these age-periods respectively, 15.93 and 19.60 per cent. of this form of ametropia. During the "age-period," 12—15 years, 96.51 per cent. of myopia is found, or $100 - 96.51 = 3.49$ per cent. of effect due to mydriatics. From 21—25 years the power of mydriatics = 15.93 per cent., or $15.93 - 3.49 = 12.44$ per cent.; and from 26—30 years $it = 19.60$ per cent., or $19.60 - 3.49 = 16.11$ per cent. increased influence in these age-periods over the effect of such agents (mydriatics), found in those aged 12—15 years. To what is this effect due? Is it produced by the hyperopia present in these cases, shown when mydriatics have not been used? To determine the cause of this, estimate the sum of dioptries of hyperopia in the several cases up to 30 years, and deduct from the sum of dioptries of myopia found up to that age in the column "maximum myopia" of the table, which will reduce the influence of age, as a factor, in causing the augmentation shown of the myopia from the use of mydriatics.

This apparent hyperopia is evident in the following table:

| No. of cases. | D H without mydriatics. | | | | |
|---------------|-------------------------|---|---|---|-----------|
| 5 | - | - | - | - | + D 1.50 |
| 8 | - | - | - | - | + D 0.75 |
| 9 | - | - | - | - | + D 0.75 |
| 17 | - | - | - | - | + D 0.50 |
| 18 | - | - | - | - | + D 1.25 |
| 22 | - | - | - | - | + D 1.00 |
| 24 | - | - | - | - | + D 0.50 |
| 25 | - | - | - | - | + D 0.50 |
| 26 | - | - | - | - | + D 0.50 |
| 31 | - | - | - | - | + D 1.75 |
| 32 | - | - | - | - | + D 1.50 |
| 35 | - | - | - | - | + D 1.25 |
| 36 | - | - | - | - | + D 1.25 |
| <hr/> | | | | | |
| Total 13 | - | - | - | - | + D 13.00 |

Compare this with the following table:

| | |
|--|-----------|
| Total apparent myopia without mydriatics up to 30 yrs. | D 193.00. |
| “ “ hyperopia “ “ “ “ “ | D 13.00. |
| Sum of absolute myopia “ “ “ “ | D 180.00. |

Compare this last quantity with the sum of absolute myopia found after the use of mydriatics up to 30 years, and the following results :

$D 180.00 - D 174.00 = D 6.00$ of myopia, to be accounted for as an effect of age or other cause. If the $D 6.00$ of M. be divided by the number of cases, up to this age, 38, or $\frac{D 6.00}{38} = D 0.157$, this calculation reveals an average difference, per case, between the apparent and absolute myopia of but .157 of a dioptric. Hence it may be assumed that removing the influence of apparent hypermetropia, the myopia, with and without mydriatics, will be equal, as appears from the records of the instrument.

Looking at the influence of age, from 12 to 30 years (as shown in the table), in modifying the degree of myopia when this instrument is used, it is seen the well known law is corroborated that myopia diminishes as age increases.

The rule that the *weakest* concave lens which will render the images tangent is the measure of the absolute myopia, is demonstrated by the instrument in many of the cases given in the table. It is believed that in all cases of simple myopia in which the subject is capable of relaxing the ciliary muscle, that such a glass will determine through the instrument the static myopia.

With the instrument, as with concave lenses alone, the patient has the power often of bringing the images of the circle together with a stronger as well as with a weaker negative glass. Thus in cases 13 and 14 the patient can, when not under mydriatics, cause the images to touch with— $D 16$ when using the full power of the ciliary muscle; but when that muscle is relaxed— $D 12$ is *only* required to render the images tangent.

The instrument, therefore, is applicable for measuring the accommodation in many cases, and the strongest,—the weakest concave lens which induces the tangency is the glass which measures this.

What influence does a diseased state of the eye have in developing the degree of myopia present when the organ is under, or

not under the effects of mydriatics? This question is shown as follows :

| | Without mydriatics. | With midriatics. | Per cent. |
|-------------------------|------------------------|---------------------|-----------|
| Eyes diseased 12 cases. | D 95.00 | D 91.25 | 96.05 |
| “ healthy, 33 “ | D 107.75 | D 89.00 | 82.59 |
| <hr/> | | | |
| Total 45 | D 202.75 | D 180.25 | 13.46 |

Thus in those with *diseased* eyes the myopia with (96.05 per cent.), and without (100.00 per cent.), the agency of mydriatics is nearly equal, being only 3.95 per cent. greater in those not subjected to such agents. In those whose eyes are not diseased the difference is greater under and without mydriatics; or $100 - 80.59 = 17.41$ per cent. in those not subjected to mydriatics.

The presence of disease of the eye in these cases, while not practically interfering with the determination of the degree of myopia, has, therefore, a tendency to render the absolute myopia more readily detected; and the absence of mydriatics to mask a portion of the myopia, in the use of the instrument, in eyes not diseased.

The influence of the several mydriatics employed may be expressed as follows :

| Mydriatic. | With mydriatic. | Without mydriatic. | Per cent. |
|--------------|-----------------|--------------------|-----------|
| Hyoscine. | D 54.50 | D 59.50 | 91.26 |
| Duboisine, | D 101.75 | D 115.25 | 88.28 |
| Homatropine, | D 7.50 | D 11.50 | 65.21 |
| Atropine, | D 16.50 | D 16.50 | 100.00 |
| <hr/> | | | |
| Cases 45 | D 180.25 | D 202.75 | |

It is thus apparent that the hyoscine exercised the greater influence upon the accommodation, the duboisine less, the homatropine still less, and the atropine the least, or none at all. The latter result cannot be due to the inefficacy of the agent, but this defect is probably due to the effects of choroiditis present in this class of cases. The result in the case of the homatropine cannot be attributed to disease, so that it is the least potent of the mydriatics.

Practically hyoscine and duboisine are equal in their effects upon the accommodation; and as the former acts more rapidly

and its effects pass off sooner, it may be preferred to the latter agent. This conclusion is based upon the cases of the table, but experience with the use of hyoscine corroborates this view.

In general a larger number of cases may change the results formed in these examples of myopia, still they point to the value of the instrument in detecting myopia.

As is well known, hyperopia may mask myopia, the degree so covered is shown as follows :

| Case. | | | | | | Total myopia found after use of mydriatics. |
|----------|---|---|---|---|---|---|
| 5 | - | - | - | - | - | D 1.50 |
| 8 | - | - | - | - | - | D 1.00 |
| 9 | - | - | - | - | - | D 1.00 |
| 17 | - | - | - | - | - | D 0.75 |
| 18 | - | - | - | - | - | D 0.75 |
| 22 | - | - | - | - | - | D 0.50 |
| 24 | - | - | - | - | - | D 0.50 |
| 25 | - | - | - | - | - | D 0.50 |
| 26 | - | - | - | - | - | D 1.25 |
| 31 | - | - | - | - | - | D 2.50 |
| 32 | - | - | - | - | - | D 2.25 |
| 35 | - | - | - | - | - | D 1.25 |
| 36 | - | - | - | - | - | D 0.75 |
| Cases 13 | - | - | - | - | - | D 14.50 = 89.65 per cent. |

Thus in the 13 cases showing hyperopia, there is 14.50 dioptries of *absolute* myopia. In the same cases there has been found 13.00 dioptries of hypermetropia. Compare these as 14.50: 13.00 :: 100.00: 89.65 per cent. That is all save 10.35 per cent. of the myopia of *these* 13 cases is masked by hypermetropia.

CONCLUSIONS.

1. That the maximum of apparent myopia is greater in those not subjected to mydriatics, as determined by the instrument.
2. That in many cases the *mydriatic* and *non-mydriatic* myopia are equal.
3. That in many cases of simple myopia, the *accommodative* myopia can be determined with the instrument, and hence the *force* of that muscle ascertained through its agency.
4. That hyperopia may mask a large proportion of the myopia, 89.65 per cent., when mydriatics are not employed.

5. That the pressure of disease in the eyes of the patients in these cases did not seriously interfere with the ascertainment of the myopia present.

6. That an instrument capable of detecting, as an average, 88.11 per cent. of myopia without the use of mydriatics, may be regarded as practically adapted to that purpose.

Finally, it should be stated that in the cases of the table each result obtained from the instrument was compared with the vision found by the use of the test-types, and they were alike in each example.

This instrument is manufactured by Messrs. Geo. Tiemann & Co., 67 Chatham street, New York City.

ZANESVILLE, Ohio, March 22, 1884.

