

MYOPIA—ACQUIRED AND HEREDITARY

ELI ANTZIS

Loyola University, Chicago, Illinois

If the parallel rays of light come to an exact focus on the retina, the refractive index is that of a normal eye. But if the rays focus in front of the retina, we have a condition known as near-sightedness or myopia. Therefore, we can say that myopia is a name applied to the refraction of an eye in which there is a focus of parallel rays in front of the retina.

Types.—Myopia is divided into two types, axial and refractive. Axial myopia is due to the elongation of the posterior segment causing the retina to be pushed back, thus the converging rays focus in front of the retina. Accommodation of the eye for near and distant vision is made possible by virtue of the elastic nature of the lens under the control of the ciliary muscle and the suspensory ligament. The lens must change shape so as to converge all rays of light exactly on the retina. Thus, when the ciliary muscle contracts, it causes the ciliary process to approach the lens and the suspensory ligament to relax, so the lens rounds up, as is necessary for near vision; conversely, when accommodating the eye for distant vision, the ciliary muscle is relaxed, the ligament becomes tense and the lens flattens.

Constant contraction of the ciliary muscle not only tends to drag the walls of the eye towards the axis, but also by slightly compressing the contents to force the cornea and fundus further apart, and so of itself creates an axial myopia out of that which has so far been refractive.¹

Unless the tissues in the posterior section of the eye are loosened by disease, elongation will not occur. But if the above conditions are satisfied, and softening has resulted, elongation will take place, thus causing myopia. Myopic staphyloma is a bulge which forms when the posterior pole pushes back deeper into the orbit.

Refractive myopia occurs when there is a change in the refractive power of the media. The anomalies in the refracting

power causing myopia are as follows: (1) an abnormal convexity in the cornea with a consequent increase in its refraction; (2) spasm of the ciliary muscle by aid of which the lens becomes abnormally convex causing an increase in refraction; (3) the error produced by an improper curve which thereby alters the total refracting power of the media.²

Progress.—We can classify myopia as to the rate it might progress. If, during a period of years, the condition of myopia does not vary to any considerable degree, the condition is known as static or stationary myopia. But if the condition takes a turn for the worse and staphyloma and changes in the retina and choroid take place, causing an increase in myopia, we have a condition known as progressive myopia.

If the rays come to a focus before reaching the retina due to some defect which occurs after birth, the resulting condition is termed acquired myopia. This includes the influence of the rate of contraction on fatigue and the recovery of the ciliary muscle. The following is a result of a physiological experiment which I performed at Loyola University: "Upon the application of an electrical stimulus to a muscle, periods of latency, contraction, and relaxation occur. The intensity of the stimulus magnifies the magnitude of muscular response. When the strength of the electrical current is increased, the magnitude of the muscle contraction increases. By stimulating the muscle through a series of electrical shocks, the muscle fatigues because the products of oxidation in the muscle fibers are carried away more slowly by the circulatory fluid. During fatigue, the latent, contraction, and relaxation periods are all increased. The degree of relaxation decreases rapidly till partial tetanus occurs."

The muscles of convergence, through hyperstimulation and lack of relaxation periods at periodic intervals, with an increase in the amount of exudate re-

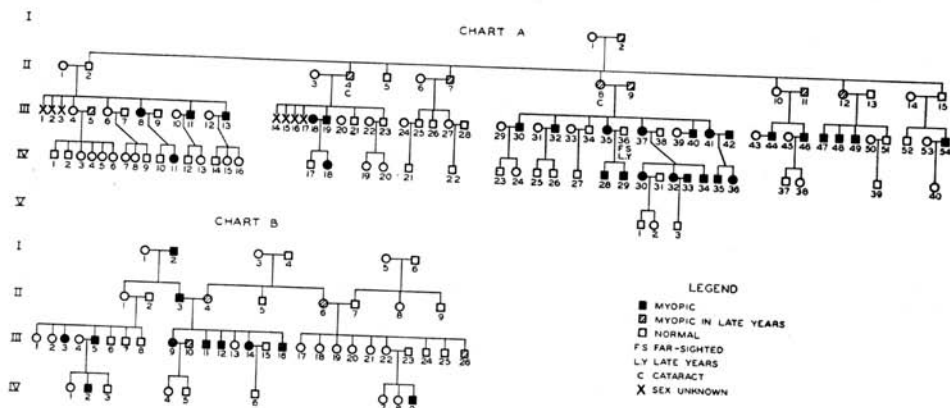


Fig. 1.—A familial study in Myopia.

CHART A—

1—the dominance of Myopia in this family is clearly shown in the third and fourth generations.

- | | |
|--|--|
| (a) 3 of 5 children (marriage of II-1 and 2) | (e) 1 of 2 children (marriage of II-14 and 15) |
| (b) 6 of 7 " " " " " " " " " " " " | (f) 2 of 2 " " " " " " " " " " " " |
| (c) 2 of 2 " " " " " " " " " " " " | (g) 3 of 3 " " " " " " " " " " " " |
| (d) 3 of 4 " " " " " " " " " " " " | (h) 2 of 2 " " " " " " " " " " " " |
- (1) IV-36 is the turning point of the younger children. She has just become 7 years old. IV-23, 24, 25, 26, 39, 40 } are all under 6 years of age.

More definite conclusions can be drawn if these children are followed through.

CHART B—

1—follow through the generations which result from I-1 and 2. Conclusion: Myopia may be acquired and definitely may be inherited.

- | | |
|---|---|
| (a) 1 of 2 children (marriage of I-1 and 2) | (d) 1 of 2 children (marriage of III-4 and 5) |
| (b) 2 of 7 " " " " " " " " " " " " | IV-3, 4, 5, 6 are under 7 years of age. |
| (c) 5 of 6 " " " " " " " " " " " " | |

maining in the muscle fibers, is found exactly as was described in the above physiological experiment. Functional or false myopia is thus produced and is considered the accumulative effect of several years.

False myopia is due to a hypertonicity sent to the ciliary. This causes the cilia muscles to flex or contract. This contraction causes an overconvexity of the crystalline lens, and light passing through a lens in such a condition is brought to a focus anterior to the retina. The light, by the time it reaches the retina is divergent, having crossed at the focal point in front of the retina. This is hastily called myopia," although actually it is pseudo-myopia. All persons, especially children, who read a book held about 4-5 inches from the eyes, develop hypertonicity of the ciliary muscles. Because of the nearness of the book, hypertonicity of the internal recti muscles occurs, causing a convergent effort in excess to that which is necessary when the book is held

the normal distance (12-18 inches) from the eyes. Accompanying the excessive convergent effort is excessive accommodation. In a short period of time, this will become a habit. The muscles go into a state of partial tetanus, and now the person must necessarily hold the book 4-5 inches from his eyes. This is a pseudo condition due to constant hypertonicity of the internal recti muscles which control convergence, and the ciliary muscles which affect accommodation. This can be relieved by resting the eyes for a short period of time; the wastes will be slowly carried away, and then the muscles will return from a state of partial tetanus to normal.

Theories.—The eye muscles are supplied by nerves from the parasympathetic (craniosacral) system. These nerves also control the visceral organs. Because of this mutual connection, a disturbance of these organs will cause the convergence-accommodation ratio to be disturbed.

This is the outstanding theory on acquired myopia.

Another causative agent is endocrine gland disturbance. The development of the secondary sex characteristics at puberty causes hormonal secretion into the blood. It is possible that this secretion would affect the ocular mechanism to cause some degree of functional myopia.

Heredity.—The eye at birth is hyperopic or far-sighted, and lacking in ciliary tonus. As development takes place, there is a physiological process of developing tonus in the ciliary muscles. Normally emmetropia is produced when the two processes are equalized, and the ciliary tonus is adjusted to focus light rays exactly on the retina. As development

continues, extreme length of the eyeball or excessive curvature of the cornea may occur, thus causing myopia. These two causes are thought to be hereditary. Dr. L. H. Snyder says, "In high myopia, some families fulfill the requirements for the dependence of the trait upon a recessive gene. In those cases, it is usually found that there is undue length of the globe. In other families, the myopia is correlated with excessive curvature of the cornea, and here we find evidence that the factor for high myopia is dominant."

BIBLIOGRAPHY

1. Refraction and Motility of the Eye—Alger.
2. *Ibid.*
3. The Genothalamic Forum, Sept., 1929—Dr. G. D. Oertel.