17 to 42 per cent. The participation of local "draining" nodes in cell-mediated hypersensitivity reactions in the cornea was discussed in the light of previous experiments on the same tissue.

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REFERENCES

Lateral inhibition and the VER in the central field of an amblyopic subject.

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Key words: VER, amblyopia, Westheimer function, lateral inhibition.

The visual-evoked response (VER) has been recorded using a small flashing light with several sizes of surround. The critical size surround producing maximum inhibition has been determined in the normal and amblyopic eye of an amblyopic subject. The critical size surround is larger in the amblyopic eye. The inhibition has been found to occur peripheral to the primary visual cortex. These results imply that at least part of the defect in functional amblyopia is located peripheral to the primary visual cortex.

The visual-evoked response (VER) does not in all cases correlate well with the psychophysical response to the same stimulus. In the case of retinal rivalry,1,2 the electrophysiologic response to the suppressed stimulus is easily recorded at the scalp, though very slightly modified. In the metachronal contrast paradigm when the stimuli are presented monocularly to the central retina as the familiar disc ring sequence of Werner,3 the detection of the disc can be completely suppressed and the VER to the disc remains intact.4 If one accepts the VER as a reflection of the activity in the primary visual cortex, it would appear that suppression of the visual image under these two conditions does not occur prior to the signal reaching the primary visual cortex.

The study of mechanisms of suppression and lateral inhibition is of importance in functional amblyopia. The neural organization in the amblyopic eye is known to differ from that of the normal eye,5,6 though the location of this organizational difference is not well delineated. Therefore, it was our purpose to examine the Westheimer function,7 a method which can measure the relative size of the inhibitory field in the normal and amblyopic eye. Westheimer7 has stated that this function is retinal in origin because it cannot be produced by a surround presented in the corresponding area of the opposite eye. We8 have found, psychophysically, that the critical area of the inhibitory field in the amblyopic eye is larger than that of the normal eye. The data presented here are the electrophysiologic correlates of our previous findings.

The stimulus was presented monocularly with the patient's refractive correction in place. The stimulus consisted of a central flashing light of variable intensity which was 2.5 minutes of arc.
Fig. 1. The relationship between the amplitude of the VER evoked by a 2.5' flashing stimulus (ordinate) and the diameter (φ) of a steady concentric surround (abscissa) is shown for three eyes. X—X, eye of a normal subject. O—O, normal eye of amblyopic subject. O—O, amblyopic eye of amblyopic subject. The curves for the normal subject and for the normal eye of the amblyopic subject are similar. The curve for the amblyopic eye is less steep and has its lowest point with a larger surround.

In diameter. Concentric with this central stimulus was a circular surround of constant intensity and variable size. The center flashed, one half second on, one half second off. The surround had an intensity of 50 ft. Lamberts and varied in size between 6.5 and 55 minutes of arc. The stimulus complex was presented on a 50 degree surround constantly illuminated at 0.7 ft. Lamberts. The intensity of the flashing light was changed with a neutral density wedge and the method of constant stimuli was used to determine the psychophysical threshold of the flashing light for each size surround. In order to collect VER data, the center flashing light was set at a luminance 2 log units above threshold and 200 responses were recorded from the scalp for each surround size. The responses were computer averaged and the amplitude and peak latency of the first two waves were measured.

Two subjects were used, one a normal individual accustomed to psychophysical experiments and the second a clinical subject with strabismic amblyopia. The second subject had a visual acuity of 20/20 in the right eye and 20/70 in the left eye. She had steady central fixation when examined with the visuscope.

VER amplitudes from one eye of the trained subject and from each eye of the amblyopic clinical subject are shown in Fig. 1. The curve for the eye of the trained subject is similar to that for the normal eye of the amblyopic subject. The lowest amplitude and longest latency of the most prominent response is found when the surround is 10 to 15 minutes in diameter. The response is significantly larger and the latency significantly shorter with smaller or larger surrounds. The response when the amblyopic eye is stimulated shows less evidence of inhibition and the greatest amount of inhibition is provided by the 25 minute surround. Fig. 2 shows the actual recording of the VER when the normal or amblyopic eye is stimulated using surrounds from 6 to 55 minutes diameter. In this patient with our electrode placement the most prominent response was a negative wave with a latency between 145 and 165 msec. for the normal eye and between 155 and 175 msec. for the amblyopic eye.

In every case, the VER amplitude showed a minimum response with the surround size similar to that which produced the highest psychophysical threshold. The fact that the critical surround size in the normal eye is larger than that found by

![Fig. 2. The VER traces from an amblyopic patient evoked by a 2.5' flashing stimulus using several sizes of steady surround for each eye. The prominent negative peak is suppressed and delayed by the 11' and 15' surrounds in the normal eye (N) and by the 25' surround in the amblyopic eye (A).](http://iovs.arvojournals.org/pdfaccess.ashx?url=/data/journals/iovs/932875/ on 10/02/2017)
Westheimer may be due to differences in stimulus size and intensity.

In accordance with the suggestion made by Westheimer, deduced from binocular psychophysical data, our electrophysiologic data shows that suppression of the stimulus occurs at some point peripheral to the primary visual cortex. Such a similarity in VER amplitude curve and psychophysical threshold curve does not exist in retinal rivalry or metancontrast. Therefore, these two phenomena must have their neural origin at a more central point. It is further noted that both the electrophysiologic and psychophysical responses from the amblyopic eye show an abnormal inhibitory field. Thus it appears that at least some of the defect in the functionally amblyopic eye is peripheral to the primary visual cortex.

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REFERENCES


Experimental cataract and wound healing in mouse lens. NANCY S. RAFFERTY. Anterior capsular cataract induced by a penetrating needle injury to the lens is being used in this laboratory as a model for studying the role of cell movements and proliferation in cataractogenesis. The injury-induced cataract model was chosen because of the specificity of the lesion and the reproducibility of the effects on the cellular behavior of the lens epithelium. The changes in the cellular organization, proliferation, and migration of the lens epithelium following a needle injury have been well described in the frog and rabbit in reports from several laboratories,1-2 and more recently in the rat.3-6 These changes consist of a protracted hyperplastic response in the injured frog lens, which generally appears grossly as a lens opacity in the living animal.7-9 A comparable hyperplastic response has not been noted in the rabbit, in which proliferation of the epithelial cells ceases when the wound is healed over.2 Furthermore, the pattern of the proliferative response differs in these species: DNA synthesis and mitosis proceed as a propagated wave outward from the wound in the rabbit and rat lens, while in the frog the proliferation begins in the outlying regions and moves rapidly toward the wound. It is not known whether the reaction of the rabbit and rat lens to injury is characteristic of mammals in general. In searching for another common laboratory mammal in which the injury response may be compared with that in the frog, rabbit, and rat, it became apparent that similar studies in mice have not been reported. Such studies form the basis of the present report.

Carworth Farms (CF1) albino male mice, weighing approximately 30 grams and 8 to 12 weeks of age, were used. The mice were anesthetized with an intraperitoneal injection of sodium pentobarbital (Nembutal Sodium) at a dosage of 60 mg. per kilogram. The lenses were injured by inserting an "Ultramicrodrill" (Circon Corp., Goleta, Calif.), having a 6 μm tip radius, through the cornea into the mid-central anterior surface of the lens. Sulfathiazole was applied to the corneal wound after the needle was withdrawn.

In the autoradiographic studies of the proliferative response, 42 mice received thymidine-methyl-H3 intraperitoneally in a dosage of 1 μCi per gram body weight (New England Nuclear Corp., Boston, Mass.; 6.7 Ci per millimole specific activity) at short intervals up to 48 hours after the lenses were injured; 12 uninjured control mice also received the labeled precursor. All mice were killed by cervical dislocation one hour after injection of the isotope. Eyes were fixed in 3:1 absolute ethanol:glacial acetic acid for 24 to 48 hours. The epithelia were removed from the lenses, flattened on slides, and autoradiograms prepared as described previously.21 All labeled interphases and all mitoses were counted in each epithelium by methodically scanning it at 1,000-fold magnification with an oil immersion objective.