

BI PRISM EFFECTS ON FIXATION DISPARITY CURVES OF CONVERGENCE

INNSUFFICIENTS

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ABSTRACT

Fixation disparity curves were taken on six convergence innsufficients. Each CI patient was subjected to a reading task in which fixation disparity curves were taken before and after the reading task. This procedure was performed a day later. However, 4BI prism in the form of spectacles were worn while performing the reading task. Wearing the 4BI prism spectacles proved to be statistically significant in reducing exodisparity for a given prism demand of 2BI, 0, 2BO, 4BO, 6BO. compared to the disparity measurments taken without prism after the near task.

INTRODUCTION

The purpose of this study is to see the effects of BI prism on convergence insufficients after a moderate amount of reading. "CI is a syndrome of oculomotor dysfunction most often thought to be characterized by a small exophoria at distant viewing distances, and ocular asthenopia after viewing a new task. The above would imply an ac/a ratio numerically smaller than the PD in centimeters, and be accompanied by a less than normal negative relative accommodation, poor positive fusional vergence ability, and inadequate nearpoint of convergence. A diagnosis of CI implies that the patient does not have sufficient sustainable positive fusional vergence ability to enable him/her to perform a desired near point task. Tests such as positive fusional vergence, negative relative accommodation, and near point of convergence are difficult to interpret for diagnostic purposes." Taken from symposium by J. James Saladin, "I believe that the use of the fixation disparity curve in the diagnosis and management of CI offers solutions to the problems with conventional techniques." However, previous studies have found some drawbacks of using the fixation disparity curve. "Even though the evidence for the reliability of F.D. curves is fairly strong, the sweeping conclusion that F.D. curves are, in general, reliable should not be made. With stable binocular systems the F.D. curves are sufficiently reliable to serve as indicators of change in oculomotor balance. They are not subject to large,

spontaneous fluctuations which would confuse any before and after comparison which an investigator might make provided statistical safeguards are taken."

A way of looking at CI is by using a control systems approach. The model is presented below.

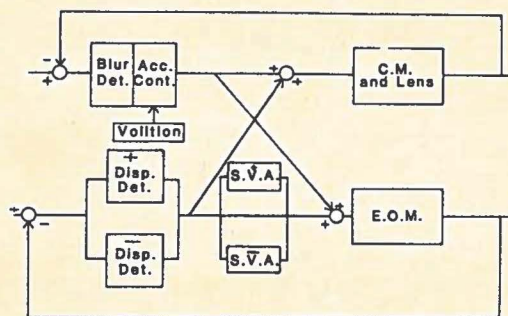


FIG. 6. The accommodative controller has been divided into a blur detector and a controller portion with the voluntary input, called volition, entering into the controller portion.

A detailed explanation of the above model is explained in a symposium by J. James Saladin. In our study we are most concerned with the lower loop. As we view a near object, disparity detectors in the cortex sends innervation to a controller and in turn to the E.O.M.. First the innervation goes to a fast controller which has a short time constant and low gain. Meaning it operates quickly but then fatigues with time. In an efficiently operating binocular system the innervation going to a fast controller, which has a long time constant but also has a high gain. This slow vergence controller will then take the load off the fast detector by amplifying the signal to the E.O.M.. If the binocular system fails to use the slow controller, the fast disparity

controller will begin to fatigue or fade, which in turn, reduces the innervation to the E.O.M.. When the system senses this, it will increase it's fixation disparity in order to provide increased stimulation to the fast detector. This is fatiguing. A greater amount of exodisparity is then needed to provide sufficient stimulation. Eventually the amount of disparity needed will be large enough to cause central suppression. In which case, the process becomes self defeating. The patient then may use accommodative convergence to hold binocular alignment.

This paper will attempt to study whether small amount of BI prism worn while reading will sharpen the disparity detectors. If so the phoria, fixation disparity, and central suppression should be reduced. This inturn, should restimulate the fast controller to send a more potent innervation to the slow but more powerful slow vergence controller. If the slow vergence controller can receive enough innervation, the binocular system should operate properly. It seems obvious that if some of the load is taken off the positive fusional vergence system, less fatigue should occur and we would expect less change in the fixation disparity curves. Furthermore, we would expect more effect on positive fusional vergence ability than on negative fusional vergence ability, and the effect would be more pronounced when the BI prism was not worn. The fixation disparity attendant to a given amount of BO prism should increase with fatigue. In the case where no prism was worn, the fixation disparity should increase in the base

out side with fatigue. There should be less of a change when BI prism is worn.

METHOD

The study was performed on CI patients with asthenopia symptoms. Each subject was given a complete vision examination. The lighting and reading distance were not kept constant for the group but were kept constant for each subject. Each subject was tested while his/her habitual refractive correction was worn. All fixation disparity data were taken at 40 centimeters with hand held prisms used in conjunction with the Disparometer. The following method was used per obtaining the fixation disparity reading: "The subjects task was to fixate the letters of the near point charts along side the nonius lines in the Disparometer and then to make an eye movement to fixate the nonius lines. The subject was to make his judgement known verbally within five seconds and return his fixation to the nearpoint charts. The question for the horizontal fixation disparity measurement was, "Is the top line to the left, to the right, or right over the bottom line? The response was always bracketed and the midpoint of the response range chosen as the angular amount of fixation disparity for that prism stimulus.

For horizontal fixation disparity curve determination, 0, 2BI, 2BO, 4BI, 4BO, 6BI, 6BO, prism diopters in that order were always used. During testing, the subjects were constantly reminded to maintain clarity and fixation of

the target letters."

Fixation disparity measurements were taken before the start of each session. A session would consist of the subject reading a chapter in Clinical Ocular Pharmacology by Jimmy D. Bartlett (20 pages which took anywhere from 30-40 minutes to read) and taking a test consisting of 20 questions from the readings. Immediately following this task another fixation disparity measurement was taken. This procedure was repeated a day later at the same time, place, and lighting; however, 4BI prism were worn in the form of spectacles while performing the task. A different chapter but same amount of pages were read in conjunction with a new set of questions.

RESULTS

Figure 1 represents the mean average of the subjects fixation disparity for each prism demand, while not wearing BI prism. The 0 represents the fixation disparity before the near task and the X represents the fixation disparity after the near task. As illustrated by figure 1, the effects of fatigue is evident by increased exodisparity on the BO side for the disparity measurements taken after the near task.

Figure 2 represents the mean average of the subjects fixation disparity for each prism demand while wearing BI prism. The 0 represents the fixation disparity before the near task and the X represents the fixation disparity after the near task. As illustrated by figure 2, the effects of relaxation is evident by decreased exodisparity on the BO side.

Figure 1. Before and after near task disparities with out prism. 0=before reading X=after reading

Figure 2. Before and after near task disparities with prism. 0=before reading X=after reading

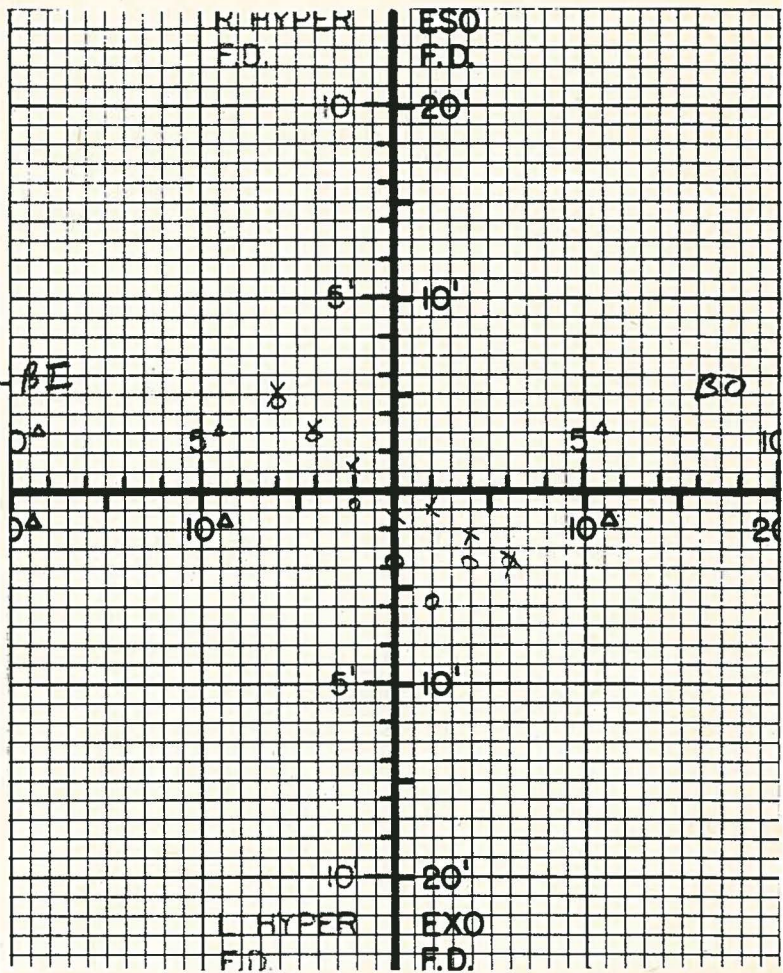
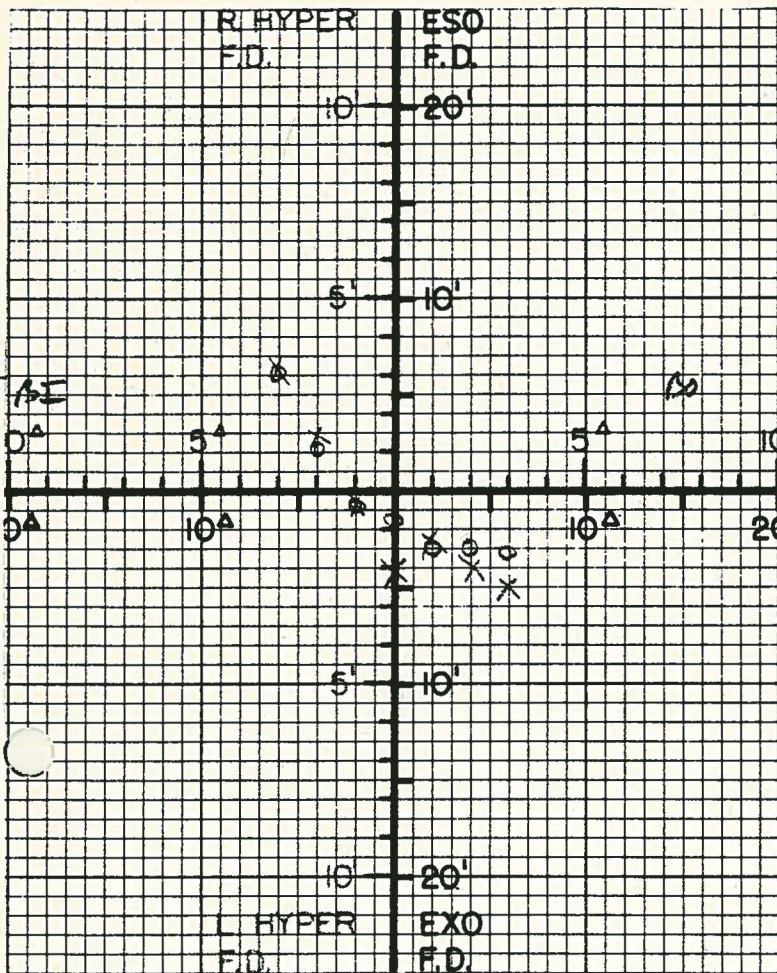


Table 1. For 6 CI patients. Differences between before and after near task fixation disparities.

	\bar{X}	s.d.	s.e.	$\hat{\Delta}$	\bar{X}	s.d.	s.e.	$\hat{\Delta}$
no prism	-5.0	6.0	2.4	6BI	-4.7	4.5	1.8	6BI
	-2.0	5.5	2.3	4BI	-2.7	5.0	2.0	4BI
	+0.67	4.8	2.0	2BI	+0.67	4.7	1.9	2BI
	+1.5	5.2	2.1	0	+3.7	3.9	1.6	0
	+3.0	7.2	3.0	2BO	+5.7	5.4	2.2	2BO
	+3.0	6.7	2.8	4BO	+3.7	3.4	1.4	4BO
	+3.3	7.2	3.0	6BO	+3.7	4.3	1.7	6BO
	-5	5.6	2.3	6BI	-5.3	3.7	1.5	6BI
with prism	-2.8	5.3	2.1	4BI	-3.2	3.8	1.5	4BI
	+0.67	5.2	2.1	2BI	-1.2	3.8	1.6	2BI
	+4.3	3.9	1.6	0	+1.3	3.3	1.3	0
	+2.7	5.5	2.2	2BO	+1.0	3.0	1.2	2BO
	+3.7	5.6	2.3	4BO	+2.3	4.6	1.9	4BO
	+4.7	7.6	3.1	6BO	+3.8	5.1	2.1	6BO

Table 2. Paired t-test performed on the without and with prism differences at the various vergence demands.

	<u>t</u>	<u>α</u>
6BI	-.06	0.39
4BI	+.04	0.65
2BI	-2.8	0.02
0	-2.7	0.02
2BO	-4.5	0.001
4BO	-2.2	0.04
6BO	-2.1	0.04

DISCUSSION

When a near demand is placed on a convergence insufficient, we would predict fatigue to occur in the oculomotor system.

Moreover, when using the fixation disparity readings to evaluate the state of the oculomotor system, we would predict a greater difference between before and after near task fixation disparities for a given BO demand.

Conversely, when comparing before and after disparities for a given BI demand, the differences should be minimal.

Illustrated by figure 1, which compares the before and after near task disparities without reading through BI prism, we can see evidence of fatigue on the BO side. The subjects showed a greater exodisparity after reading as compared to the disparities taken before reading. Conversely, the BI in side showed minimal differences between before and after disparities. This supports are prediction that near task should minimally effect the BI side of the disparity readings on a convergence innsufficient.

As stated previosly, when a near demand is placed on a CI patient, we would predict fatigue to occur in the oculomotor system. However, if a moderate amount of BI prism is placed before the eyes while reading, will it reduce the BO demand significantly enough to allow the system to relax instead of fatigue? Illustrated by figure 2, which compares the before and after disparities with reading through BI prism, it is evident that relaxing took place. The subjects showed less exodisparity after reading as compared to the disparities taken before reading. This would lead us to believe that BI

prism does allow the oculomotor system to relax and perhaps restimulate it's fast disparity detectors to send a more potent innervation to the slow but more powerful slow vergence controller.

Again, the BI side showed no apparent difference for 6BI and 4BI prism demands which was predicted. However, under the demand of 2BI prism diopters, the wearing of BI prism did reduce the exodisparity. At first one would think this disobeys the belief that BI prism should not effect the BI side of a convergence innsufficient. However, if the oculomotor system has exolatency, the fixation disparity reading taken at 2BI prior to the near task will falsely read the disparity as less exo. This would account for the reduced exodisparity after the prism was worn at 2BI, indicating that a relaxation had taken place.

A comparison of the difference between the before and after disparities of the without prism and with prism disparities was statistically analyzed by the paired t-test. The t-test showed a significant difference at 2BI, 0, 2BO, 4BO, 6BO, prism demands. The question arises though, does statistical significance necessarily indicate clinical significance?

Each subject was asked if wearing the BI prescription subjectively reduced asthenopia. The overall response was that the BI prescription made no difference.

Further research in this area is needed before one can prescribe BI prism with confidence as a treatment mode for CI patients. Future research may include BI prism worn on a full time basis.

CONCLUSION

It appears that a moderate amount of BI prism worn while reading will statistically decrease the exodisparity of a convergence insufficient. The added BI may reduce the convergence demand enough to allow for a stronger signal to exist in the system. The clinical significance has yet to be determined.

REFERENCES

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Subject 1

BVA OD +0.25 20/20 OS +0.25 20/20
Phoria BI vergence BO vergence Phoria thru +1.00
6M 2 exo X/10/8 8/20/10
40cm 5 exo 16/25/15 10/30/25 6 exo

Knott retinoscopy OD +0.75 OS +0.75
NPC to nose

Subject 2

BVA OD Plano 20/20 OS Plano 20/20
Phoria BI vergence BO vergence Phoria thru +1.00
6 M 2 exo X/10/8 8/20/16
40cm 8 exo 18/22/20 X/22/18 10 exo

Knott Retinoscopy OD +0.25 OS +0.25
NPC 12cm

Subject 3

BVA OD +0.75 20/20 OS +0.75 20/20
Phoria BI vergence BO vergence Phoria thru +1.00
6 M 2 exo X/8/4 14/18/15
40cm 6 exo 18/22/19 13/25/20 10 exo

Knott Retinoscopy OD +0.25 OS +0.25
NPC 12 cm

Subject 4

BVA OD +0.25 20/20 OS +0.25 20/20
Phoria BI vergence BO vergence Phoria thru +1.00
6M 1 exo X/8/5 14/20/15
40cm 4 exo 12/20/16 8/12/4 6 exo

Knott Retinoscopy OD +0.50 OS +0.50
NPC to nose

Subject 5

BVA OD 1.00 20/20 OS -1.25 20/20
Phoria BI vergence BO vergence Phoria thru +1.00
6M 2 exo X/7/5 15/25/20
40cm 4 exo 13/21/14 20/24/22 6 exo

Knott Retinoscopy OD +0.25 OS +0.25
NPC to nose

Subject 6

BVA OD Plano 20/20 OS Plano 20/20

	<u>Phoria</u>	<u>BI vergence</u>	<u>BO vergence</u>	<u>Phoria thru +1.00</u>
6M	1 exo	X/8/5	14/20/15	
40cm	6 exo	20/24/20	10/20/16	6 exo

Knott Retinoscopy OD +0.50 OS +0.50
 NPC to nose

Fixation disparity measurements

--exo

+eso

	Subject	6BI	4BI	2BI	0	2BO	4BO	6BO
before reading without risk	1	+3	0	-2	-3	-2	-4	-6
	2	-4	-6	-8	-10	-12	-10	-4
	3	+1	-2	-4	-4	-12	-12	-16
	4	+10	+6	+4	+2	+2	+2	+2
	5	+10	+8	+4	+4	+4	+2	+4
	6	+10	+6	+2	+2	+2	+4	0
after reading without risk	1	+4	+3	0	-4	-2	-4	-6
	2	-4	-6	-8	-10	-10	-8	-6
	3	+4	0	-4	-6	-8	-12	-18
	4	+12	+8	+6	+2	+2	+2	0
	5	+10	+8	+4	-4	+4	+2	+4
	6	+4	+4	-2	-4	-2	-2	-2
before reading with risk	1	+6	+4	-2	-6	-6	-2	-2
	2	-4	-6	-8	-10	-12	-8	-4
	3	+4	0	-2	-4	-12	-8	-12
	4	+8	+6	+2	0	0	0	0
	5	+6	+8	+6	0	0	-2	-2
	6	+8	+4	0	-2	-4	-2	-2
after reading with risk	1	+8	+5	+2	-2	-2	0	-2
	2	-2	-4	-5	-6	-6	-4	-3
	3	+6	+2	0	-2	-2	-10	-14
	4	+6	+6	+4	-2	+2	+2	-2
	5	+8	+6	+6	+4	+2	+2	0
	6	+6	+4	0	0	0	-4	-2

1. Which of the following statements is not true of herpes simplex I
 - a) primary infection with the virus occurs most commonly between 2-5 years of age
 - b) by age 15, 90% of the population is infected systemically
 - c) under age of 6 months, the individual is most susceptible to herpes
 - d) 26% of people who develop herpes the first time will have a second attack

- 2) Which of the following statements are false
 - a) eye may be painful in the initial stages
 - b) loss in corneal sensitivity may occur
 - c) increase lacrimation
 - d) mucopurulent discharge

3. In immunocompetent individuals, which of the following statements are false
 - a) disciform keratitis is self limiting
 - b) lesion may persist for years
 - c) iridocyclitis may appear
 - d) hypopyon may be present

4. Which of the following drugs are not used in treating herpes
 - a) idoxuridine
 - b) vira-A
 - c) viroptic
 - d) silver nitrate

5. Which drug is used when debridement is used
 - a) idoxuridine
 - b) vira-A
 - c) viroptic
 - d) silver nitrate

6. If most of the anti virals fail, what would be the next step
 - a) debridement
 - b) silver nitrate
 - c) viroptic 5X/day
 - d) steroid

7. If the corneal lesion is on the visual axis, which drug is preferred over the anti virals

- a) idoxuridine
- b) trifluridine
- c) vira-A
- d) viroptic

8. Which of the following signs is not true of acute epithelial keratitis associated with herpes zoster

- a) small, fine dendrites raised edges
- b) resolve in 4 to 6 days (the dendrites)
- c) lesions usually appear in central cornea
- d) stain with fluorescein and rose bengal

9. Which of the following signs is not true of corneal mucous plaque keratitis associated with herpes zoster

- a) white gray plaque
- b) plaques may appear anywhere on the cornea
- c) lesions change in shape day by day
- d) fluorescein stains brilliantly

10. Which of the following is not a treatment mode for herpes zoster

- a) topical steroids
- b) systemic steroids
- c) silver nitrate
- d) hospitalization

11. Which of the following are groups most susceptible to molluscum contagiosum virus

- a) infants
- b) children
- c) adults
- d) elderly

12. Which of the following is the rarest form of entropion

- a) congenital
- b) spastic
- c) involutional
- d) cicatricial

13. Which of the following statements are not true concerning marginal ulcers

- a) caused by exotoxin
- b) associated with viral infections
- c) caused by antibody-antigen reactions
- d) age dependent

14. Which of the following statements are not true concerning phylctenular ulcers

- a) caused by re-exposure to antigen
- b) associated with viral infections
- c) appear pinkish white
- d) treated with topical steroids

15. Which of the following organisms normally cannot attach a healthy cornea

- a) neisseria gonorrhoeac
- b) cornyebacterium diptheriac
- c) hemophilus influenea
- d) staphyloceus aureus

16. Which of the following statements is not true of central bacterial ulcers

- a) the hypopyon that accompanies it is almost always sterile
- b) associated with stromal infiltrates
- c) ulcers progress from central to peripheral cornea
- d) folds in descemets may be present

17. A S. Aureus ulcer may be monitored during daily office visits if all the following are present except one

- a) ulcer is less than 3 mm
- b) not in visual axis
- c) present s hypopyon
- d) patching is performed

18. Which of the following is the most common gram-negative organism causing corneal ulcers

- a) S. Aureus
- b) P. Aeruginosa
- c) S. Pneumonia
- d) Hemophilus

19. Which of the following statements is false about fungal corneal ulcers

- a) common
- b) devastating effect on eye
- c) easy to treat
- d) more prevalent in the south

20. Most fungal infections are treated with

- a) nestatin
- b) bacitracin
- c) polymixin
- d) neosporin

1. Of the following signs, which one is not common to punctate epithelial keratitis

- a) easily seen with direct illumination
- b) stain predominantly with fluorescein dye
- c) presents as an area of white or gray opaque spots
- d) is often seen in conjunction with PEK

2. The principle mechanism of attack by S. Aureus is

- a) secretion of an exotoxin
- b) direct invasiveness of the organism
- c) dyssecretion from the tear producing glands
- d) cell destruction by the living organism

3. Which of the following are not characteristics of blepharitis

- a) dilated blood vessels
- b) infiltrates
- c) white lashes
- d) trichiasis
- e) madarosis

4. Of the following preparations used to treat staphylococcal blepharitis, which one has the higher incidence of hypersensitivity reactions

- a) neomycin
- b) erythromycin
- c) bacitracin
- d) polymyxin B
- e) bacitracin

5. The follicles obtained from adult inclusion conjunctivitis are seen primarily in the

- a) fornices
- b) caruncle
- c) plica
- d) lid margin

6. Which of the following statements is not true of inclusion conjunctivitis

- a) corneal involvement occurs late in the disease process
- b) keratitis occurs in the inferior half of the cornea
- c) bluish conjunctiva is mild to moderate hyperemia
- d) may be associated with Reiter's Syndrome

7. Inclusion conjunctivitis is most common in which of the following groups

- a) 2 - 6
- b) 6 - 15
- c) 15 - 35
- d) 35 - 60

8. Which of the following is not true of inclusion conjunctivitis

- a) may be reactivated by oral contraceptive
- b) may be reactivated by a urethritis
- c) usually bilateral
- d) inclusion bodies from trachoma patients cannot be distinguished from inclusion conjunctivitis

9. Which of the following medications are ineffective against chlamydia

- a) tetracycline
- b) erythromycin
- c) topical antibiotics
- d) sulfonamides

10. Which of the following is not a common sign of acne rosacea keratitis

- a) peripheral marginal punctate keratitis
- b) infiltrates
- c) superior corneal involvement
- d) telangiectasia

11. Which of the following therapy is ineffective against acne rosacea keratitis

- a) topical antibiotics
- b) tetracycline
- c) lid scrubs
- d) topical steroids

12. Which of the following statements is false about taygeson keratitis

- a) mainly a superior cornea disease
- b) lesions occur as coarse gray epithelial defects
- c) stain with both fluorescein and rose bengal
- d) affects only the epithelium without any stromal involvement

13. Which of the following is an effective treatment of thygeson keratitis

- a) antiviral drugs
- b) steroids
- c) lid scrubs
- d) antibacterial drugs

14. Which term is not associated with trachoma

- a) chlamydia
- b) ardesline
- c) ~~Herbits~~ pits
- d) horner-trantas dot

15. Which of the following is the most common cause of blindness from trachoma

- a) dacrystenosis
- b) tear deficiency syndromes
- c) infiltrat~~s~~
- d) entropian

16. Which of the following state is not true of vernal conjunctivitis

- a) bilateral
- b) mediated by an immune hypersensitivity reaction
- c) rare in adults over 25
- d) disease last an average 2-3 years

17. Which of the following is the most prominent symptom of vernal

- a) photophobia
- b) itching
- c) ropy discharge
- d) foreign body sensation

18. Which of the following is not recommended

- a) pulse steroid treatment
- b) warm compress
- c) antihistamines
- d) cromoglycate

19. Superior limbic keratoconjunctivitis is not

- a) thyroid related
- b) occur in the superior limbus
- c) unilateral
- d) stained by flourescein

20. Treatment of superior limbic involves all but one of the following

- a) ocular lubricants
- b) silvernitrate solution
- c) mercury solution
- d) topical steroids