OPHTHALMOLOGIC FINDINGS AMONG ALASKAN ESKIMOS OF THE NORTON SOUND AND BERING STRAITS REGION

G.H.M.B. VAN RENS

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Ophthalmologic findings among Alaskan Eskimos of the Norton Sound and Bering Straits region

Oogheelkundige bevindingen bij Eskimos in het Norton Sound en Bering Straat gebied te Alaska

een wetenschappelijke proeve op het gebied van de Geneeskunde en Tandheelkunde

PROEFSCHRIFT

TER VERKRIJGING VAN DE GRAAD VAN DOCTOR AAN DE KATHOLIEKE UNIVERSITEIT TE NIJMEGEN, VOLGENS BESLUIT VAN HET COLLEGE VAN DECANEN IN HET OPENBAAR TE VERDEDIGEN OP VRIJDAG 9 SEPTEMBER 1988 DES NAMIDDAGS TE 1.30 UUR PRECIES,

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To Engeline,
Geert, Eveline and Fleur

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Contents

Introduction

In the last 30 years articles have regularly appeared on the frequent occurrence of a number of eye diseases in Eskimos. These publications related to both the inhabitants of Greenland and the inhabitants of Canada, Alaska and the U.S.S.R.

At first, most interest was aroused by the phlyctenular keratoconjunctivitis. This is an inflammatory condition of the cornea and conjunctiva, caused by an oversensitivity reaction to the antigens of, in the main Mycobacterium tuberculosis, but sometimes Staphylococcus (Van Balen, 1979; Vastine, 1980; Grayson, 1983). Up to the nineteen fifties this condition was frequently seen and was the most important cause of poor sight and blindness in young Eskimos (Fritz et al., 1951).

A second condition of the cornea and conjunctiva which received much attention in the literature was spheroid degeneration or climatic droplet keratopathy. This condition was first described by Freedman (1965) and was characterized by the accumulation of golden-brown, hyaline drops in the subepithelial layer of the cornea and conjunctiva (Vastine, 1980; Grayson, 1983). The condition is mainly seen in elderly men and can cause deterioration of vision. Ultra-violet radiation is thought to be the cause.

Two Danish ophthalmologists, Clemmesen and Alsbirk, in particular, have studied extensively the frequent occurrence of angle-closure glaucoma in Eskimos in Greenland. Primary angle-closure glaucoma occurs mainly in hypermetropic eyes with a small corneal diameter and a comparatively shallow anterior chamber. Growth of the lens causes the space between the root of the iris and the chamber angle to become steadily smaller with advancing age. When the pupil widens the iris can close off the trabecular system, a fine meshwork in the chamber angle which regulates the drainage of the aqueous. This may lead to a, sometimes acute, rise in intra-ocular pressure. This raised intra-ocular pressure may drop again to normal, but sometimes rises to more than 80 mm Hg. and can then cause blindness within 24 hours, as this pressure makes the blood supply to the optic nerve-head through the choroidal vascular network impossible, so that

ischaemic necrosis of the fibres of the optic nerve results. Immediate treatment is essential with miotic eyedrops (Pilocarpine 2%); this may be combined with an aqueous-reducing drug, a so-called carboanhydrase blocker (Diamox). If reduction of the intra-ocular pressure is not achieved, an operation is imperative preferably within 6 hours, but at the latest within 24 hours: a so-called peripheral iridectomy, consisting of the excision of a piece of tissue from the attachment of the iris in order to make the outflow of the aqueous possible once more. A rise of pressure in the second eye within two years is often observed. Especially in the polar region, where the inhabitants sometimes live thousands of kilometres from the nearest Eye Clinic and the weather conditions sometimes make transport impossible for weeks on end, this eye disease can easily lead to blindness. Angle-closure glaucoma can also occur in a subacute and a chronic form (Henkes and Van Balen, 1976; Van den Heuvel, 1978; Colenbrander and Von Winning, 1980; Epstein, 1986).

In 1969 a publication by Young et al. appeared, giving the results of an investigation of the increasing occurrence of myopia in the younger generation of Eskimos, whereas this was hardly ever seen in their parents and grandparents. Following Young et al.'s publication (1969) various authors have reported on myopia in young Eskimos.

In myopia the focal point of the optic system of the eye lies in front of the retina. This can occur either because the refractive power of the optic system is too high, or because the axial length is too long, or a combination of the two. In all cases, in order to see clearly in the distance a negative lens is needed, which causes the focal point of the incident light to fall on the retina (Henkes and Van Balen, 1976; Curtin, 1985).

By reason of these reports, an epidemiological study was carried out in 1984 at the request of the State of Alaska, on the eye diseases found in the Kotzebue region of the State of Alaska (Alaska Eye Survey I). The study was performed by Sheila Arkell, epidemiologist, and David Lightman, ophthalmologist. The most important problems encountered were the frequent occurrence of myopia in the younger Eskimos and of narrow chamber angles susceptible to closure in the older population.

The present study of the prevalence of eye diseases in the Eskimo population of the Norton Sound and Bering Straits region of Alaska, the Alaska Eye Survey II, was carried out at the request of the Norton Sound Health Corporation. The study was funded wholly by a gift from the State of Alaska, Department of Health and Human Services, to the Norton Sound Health Corporation, Nome, Alaska.

The aims of the present study were the following:

1. To identify the major causes of visual impairment in the Eskimo population by age and sex.
2. To assess the extent of the ophthalmic needs in the community and the existing resources for meeting these needs.
3. To define, when appropriate, intervention strategies in the treatment and prevention of ocular disorders that address the needs identified.
4. To provide a baseline against which future intervention programs can be evaluated.
5. To investigate specific disorders of importance to Alaskan Natives, such as changes in the frequency of phlyctenular disease, the frequency and distribution of uveitis, angle-closure glaucoma, and myopia.
6. To provide additional data of interest to the study of arctic ophthalmology.
7. To provide an ophthalmic service for the inhabitants of the Norton Sound and Bering Straits region, including the prescribing of glasses and referral, when necessary, of patients with ophthalmic problems to the Nome Hospital or the Eye Clinic of the Alaska Native Medical Center in Anchorage.

The fieldwork took place in eight, randomly selected villages in the Norton Sound and Bering Straits region, in the periods October and November 1986 and February 1987.

The fieldwork was performed, in addition to the author of this thesis who did the ophthalmic examinations on all patients, by Sheila Arkell, epidemiologist, and Wes Charlton, optometrist.

The patients' data were transcribed in code on floppy disks at the Institute for Social and Economic Research, University of Alaska.

The data analysis was completed in the Department of Mathematical Statistical Advice of the Catholic University of Nijmegen, The Netherlands.

The results of the fieldwork were reported to the Board of the Norton Sound Health Corporation. With their permission these results are published by the author in this thesis.

As the investigation took place in the U.S.A., using American instruments such as Snellen's test-types for use at 20 feet, in this thesis the American notation for visual acuity (tested at 20 feet instead of 6 metres) and the American definition of blindness (visual acuity $\leq$20/200) are used.

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CHAPTER 1

Review of the literature

1.1. Introduction

The first reports on ophthalmic diseases among Eskimos were published in the Danish literature. In the fifties, sixties and early seventies, interest in the special diseases in this population increased. This led to more articles and a special Arctic Ophthalmology Symposium in 1973, where in particular the results of a Canadian Arctic Ophthalmological Survey were reported.

The most important points in the literature concerned angle-closure glaucoma, climatic droplet keratopathy, phlyctenular keratoconjunctivitis and the increasing rate of myopia among the Eskimo population, as can be seen in this review of the literature.

1.2. Refraction

Bind (1950) found, during an ophthalmic survey in 1947, among 250 Eskimos of the Eastern Canadian Arctic, not one single case of myopia. Presbyopia was found in 17, hypermetropia in 6 and hyperopic astigmatism in 8 persons.

Young et al. (1969) carried out a study on volunteer Eskimo families at Barrow, Alaska. This population did not represent a random sample of the total population. There was no correlation between refractive errors of parents and children, whereas the correlation between siblings was high and significant. Almost no myopia was found among the grandparents or parents, but approximately 58% of their offspring was myopic. The authors' interpretation was that there was no major hereditary component, but a strong environmental component, such as school attendance, could explain the sibling correlation. Refractions were done with and without cycloplegics.

Young and Leary (1972) did a survey among 71 Eskimo families, consisting of three generations. It was not clear in this report in which year and

district or country the survey took place. The results of this study indicated that the initial size and component relationships within the one to two-year-old eye are probably inherited, along with high hypermetropia and corneal power in older children and adults. They found no evidence that any other components were inherited. Both cycloplegic and subjective refractive procedures were followed. Ultrasonic measurements showed a shallower anterior chamber in the parents than in the children, but the sum of the anterior chamber depth and lens thickness was the same in both generations.

Adams (1973), after giving a short history of the development of ophthalmological care, described the protocol for history-taking and examination during the Arctic Ophthalmological Survey 1970-71 in 16 Northern Canadian settlements.

Morgan and Munro (1973) reported the results of this survey of the Yukon and Northwest Territories. Astigmatism was found in 783 out of 2042 examined Eskimos, 719 had mild or moderate and 64 severe astigmatism. The prevalence of myopia was found to be as high as 35% in the 15-year-old group, decreasing to about 5% in people older than 25 years. Severe myopia (more than 5 diopters) was not a major problem in this population. A marked difference in astigmatism rates for Indians and Eskimos, both living in this district, could not be explained. The peak prevalence of myopia at age 15-25 years was found in both Eskimos and Indians. In all cases, as part of the ophthalmological examination, the refractive status of the eye was determined by retinoscopy after cycloplegia. As explanations of the increasing rate of myopia in the younger Eskimos, dietary changes, school attendance and genetic hypotheses were suggested.

Cass (1973) gave a survey of 10 years' northern ophthalmology in Canada. She described the problems of working in this primitive and barren area. The prevalence of myopia changed in one village from 2% in 1958 to 23% in 1970. In students, a changing prevalence from 6.5% in 1958 to 65% in 1970 was found in Eskimos, but the same change was also seen in Indians and Métis. The author suggested a correlation between the changing refractive errors and a change in diet from high protein and low fat, salt and carbohydrate to low protein and high fat, carbohydrate and salt.

Morgan et al. (1975) visited two isolated Canadian Arctic communities. An increase in myopia among the young of both sexes was reported, the proportion of myopes was higher among females then among males. No genetic cause of this 'epidemic' of myopia could be found. The author suggested that a cultural factor might be responsible. School attendance was mentioned as a possible cause.

Woodruff and Samek (1976) examined in 1971 76.6% of the total population (180 persons) of the Belcher Islands in Canada. The Belcher Island Eskimos showed remarkably little astigmatism. A low prevalence of myopic errors was found, 23.7%, 43.5% were emmetropic, 32.7% hyperopic. The mean spherical equivalent refractive state was + 0.53, with a standard deviation of ± 0.85 diopters. The mean for females was + 0.70 ± 0.82, for males + 0.35 ± 0.84. The way the refractive errors were measured was not clear in this publication. The authors speculated that the relatively recent exposure to white civilization was the reason for the low prevalence of myopia.

Alsbirk (1979) gave the results of refraction, using the subjective technique, in 508 West Greenland Eskimos above the age of 15 years. The survey, however, took place in 1972. Moderate myopia, −1 to −5 diopter, was found in 13.3%, and higher myopia in 0.8%. There was marked correlation between axial and vitreous length and refractive error. A low correlation in refractive errors was found between child and parent. The author concluded that his study supports the idea that environmental factors play an important rule in refractive errors.

Johnson et al. (1979) screened 87% of the available members of the population of Nain in Labrador for refractive errors by means of retinoscopy and measured the axial length by an optical method. Myopia $\geqslant -0.25$ D was found in 17.8% of Eskimos. Emmetropia was found in 9.6% and hyperopia in 72.6%. Eskimos had a significantly longer axial length for right eyes than Caucasians and mixed races. No significant correlation was found between the refractive errors of parents and offspring but there was a significant correlation between them for axial length.

Rozenblum (1984) examined 4863 schoolchildren of the Soviet Far North. The prevalence of myopia was 11 to 39% in the north, and 5 to 8% in the south. No significant difference was found between the rate of myopia in the indigenous population and in newcomers to the North. To prevent myopia, recommendations such as active physical training, special eye exercises, and accommodation training were given. As the publication was in Russian, not all the information could be understood.

Alward et al. (1985) did refractions on 92% of all persons born between November 1960 and December 1962 in 10 remote Yupik Eskimo villages of Southwestern Alaska in the period from November 1982 to May 1983. Cyclopentolate was used. Refractive measurements ranged from −10.63 to +4.50. Of these young adults, 68% were found to have myopia of −0.50 diopters or more, 23% to be emmetropic and 9% to be hyperopic. The mean refractive error was −1.63, −1.36 for men and −1.91 for women.

Astigmatism, 0.50 diopters or more, was found in 29%. Data on 37 pairs of siblings showed no genetically determined information.

Arkell and Lightman (1985) did a survey in the Maniilaq region of Alaska in 1984. In a total population of 971 Eskimos, 38.3% were myopic, 39.9% essentially emmetropic and 21.9% hyperopic. The prevalence of myopia was significantly greater among females (43%) than males (34%), while there was no difference in the frequency of hyperopia between the sexes. In this study, the subjective technique of refraction was used. Fifty percent of the Natives between 12 and 39 years of age were myopic as compared to only 17% of Natives above the age of 40. Astigmatism occurred in 51% of Native eyes and was 2.5 times more likely to be with the rule than against; oblique astigmatism was present in 22% of all astigmatic eyes.

1.3. Strabismus

Reed and Hildes (1959) found 4 cases (0.8%) of strabismus in 503 Eskimos living on the west coast of Hudson Bay.

Wyatt and Boyd (1973) reported on the prevalence of strabismus in a randomly selected population in Northern Canada. Among 2768 Eskimos, 53 cases of heterotropia (1.87%) were found. No significant difference was found between the sexes, or in comparison with other racial groups in this North Canadian district. Heterophorias were not recorded in this study. The convergence/divergence ratio was 0.62 to 1. In the literature the author found in other studies ratios varying from 25 to 1 to 2.6 to 1. The difference was due to a large discrepancy in the prevalence of convergent strabismus, 0.76% of the population in this study.

Cass (1973) claimed in her report that 'no Eskimos ever have concomitant strabismus unless white blood is present'.

Woodruff and Samek (1976), however, found 9 cases (6.5%) of strabismus in 138 Belcher Island Eskimos .

Johnson et al. (1984) found among 330 Labrador Eskimos 16 (4.8%) cases of strabismus.

1.4. Visual acuity

Woodruff and Samek (1976) found in the Belcher Island Eskimos a visual acuity of 20/30 or better for all eyes after correction in males. In females, 3 persons had a visual acuity of less than 20/30, due to corneal scars in two

eyes and amblyopia in one eye. In total, only 1 person (0.72%) had a bilateral visual acuity of less than 20/30 after correction.

Arkell and Lightman (1985) found in their study that 83% of all eyes had a visual acuity of 20/30 or better on presentation. In 12.7% the cause of decreased visual acuity was a refractive error. Other causes of a visual acuity of 20/40 or less were cataract in 1.3%, amblyopia in 1.1%, age-related macular degeneration in 0.45%, corneal scars in 0.18%, glaucoma in 0.08% and other or unknown causes in 1.02%.

1.5. Cornea and conjunctiva

1.5.1. Phlyctenular keratoconjunctivitis (P.K.C.)

Mould (1940) visited Eskimo villages in 1938 in north-western Alaska. Bilateral corneal opacities were found in 57 patients. The author suggested that there was a relationship between the opacities and epiblepharon. To the author, tuberculosis failed to explain the disease, but was frequently seen.

Fritz et al. (1951) found in 1946, in 400 natives of the Bering Sea-Arctic Slope region of Alaska, 127 cases of corneal opacities, caused by phlyctenular keratoconjunctivitis. In 1949, 346 Eskimo and Indian schoolchildren were examined. Ten of these children had active phlyctenulosis, and corneal scars were observed in 149 cases. In only 6 cases the scarring was not believed to be due to phlyctenulosis. Of the other 143 cases (286 eyes) 27 eyes had a visual acuity of 20/40 or less, 22 a visual acuity of 20/70 or less and 9 eyes a visual acuity of 20/200 or less. In all but 4 eyes the visual loss was due to corneal cicatrization. Most cases gave a history of red eyes before school age. In the author's opinion, phlyctenular keratitis was the major eye problem among the children of Alaska.

Fritz and Thygeson (1951) described the clinical picture of phlyctenular keratoconjunctivitis among 1,187 Alaskan Indians and Eskimos. In two hospitals they found the prevalence of phlyctenulosis to be 39% and 45% of the patients, respectively in the general population 10.6 to 27.4%, and in schoolchildren 14.9 to 35.4%. In some cases active phlyctenulosis was seen. All cases with active phlyctenular keratoconjunctivitis showed positive tuberculin reactions and X-ray evidence of active or inactive tuberculosis. There was a correlation between prevalence of tuberculosis and phlyctenulosis rate in the villages.

Thygeson and Fritz (1951) and Fritz and Thygeson (1951) treated 14 cases

of active phlyctenular keratoconjunctivitis with topical cortisone acetate in 12 cases and subconjunctival injections in two cases. All patients responded dramatically to the use of cortisone. This was the first report of the treatment of phlyctenulosis with cortisone. The authors concluded that the prompt response of the phlyctenular keratoconjunctivitis to cortisone added support to the theory of the allergic nature of the phlyctenule.

Duggan and Hatfield (1958) examined a group of 467 Indians and Eskimos, all patients of a hospital in the north-west of Canada. In 17.2% of the examined eyes, signs of active or inactive phlyctenulosis were found. Statistics showed a remarkable similarity to the findings among Alaskan Natives found by Thygeson et al.

Reed and Hildes (1959) did a survey in 1958 of Eskimos living on the west coast of Hudson Bay. Among 503 persons, 4 had active phlyctenular keratoconjunctivitis and 31 (7%) had corneal scars. In 3 cases, both eyes had a visual acuity of less then 20/200 and in 7 other cases there was a serious defect in one eye only. A slit lamp was not used in this study.

Farson (1961) studied in 1957-1958 all schoolchildren between 6.5 and 10.5 years of age in the Alaskan Eskimo village of Barrow. According to the records, a total of 26 children out of this group of 164 were treated for phlyctenular keratoconjunctivitis, and another 39 had possible phlyctenulosis. Of the 26 definitive cases, 25 were tuberculin positive; of the 39 possible cases, 38 were positive. Of 99 children without PKC, 67 were tuberculin positive , and 32 negative. The average age of tuberculin conversion was about four years in this group.

Philip et al. (1965) did a study among Eskimos in 24 villages in south-western Alaska. Of 4,635 persons, 40% were found to have corneal opacities. Opacities were infrequent among very young children, but 53% of the schoolchildren and 45% of the adults had scarring. Of the children with corneal scars, 93% were tuberculin positive, whereas only 39% of children without scars were reactors. It was believed by the authors that tuberculosis is the major etiological factor in phlyctenular keratoconjunctivitis among Eskimos in south-western Alaska.

Gillan (1970) found, among 189 Canadian Eskimos in Frobisher Bay, 6 cases (3.2%) of active phlyctenulosis, 25 (13.2%) had scarring of phlyctenular origin.

Wyatt (1973a and 1973b) found among 2833 Eskimos in the Canadian North, in 7.4% inflammatory corneal scarring. There was a strong correlation between this scarring and a positive history of tuberculosis. Scarring was significantly more common in Eskimos than in other ethnic groups.

Clemmesen (1973a) reported that, after a modern campaign against

tuberculosis, the percentage of phlyctenular ophthalmia in ophthalmic office work in Greenland was reduced from 39% in 1948 to 0.8% in 1971.

Smith et al. (1975a and 1975b) reported the results of 18 corneal transplantations in Alaskan Natives for the treatment of phlyctenular scarring. Fourteen (79%) patients had clear grafts, 12 of them (86%) had improved vision. The average follow-up was 46 months.

1.5.2. Spheroid degeneration, climatic droplet keratopathy or Labrador keratopathy

Freedman (1965) described a special form of corneal degeneration in the inhabitants of Labrador in eastern Canada. This degeneration occurs in the interpalpebral region of the cornea without vascularization, is bilateral, affects predominantly men and is nonfamilial. The disease was graded I to III. In the earliest type (I), only the medial and lateral parts of the cornea show a greyish stippling of fine opaque particles in the region of Bowman's membrane, with a strip of spared cornea between the limbus and the opacity. In grade II, the subepithelial opacity has spread to involve the pupillary area, giving a visual acuity of 6/18 or higher. In grade III, the opacity increases in extent and density, spreads deeply into the stroma and is visible to the unaided eye. There are also yellowish-brown, subepithelial nodules at the borders of the opacity. The visual acuity is less than 6/18. Grade I changes were found by the author in 90% of all men over the age of 40 years. Genetic causes, other eye diseases or nutrition played no role in the etiology. Climatic factors such as solar radiation, cold weather, relatively low humidity and ice particles in the air could be etiological factors.

Forsius (1972) described chronic and acute climatic changes observed in the eyes of Eskimos and U.S.S.R. Cheremisses. Band-shaped climatological corneal degeneration seemed to be less common and less malignant among the Eskimo populations studied, who were living in the regions at latitudes in the seventies, than among those living in the more southerly regions of Labrador. Pterygium seemed to be about equally common in Eskimos and Lapps. The occurrence of pingueculae was about the same in all populations and much higher than in the urbanized Finns.

Freedman (1973) reported cases of Labrador keratopathy and band-shaped nodular dystrophy both in Eskimos and in patients from Kuwait, South Africa, Australia and Mexico. Both conditions could be considered as examples of an identical disease process with a spectrum of severity. Climatic exposure could be of etiologic importance. The author proposed the term climatic droplet keratopathy for both conditions.

Garner et al. (1973) described the pathological findings in climatic droplet keratopathy. Histochemical staining methods and electron microscopy indicate that the droplets in the superficial stroma are composed of a protein which has many of the characteristics of a keratin precursor or variant.

Wyatt (1973b) found Labrador keratopathy in 29 men (9%) out of 320 men aged 40 years and over inhabiting the Canadian North. 21 had stage I and 8 stage II keratopathy. Only 3 cases were seen in women.

Johnson and Ghosh (1975) found Labrador keratopathy in 56% of 363 men and 16% of 449 women above the age of 40 years, living in northern Newfoundland and Labrador. Light and electron microscopy of 5 corneal specimens showed globules, located mainly in Bowman's layer and in the superficial stroma. In the authors' opinion, the origin of the globules is in Bowman's layer and the stroma, possibly from collagen fibrils.

Young and Finlay (1975) examined, in 1973, 929 patients in the northern peninsula of Newfoundland and eastern Labrador. Below the age of 30 years, no spheroidal degeneration was seen. In men in the group 30-39 years, 13% showed degeneration, 40-49 years 48%, 50-59 years 66%, 60-69 years 79% and above the age of 70 years 86% had spheroidal degeneration. The numbers were too small to assess the racial prevalence. The degeneration was associated with outdoor occupations. Ultraviolet radiation was believed to be a causative factor, and prophylaxis by means of appropiately filtering glasses was recommended.

Norn (1978 and 1979) studied, in a series of 659 Eskimos from Arctic southwest Greenland, the prevalence of spheroidal degeneration. The degeneration was observed in 12.3% of the Greenlanders. A rising prevalence was recorded with increasing age, no cases were seen before the age of 30 years. The prevalence was independent of sex. In 74% the spheroidal degeneration was found in the conjunctiva, in 18% in the cornea and in 8% in both. Spheroidal degeneration was related to pingueculae, but no correlation was found with pterygium. The results were compared to the findings in 810 Copenhagen Caucasians.

1.5.3. Corneal diameter

Alsbirk (1975) studied the corneal diameter in 1211 adult Greenland Eskimos. Measurements were made with a Wessely keratometer. The average of the horizontal and vertical readings was taken as the corneal diameter. The mean was 10.98 mm, with a standard deviation of 0.42 mm. There was a

remarkable difference between Eskimos and a control group of Danes, who had significantly larger corneae, about 0.5 mm larger than the Eskimos. The corneal diameter and the depth of the anterior chamber were positively correlated.

1.6. Angle-closure glaucoma

Alsbirk (1970) carried out a glaucoma survey in the Umanaq district of Greenland in 1967. On the basis of 1108 normal eyes, measured with a Schiotz tonometer, the mean tension found was 15.7 mm Hg with a standard deviation of 3.0 mm. Eyes of women above 40 years of age showed a significantly higher tension than those of men (16.35 and 15.1 mm Hg).

Clemmesen and Alsbirk (1971) did gonioscopic screening on 396 persons above 40 years of age in the same Umanaq district. Apart from 11 previously known cases of glaucoma, the screening revealed 11 new cases, 6 of them angle-closure glaucoma in women. Gonioscopic screening of 236 persons showed 31 occludable angles and 10 suspect occludable angles. It was evident that Greenlanders had a lower chamber depth than Europeans.

Clemmesen (1971) described in a separate report the technique and classification used in this study.

Cass (1973) found glaucoma to be extremely rare in Eskimos, the only six cases she saw in more than 10 years of work in northern Canada were all angle-closure glaucoma.

Alsbirk (1973) stated in a preliminary report to the Arctic Ophthalmology Symposium that angle-closure glaucoma (a.c.g.) was found in 2.1% of women and 0.9% of men above 40 years of age in the Umanaq district of West Greenland. Open angle glaucoma was found in 0.3% and 0.2% respectively. Of all primary glaucomas, 86% (94 out of 109 cases) were of the a.c.g. type. Ultrasound biometry showed that the thickness of the lens in a.c.g. patients was 6.8% greater than in control patients of the same age and sex, and that the mid-lens position was 8.3% nearer to the posterior surface of the cornea. Comparison of 70 Eskimos with 70 Danes showed only a significant reduction in the mid-lens depth (3.9%) in Eskimos. The mean corneal diameter of 600 Eskimo women over 40 years of age was 11.0 mm, 0.5 mm less than the value for Caucasians.

Clemmesen (1973b) reported the results of gonioscopic screening in 332 persons above 40 years of age in Greenland. Occludable angles were found in 2% of men and 19% of women, whereas suspect occludable angles were found in 6% of men and 5% of women. The author recommended public

health educational programmes to stimulate better recognition and treatment of angle-closure glaucoma.

Drance (1973) gave the results of a survey of ocular diseases in the Canadian North, performed in 1971. Among 2,781 Eskimos of all ages the prevalence of angle-closure glaucoma was 0.58%. However, in the 377 Eskimos above the age of 40 examined, 4.3% were found to have angle-closure glaucoma: 2.9% primary a.c.g. and 1.4% secundary a.c.g. The distribution in this age group was 5% in women and 3.6% in men. Of all the eyes affected, 50% were blinded by the disease, and 12.5% of all patients were bilaterally blind. Random gonioscopic and anterior-chamber depth measurements carried out in 2 villages suggested that 10-25% of all females over the age of 40 were liable to angle closure.

Alsbirk and Forsius (1973) measured anterior chamber depth (A.C.D.) in Eskimos from Greenland, Canada and Alaska by optical pachymetry. Analyses of the results from nearly 1600 Eskimos demonstrated that the A.C.D. level in all the subgroups was significantly lower than in Caucasians. Different results in the youngest age groups seemed to be influenced by the increasing rate of myopia.

Drance et al. (1973) performed a study among a randomly selected group of Eskimos in the Canadian North. The anterior chamber depth of the Eskimos' eyes, measured by optical pachymetry, showed a decrease with age, whereas the anterior chambers in Indians showed little change in time. The group of myopes whose refractive error was 1.25 diopter or more had an anterior chamber which was very significantly deeper. Gonioscopic grading of the width of the anterior chamber angle in Eskimos showed a marked narrowing of the angle with age among Eskimos but much less narrowing in Indians.

Alsbirk (1976), in his thesis which surveys his previous work, interprets the small anterior chambers in Eskimos as a result of genetic adaptation to the arctic environment. Corneal protection may have been the significant advantage and the a.c.g. in elderly persons a relatively less important price.

Cox (1984) did a glaucoma survey among the Alaskan Eskimos. The author got his information by reviewing all patient charts from the Alaska Native Medical Center, which is the principle source of health care for Eskimos living in Alaska. The overall prevalence of primary angle-closure glaucoma was found to be 0.44%, but the condition was three times more common in women than in men. Primary open angle glaucoma was found to be equally common in both sexes, 0.01%. In the over-40 age-group, the prevalence of primary a.c.g. was 3.27% for women and 1.01% for men.

Johnson et al. (1984) found no case of primary a.c.g. in 330 Labrador

Eskimos. They found the anterior chambers in Caucasians to be just as shallow as in Eskimos.

Arkell and Lightman (1985) and Arkell et al. (1987), in the Alaska eye survey in the Maniilaq region, found a.c g. in 0.21% of all men and 0.83% of all women. In this study 1686 Eskimos were examined. Prevalence of a.c.g. above 40 years of age was 2.65%. Classification of angle depth in grades showed the occurrence of narrow angles (gr I and II) to be twice as frequent in females as in males.

Robin et al. (1986) described the treatment of 44 Eskimo eyes with occludable angles with a portable Q-switched neodymium-YAG laser. As a result of the survey of Arkell and Lightman, iridotomies were created on the Eskimos with an occludable angle in the Maniilaq region.

Alsbirk (1986) estimated limbal chamber depth in 505 adult Greenland Eskimos. The study was performed in 1979. Axial chamber depth was measured by pachymetry. A lower temporal chamber depth score compared with nasal depth was found in about 50% of all eyes, but did not reflect a narrower angle gonioscopically. The sensitivity of the Van Herick slitlamp test was found to be 91% in detecting eyes with an anterior chamber depth of less than 2.0 mm.

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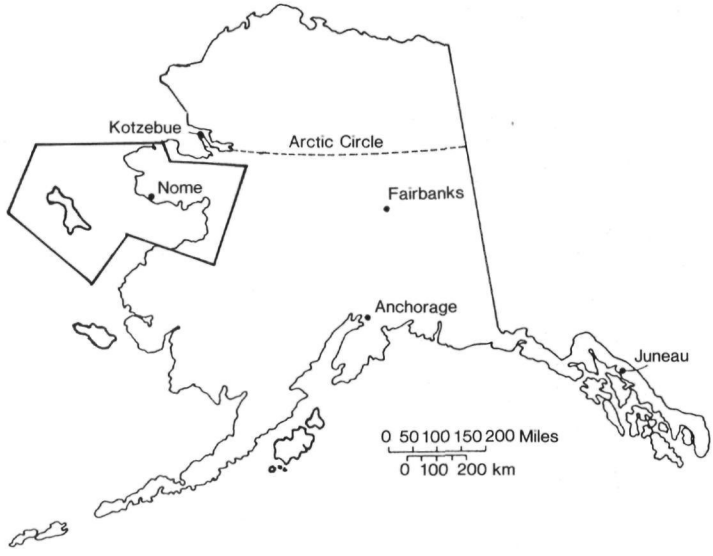

Figure 1. The area of the study: The Norton Sound and Bering Straits Region in Alaska.

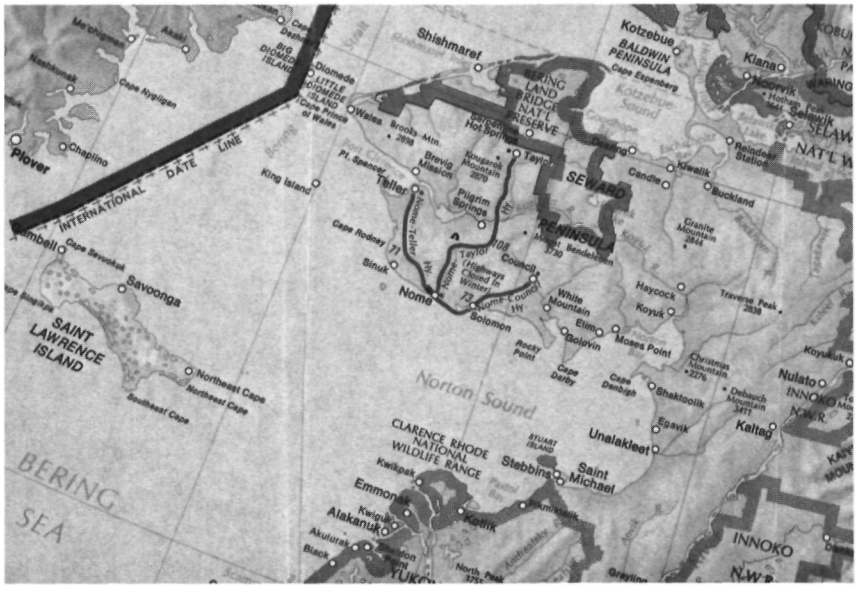

Figure 2. The Norton Sound and Bering Straits region.

CHAPTER 2

The situation of the study: the Norton Sound and Bering Straits region of Alaska

2.1. Alaska

On 18 October 1867, the United States of America bought Alaska from the Russians for 7,200,000 dollars. For this sum, an area of 589,757 square miles or 1,527,470 square kilometers, about one fifth of the total surface of the rest of the United States, was added to the U.S.A.. On 3 January 1959, Alaska joined the Union as the 49th state.

The State of Alaska extends 1400 miles or 2250 km from north to south, from 72 to 53 degrees north latitude, and 2400 miles or 3860 km from east to west, from 173 to 130 degrees east longitude. In 1983 the total population of the state was 510,554, which is 0.2% of the total population of the United States. More then 40% of the inhabitants live in Anchorage, 227,070. Another 64,810 people live in Fairbanks and 25,964 in the capital Juneau. The rest of the country is very sparsely populated. About 14.5% of the population are Natives; 40,000 of them are Eskimos.

The State of Alaska is subdivided into areas, one of them being the Norton Sound and Bering Straits region.

2.2. The Norton Sound and Bering Straits region

2.2.1. Geography

The Norton Sound and Bering Straits region is essentially the southwestern three quarters of the Seward Peninsula and the coastal drainages as far south as St. Michael. The area is 26,000 square miles (67,000 square km), bounded on the east by the Nulato Hills, on the south and southwest by Norton Sound (part of the Bering Sea), on the west by the Bering Strait, which join the Bering and Chukchi Seas, and on the northwest by the Chukchi Sea.

The Seward Peninsula encompasses practically all types of land features,

including mountains, highlands, plateaus, coastal plains, and interior basins and valleys. The subregion has an extensive coastline, including the King, Little Diomede and St. Lawrence Islands. The latter island is the largest with a surface area of 1780 square miles or 4610 square km.

2.2.2. Climate

The climate of the region is maritime in summer and fall, and continental in late winter. Winter is the longest season, extending from late October through April. By December, the daylight hours have been reduced to four. The Bering Sea is then usually frozen; the ice is 4-7 feet thick and can extend to 2-6 miles offshore. The sea ice is responsible for the transition from a mild winter maritime climate to a cold continental climate. The average temperature in January is 2 degrees F.

Spring is in April and May, when the ocean ice usually breaks up. By early June most of the lower elevations are snow-free.

Summer is from mid-June to mid-August. Normal average summer temperatures range from 30 to 50 degrees F.

Fall is from mid-August through mid-October. Permafrost is continuous throughout the subregion, but is less thick than in more northernly areas. The permafrost appears to thaw only near deep lakes or major streams. There are no glaciers.

The wind blows most of the time. In the summer, it generally blows from the south or southwest at 7-10 knots. During the winter, it generally blows from the north or northeast at 10-15 knots. On the islands, however, the windspeed is usually 5-10 knots higher.

2.2.3. Population

The population is young and predominantly Alaska Native. The region's average age is only 22 years and in the villages is below 20 years. There are more men than women, giving a high rate of unmarried men.

About 61% of the population lives in the fifteen villages, 39% lives in Nome. In 1984 the total population of the region was 8137, 3732 of them lived in Nome.

Many people are dependent on state, federal and local government jobs. About 48% of Nome residents, compared to 35% of village residents, have government jobs. To a lesser extent tourism, gold mining, fishing, reindeer

herding and summer construction contribute to the economy. However, unemployment is high, especially in the villages. Further, the cost of living in the region is very high. Food purchases, for example, in Nome are 76% more expensive than in the former 48 states of America and in the 15 Bering Straits villages even up to 3 times as expensive as in the lower 48. Hunting plays an important role in securing basic food supplies. About 68% of all village residents obtain one half or more of their food from subsistence activities. Taking into consideration the high cost of living in the region, an estimated 42% of Alaskan Native families lives below poverty level, compared to only 9.5% of non-Native families.

2.2.4. Education

In 1977, Alaska began a high school construction program in villages across the state. By 1980, 100 new schools had been completed. Since 1970, the percentage of Natives aged 18-24 years completing high school has risen from 38% in 1970 to 59% in 1980. Meanwhile, the number of non-Natives completing high school rose from 68% in 1970 to 83% in 1980. College level education is still very exceptional for Natives. In 1983, only 0,8% of Natives had completed a college education.

2.3. Alaska Native Claims Settlement Act

In 1971, the Alaska Native Claims Settlement Act (A.N.C.S.A.) was passed. Under A.N.C.S.A., Alaskan Natives relinquished their aboriginal title to three quarters of the State of Alaska in exchange for 40,000,000 acres of land in fee simple title and 900 million U.S. dollars in cash. Thirteen regional corporations, and a village corporation for each village with 25 or more Native residents, were formed, to carry out the intent of the act. The Bering Straits Native Corporation covers the same area as the Norton Sound Health Corporation, and is one of the thirteen regional corporations.

Savoonga and Gambell, however, opted for joint title to all of St Lawrence Island rather than a cash settlement.

2.4. The health system

Each of the 15 villages has its own clinic. All clinic buildings have an office with radio and telephone, an examination room with facilities for obstetrics and general medical equipment, medical preparations and resources for medical emergency cases. All clinics have electricity, some have a flush toilet or running water. Because of the barren climate, a sewer-system and water-system are very expensive and very vulnerable to damage caused by freezing or subsidence due to thawing of the upper layer of the soil.

The primary health aide, or an alternative health aide, does consultations in the clinic and is on call for emergency cases outside the office-hours. Furthermore, the health aide cooperates in preventive medical programs, such as giving vaccinations, baby care consultations, visual acuity screening of children, etc. When necessary, a general practitioner from the Nome Hospital is available to the health aide 24 hours a day for advice or assistance. The patient can be referred to the Nome Hospital, or the patient can be seen by the doctor in the clinic, or at home. All villages, except Little Diomede, have a runway and a daily air-service to Nome, weather permitting.

The village clinics are independent: the Nome Hospital supplements the clinics. Five general practitioners work in the Nome Hospital, together with nurses, a physical therapist, a pharmacist, a dietician, mid-level practitioners, an optometrist and technicians.

Each clinic is visited by one of three dentists twice a year.

2.4.1. Visual health

Visual health includes all aspects of prevention, maintenance and treatment to promote optimal eyesight and ocular health. In recent years, the availability of an optometrist and ophthalmic assistant has resulted in regular eye care at Nome and visits to surrounding villages at least once annually. Primary eye care needs are met by routine screening for abnormalities and diseases, refracting, early glaucoma detection and follow-up, and services for dispensing and maintaining eye wear. In 1985, a total of 2,545 patients were seen by the optometrist and his assistant.

The eye care program coordinates quarterly ophthalmological clinics. These clinics are available to Alaskan Natives and are served by a specialist from the Alaska Native Medical Center in Anchorage. In 1985, 3 ophthalmology clinics were held and 98 patients were seen by an ophthalmologist.

Support and training of village health aides in ocular first aid, school vision screening and the detection of eye diseases are other important tasks of the optometrist.

Eye care has a high priority among village residents. In village public meetings held during 1984, eye care was identified as the leading priority in village health. Villagers would like additional eye testing and easier access to eye wear for those needing corrective lenses.

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CHAPTER 3

The fieldwork

3.1. Instruments and methods

The fieldwork took place in two periods in the late fall and winter of 1986-1987. In these periods, the majority of the inhabitants are in their villages and the most representative population is to be expected. The children are at school and can be examined there. Because of the cold weather and short days, the male population, whose predominant occupation is hunting and fishing, is more likely to be at home. In the winter the ocean is frozen and the cold weather limits hunting.

The first part of the fieldwork was done during the period from October 16 to November 18 1986. Then a break was taken because of the Christmas vacations, when it was impossible to make appointments.

The second part of the fieldwork was done during the period from January 30 to February 16 1987.

During both periods, every day, including Saturday and Sunday, patients were scheduled from 9 in the morning to 10 in the evening. In the evenings the paperwork was also checked for accuracy.

The Norton Sound and Bering Straits region includes 15 small villages of approximately 120 to 800 inhabitants, and the town Nome with about 3800 inhabitants. Nome has a small hospital, where in addition to 5 general practitioners there is a full-time optometrist. To obtain a representative sample of the whole region, a random selection of 10 of the 15 villages, with the exception of Unalakleet, was made. Unalakleet was not included in the sample frame because it had 800 inhabitants and would have been overrepresented. The 10 selected villages had together about 2950 inhabitants.

During the first trip, 6 villages were studied: Saint Michael, Stebbins, Shaktoolik, Elim, Brevig Mission and Wales. During the second period Savoonga and Gambell were visited, both on Saint Lawrence Island. During this trip visits to Shishmaref and Little Diomede were also planned. However, visa problems encountered by the ophthalmologist caused loss of time and prevented visits to the last two villages.

The fieldwork was performed by an epidemiologist, an optometrist, an ophthalmic assistant and an ophthalmologist. The local health aide, an inhabitant who had some basic medical training, assisted with the scheduling of the patients.

From Nome, the team travelled to the villages in small two-engined airplanes. This form of transportation limited the amount of medical equipment that could be carried. A summary of the most important equipment that was used is given in the list at the end of this chapter.

The health aide and the principal of the school were warned of the arrival of the eye-team beforehand. They were informed of the exact date of arrival 2-3 days in advance.

Upon arriving in the village, all children in the preschool group, kindergarten, elementary school and high school were examined first. The examination took place in the school buildings and included all the children in the school at that time, giving a high response rate of examined children. During the school examinations, the health aide made appointments for the babies and adults.

The examination of the children under four years of age covered external abnormalities, fixation of both eyes, cover and uncover tests, motility and the inspection of the anterior segment of the eye, the media and the fundus.

Children between four and six years old were also checked for visual acuity in each eye, with a Snellen illiterate E chart at 20 feet. The near acuity was tested with a symbol chart. Children who were unsuccessful with the 'E game', as well as preverbal and uncooperative children, were observed for fixation and following behavior. Stereo-acuity was tested with the fly and animals of the Titmus Fly stereo tests.

In children above six years of age, the distant visual acuity was tested with a Snellen letter chart at 20 feet, and the near acuity with the A.O. nearpoint rotochart. If a child had distance spectacles, these were worn during the tests and the lensometry of the glasses was noted on the form. The stereo-acuity was tested with the Titmus Fly stereo tests.

In all children above 14 years of age, the eye pressure was measured with the Kowa hand applanation tonometer. Applanation tonometry provides a simple and reliable method for measuring intra-ocular pressure. In the tonometer, devised by Goldmann, pressure is measured directly as the force required to flatten a standard area of the cornea (3.06 mm. diameter). Since the applanation tonometer does not displace much fluid (approximately 0.5 ul.) or increase the pressure in the eye significantly, this method is almost independent of ocular rigidity. In addition, the method is little influenced by variations in corneal curvature (Kolker and Hetherington,

1970). With the Kowa tonometer the intra-ocular pressure can be measured with a precision of 1 mm Hg. In each village the instrument was calibrated before the examination was started.

In some of these children, the axial length of the eye and the anterior chamber depth was measured with the Bio-1 ultrasound. In this instrument sound waves are formed at the tip of a probe where a transducer, consisting of a quartz crystal with piezo-electric qualities, is located. A non-focused beam is used in this A-scan instrument, allowing pattern recognition at different distances from the ultrasound probe (Shammas, 1984). With the help of this portable echographic instrument the axial length of the eye can be measured with a precision of 1 mm. This instrument was also recalibrated in each village after transport. This instrument was chosen because, as far as we know, it is the only portable echographic instrument available. It was originally designed for the control of the thickness of the joints in the oil pipeline in Alaska; it is therefore designed to be extremely resistant to the effects of much transportation and exceptionally low temperatures.

Children with a visual acuity of less than 20/30 in one or both eyes, or not showing decrease with the plus-one test, were asked to come back to the clinic after school, if necessary accompanied by a parent, for refraction. When necessary, retinoscopy after mydriasis was performed. A prescription for glasses was given to the children who needed one. Amblyopia under the age of 8 years was treated by patching. The supervision of this therapy was in the hands of the health aide, who was in contact with the optometrist in the Nome hospital.

Examination of all the other inhabitants of the village took place in the clinic. The set-up depended on the building. The Snellen letter chart was always illuminated with the same standing lamp. For the refractions, the same projector was always used, or a trial lens set with the Snellen letter chart.

A home visit was made to persons who were unable to visit the clinic.

There were three forms for each person, on which the examination results were recorded. These forms are included in the supplement. Each page of every form was marked with an identifying number for both village and person.

The first form was used by the epidemiologist or ophthalmic assistant, and contained the patient's personal record. The name, date of birth, sex, race and village were noted. Then the patient was asked his or her history with reference to the following diseases: diabetes, high blood pressure, thyroid disease, heart disease, a stroke and tuberculosis. If the patient used medicaments, these were noted. The patient was also asked about the use

of glasses, and when the last prescription had been given. If not used, the reason was noted. There were specific questions about eye diseases, injuries, and surgery or medication to the eyes.

The second form was used by the optometrist or his assistant. It showed the visual acuity for distance, with or without glasses, and the near visual acuity for each eye. The visual acuity was determined with Snellen's test chart or a projector with Snellen's optotypes in the sizes: 20/15, 20/20, 20/25, 20/30, 20/40, 20/50, 20/60, 20/70, 20/80, 20/100, 20/160, 20/200, 20/300 and 20/400. A visual acuity of 20/80, for example, signifies that the person can just see at 20 feet without errors the optotype which a normal person can just see at 80 feet without errors. If the patient used glasses, the lensometry was noted. The results of the Titmus Fly stereo tests were also recorded on form 2. If a subjective or cycloplegic refraction was performed, the results and best visual acuity were noted. When the patient was given a prescription for glasses, this was recorded on the form too.

The third form was used by the ophthalmologist. The eye pressure check, however, was done by the optometrist in most cases. The external examination was recorded and tests for fixation, cover and uncover tests and tests for motility. The examination of the anterior segment was done with the Kowa slitlamp or, in very small children, by penlight. Abnormalities of the conjunctiva were noted. In the cornea, scars from infections, trauma, climatic droplet keratopathy, pterygia and active phlyctenulae were also recorded. The anterior chamber was examined for signs of active or old iritis. If atrophy, posterior synechiae or the results of peripheral iridectomy were seen in the iris, this was noted on the form.

An estimation of angle depth was made on all patients who underwent a slitlamp examination (according to a method and criteria modified from Van Herick et al., A.J.O. 1969). The slitlamp beam was as narrow as possible and oriented perpendicularly to the peripheral corneal surface. The angle opening was viewed at approximately 60 degrees from the light beam. The angle was measured at the temporal and nasal periphery just in front of the limbus. For grading purposes, only the narrower angle was recorded. The width of the corneal section was the unit for the estimation of angle depth. If the space between the cornea and the iris was equal to or greater than one corneal thickness, it was recorded as a grade 4 angle. If the space was between one and one half or equal to one half corneal thickness, it was grade 3. A grade 2 angle was between one half and one quarter or equal to one quarter of the slit beam, and a grade 1 angle was less than one quarter. The two latter grades are potentially occludable and gonioscopy was performed on these eyes. Tonometry was performed by the optome-

trist on all patients over 14 years of age using the Kowa hand applanation tonometer, before gonioscopy or mydriasis.

The length of the axis and the depth of the anterior chamber of the eye were measured with the Bio-1 ultrasound in a randomly selected group of patients. All patients with an occludable angle, grade 1 or 2, were examined with the Haag Streit goniolens after the eyes had been topically anesthetized. Patients with a history of symptoms of angle-closure glaucoma, or with an intraocular pressure higher than 21 mm Hg, were also gonioscoped. The depth of the angle of each eye was graded in the following way, according to the narrowest angle in any quadrant, as estimated by the author:

Grade 0 = 0 degrees (closed)
Grade 1 = 1-10 degrees
Grade 2 = 11-20 degrees
Grade 3 = 21-30 degrees
Grade 4 = more then 30 degrees.

The angle was classified as an 'occludable' angle if trabecular meshwork was not visible in at least three quadrants and the ciliary body in two. Other angle abnormalities, such as peripheral anterior synechiae, rubeosis, recession of the ciliary body, tumours, etc, were noted.

Unless there were contraindications, the following patients were examined in mydriasis:

- All patients over 29 years old
- All patients with unexplained visual acuity of less than 20/30 in either eye
- All patients with idiopathic or potentially refractive strabismus
- All other patients with suspect pathology of the eye.

Mydriasis was obtained with one drop each of tropicamide 1% and phenylephrine 2.5%. Patients who required cycloplegic refractions were dilated with cyclopentolate 1%. The routine examination under mydriasis consisted of slitlamp examination of the lens and both direct and indirect ophthalmoscopy. Furthermore, direct and indirect ophthalmoscopy were performed routinely on all other undilated patients if possible.

The lens was examined for cataract, dislocation, aphakia, pseudophakia and after-cataract. The anatomical location of opacities was described, and the most probable etiology was classified. Cataract was defined as any lens opacities that interfere with vision.

The vitreous was observed for abnormalities such as haemorrhages and strands.

The optic disc was examined for glaucomatous excavation, which was defined by the horizontal and vertical cup-disc ratio, and the thinnest part of the neural rim.

Photo 1: Eskimo village on the Bering Straits coast.

Photo 2: In small airplanes the team travelled to the villages.

Photo 3: Dog-sledding is no longer the way of winter-time transportation.

Photo 4: The clinic of Saint Michael.

Of special interest were macular diseases, which included retinal pigment epithelial atrophy, drusen, disciform scars, diabetic retinopathy and signs of high blood pressure.

Retinal pigment epithelial atrophy was defined as a coarse-grained alteration of the retinal pigment in and around the fovea and was subdivided on subjective grounds into minimal or significant.

Drusen were defined as small colloid-like yellow spots or large, soft yellow spots appearing as defects in the pigment epithelium. Less then 10 drusen was defined as minimal, ten or more as significant.

The peripheral retina was also examined for signs of diabetic retinopathy and hypertension. Retinal scars, holes, detachment, etc, were noted as abnormal findings in the peripheral retina.

If necessary, an estimation of the visual field, by Donders' method was performed.

When glaucoma was found, this was classified as primary open angle glaucoma, acute angle-closure glaucoma, subacute or chronic angle-closure glaucoma or other etiology.

Patients with a shallow anterior chamber and a chamber angle judged during gonioscopy to be occludable, are not regarded as glaucoma patients in this thesis. The terms 'prodromal' or 'latent' angle-closure glaucoma found in the literature, are not used for these patients.

Subacute angle-closure glaucoma can be defined as a condition in which the patient, usually for some months, has suffered periods of blurred vision, associated with halo vision and pain around the eye, mainly in the evenings. At examination, the intra-ocular pressure is normal or not raised above 45 mm Hg, the anterior chamber is shallow and the angle is partially, not completely, closed. The optic disc is normal.

Acute angle-closure glaucoma is diagnosed in the clinical setting of a sudden onset of symptoms (including pain, redness, headache, halos, nausea) in the presence of a gonioscopically completely closed angle and a markedly elevated intra-ocular pressure (more than 30 mm Hg.).

In chronic angle-closure glaucoma the intra-ocular pressure is raised without symptoms, the anterior chamber is shallow, the angle is occluded or nearly occluded and there are adhesions in the chamber angle. The optic disc shows a glaucomatous excavation and there is glaucomatous visual field loss.

When visual acuity of less than 20/30 in one or both eyes was found, the most likely etiology of the visual loss was recorded. Finally the conclusion was drawn: either a normal examination, with or without prescription of glasses, or an examination revealing pathology in one or both eyes, with or

without referral to the Eye Department of the Alaska Native Medical Center in Anchorage.

All noted abnormalities were coded according to the International Classification of Diseases (I.C.D.-9).

3.2. Results

3.2.1. The response of patients

A census had been taken of the residents of each village which was visited. These data, however, were not the same as the census which was taken with the help of the health aides in each village. The health aide updated the census by deleting the names of residents who had died, moved or were out of town. This update provided the final count of the total number of inhabitants currently in the villages on arrival. An updated census was necessary because of the high mobility of the population.

In the first row of Table 3.1, the official census of each village is given. The second row shows the updated numbers. In the third row, the absolute numbers of persons examined in each village are given. The percentage of persons examined, according to the official census, is given in row 4, according to the updated numbers in row 5.

The total number of residents in the 8 villages, according to the January 1986 census of the Department of Community and Regional Affairs of the State of Alaska, was 2365. The total of the updated census was 2208. During the survey, 1848 patients, living in the eight villages, were examined, and 5 who did not live there. In total, therefore, 1853 residents were examined. The average response rate of the residents during the whole survey, according to the updated census, was 83.7%. Brevig Mission had the highest response rate with 91.6%, the lowest response was in Gambell with 76.0%, according to the updated census.

3.2.2. Race

The total population was subdivided according to race. Of all the examined inhabitants of the villages, 1668 people or 90.0% were pure Eskimo, 2 persons or 0.1% were Indian, 1 person, or 0.05% was Aleut and 2 persons or 0.1% were mixed Eskimo and Indian. In total, 1673 or 90.3% were Alaskan Natives. Because there is often no distinction in the literature

Table 3 1 The response

Village	St Michael	Stebbins	Shaktoolik	Elim	Brevig M	Wales	Savoonga	Gambell
Official census	299	368	171	248	159	143	500	477
Updated census	266	306	178	240	143	122	483	470
Persons examined	229	269	155	211	131	105	391	357
[1]Percentage	76 6%	73 1%	90 6%	85 1%	82 4%	73 4%	78 2%	74 8%
[2]Percentage	86 1%	87 9%	87 1%	87 9%	91 6%	86 1%	81 0%	76 0%

[1] Percentage of persons examined according to official census
[2] Percentage of persons examined according to updated census

Table 3 2 Race-distribution per village

Village	St Michael	Stebbins	Shaktoolik	Elim	Brevig M	Wales	Savoonga	Gambell	Other	Total
Eskimo	210	249	138	177	128	70	359	335	2	1668
Indian	–	1	–	–	–	–	–	1	–	2
Aleut	–	–	–	–	–	–	1	–	–	1
White	11	1	7	8	2	5	3	13	2	52
Don't Know or other	–	4	–	–	–	–	–	–	–	4
Eskimo-Indian	–	–	–	–	–	1	–	1	–	2
Eskimo-White	7	8	10	26	1	28	26	6	1	113
Eskimo-Other	1	6	–	–	–	1	2	1	–	11
All	229	269	155	211	131	105	391	357	5	1853

between the native races, and there are only 5 Indians, Aleuts and mixed Eskimo-Indians involved, in the rest of this study the term Alaskan Native will be used for all Natives.

Fifty-two persons or 2.8% were white; 113 or 6.1% were mixed Eskimo and white. Four persons or 0.2% were of other races, and 11 or 0.6% were mixed Eskimo and other races.

Table 3.2 shows the racial categories for each village. It is clear that Wales is an exception with a relatively low percentage of Alaskan Native residents.

Table 3.3 shows the total population in 10-year age groups subdivided by sex. The population of the Norton Sound and Bering Straits region is a young population, 49.4% of all men and 50% of all women are younger than 20 years of age! Only 7% of the males and 7.6% of the females are older than 60 years. No whites or other races, and only 2 of mixed race belonged to this last category.

As these tables show, the population is predominantly Eskimo. Furthermore, most white people are school teachers and their families, who often spend their summer vacations in the lower 48 states, where they also visit the dentist and ophthalmologist. As was to be expected, the white population in the villages gave a relatively low response. Because of their low

Table 3.3. Age distribution of all respondents.

Age-groups	Male	Female	Total
0– 9 years	251	253	504
	26.7%	27.7%	
10–19 years	213	204	417
	22.7%	22.3%	
20–29 years	156	155	311
	16.6%	17.0%	
30–39 years	118	113	231
	12.6%	12.4%	
40–49 years	66	64	130
	7.0%	7.0%	
50–59 years	69	56	125
	7.4%	6.1%	
60–69 years	39	34	73
	4.2%	3.7%	
70–79 years	22	27	49
	2.3%	3.0%	
80+	5	8	13
	0.5%	0.9%	
Total	939	914	1853

absolute numbers, analysis of the whites, mixed races and other races would have little importance, and was not the subject of this thesis.

3.2.3. The Eskimos

The total number of Eskimos (1668) is given in Table 3.4; 828 or 49.6% are women and 840 or 50.4.% are men.

The Eskimos, together with the other 5 Natives, are subdivided into 10-year age groups of males and females. It is clear that the Eskimo population is a young population. The mean age for the women in this survey was 21.7 years in St Michael to 33.9 in Wales, and 20.0 years for the men in Stebbins to 33.4 years in Wales. These figures correlated well with the official figures.

Wales had the oldest population of both men and women. Furthermore, Wales had a relatively high percentage of non-Native residents. Of all the Bering Straits villages, Wales is one of the oldest communities and was once a trading centre for the Siberian Eskimos and the Chuckchi; with about 500 people it was one of the largest villages. Today, with only 143 official

Table 3 4 Age distribution of Alaskan Natives

Age-groups	Male	Female	Total
0– 9 years	220	226	446
	26 1%	27 2%	
10–19 years	184	178	362
	21 8%	21 4%	
20–29 years	140	146	286
	16 6%	17 6%	
30–39 years	109	100	209
	13 0%	12 0%	
40–49 years	61	58	119
	7 2%	7 0%	
50–59 years	63	55	118
	7 5%	6 6%	
60–69 years	38	34	72
	4 5%	4 1%	
70–79 years	22	26	48
	2 6%	3 3%	
80+	5	8	13
	0 6%	1 0%	
Total	842	831	1673

inhabitants, it is one of the smallest communities, which may be the explanation of the older population

3.3. Conclusion

During fall and winter 1986-1987, an epidemiologic survey of eye diseases among the Eskimos of the Norton Sound and Bering Straits region was performed. The set-up and the methods and instruments used are described In 8 randomly selected villages the response was 83 7 %, excluding 5 non-residents Of this population, 1668 persons, or 90 0%, were pure Eskimo Of the Alaskan Native population, 48 3% was younger than 20 years, 49 6 % were women and 50 4% were men

To conclude, a high and representative response rate from the Eskimo population was achieved during this survey This allows us to make a statistical analysis of the eye diseases found among the Eskimo population of the Norton Sound and Bering Straits region

3.4. Literature

1 Van Herick W, Shaffer RN and Schwartz A (1969) Estimation of width of angle of anterior chamber Incidence and significance of the narrow angle Am J Ophthalmol 68 626 629
2 Kolker AE and Hetherington J Jr (1979) Diagnosis and therapy of the glaucomas St Louis Mosby p 61
3 Shammas HJ (1984) Atlas of ophthalmic ultrasonography and biometry St Louis Mosby p 2-11

LIST OF INSTRUMENTS

Pentax OLH-1 lensometer
Kowa HA-1 applanation tonometer
A O phoropter
Kowa fiberoptic slitlamp
A O projector and slides
Copeland-Optec 360 streak retinoscope
Snellen charts for 20 feet
Titmus Fly stereo tests
A O nearpoint Rotochart
Zeiss indirect ophthalmoscope
Nikon 20 dpt lens

M.P.V. Bio-1/A ultrasound
Topcon IT-1 adjustable instrument table
Welch-Allyn direct ophthalmoscope
Topcon trial lens set

CHAPTER 4

Visual acuity and causes of blindness

4.1. Introduction

Information about the visual acuity and the causes and prevalence of blindness in Eskimos is scarce (Cass, 1973; Wyatt, 1973; Woodruff and Samek, 1976; Johnson et al., 1984; Arkell and Lightman, 1985). In these studies (with the exception of Cass, 1973), however, the Eskimos form only part of the population examined, varying from 49% in the study of Johnson et al. (1984) to 89,3% in Arkell and Lightman's investigation (1985). All these investigators apply the U.S. criteria for blindness: visual acuity of 20/200 or less or a visual field smaller than 20 degrees. In Cass's publication causes of blindness are given without stating whether the blindness is monocular or bilateral and the criteria for blindness applied are not specified.

4.2. Methods

During the investigation the visual acuity of each person was determined, as described in Chapter 3. However it was not possible to obtain adequate information from all persons. The rule was to examine fixation and following movements below the age of 4 years. Some patients were unable to cooperate because they were either too young or too old, or for some other reason. Both near and distant vision were determined, but only the figures on distant vision were analysed, as this information could be compared with other studies. On page 3 of form 3, the cause of a visual acuity below 20/30 was noted for each patient; this information was also used as the cause of blindness. The U.S. standard definition of blindness, visual acuity of 20/200 or less, was used. In addition the W.H.O. standard of visual acuity of 20/400 or less, was used in order to make comparison with other publications possible. The extent of the visual field was not used as a criterion of blindness as this could not be determined accurately.

4.3. Results

4.3.1. The presenting distant visual acuity

Table 4.1 gives the presenting distant visual acuity for all Alaskan Natives, for the right, left and better eye. 1121 right and 1121 left eyes (67%) were examined uncorrected; 547 right and 547 left eyes (32.7%) were corrected with glasses or contact lenses, and in 5 cases (0.3%) this information was missing.

Visual acuity higher than 20/40 was found in 1036 (61.9%) right and 1048 (62.4%) left eyes.

Fixation and following behaviour (in children) was found in 222 (13.3%) left and right eyes, 18 persons (1.1%) were impossible to assess.

Table 4.1. Presenting distant visual acuity of Alaskan Natives. Right, left and better eye.

V.A.	OD M	OD unc	OD cor	OD tot	OS M	OS unc	OS cor	OS tot	Bet unc	Bet cor	Bet tot
90	2	18	0	18	2	18	0	18	17	0	17
70	0	222	0	222	0	222	0	222	222	0	222
60	0	7	3	10	0	1	3	4	1	0	1
50	0	1	0	1	0	0	0	0	0	0	0
40	0	0	2	2	0	1	0	1	0	0	0
30	0	3	5	8	0	2	2	4	1	0	1
01/60	0	0	2	2	0	1	1	2	1	0	1
05/200	0	2	0	2	0	2	3	5	1	0	1
20/400	0	4	1	5	0	6	4	10	1	2	3
20/300	0	1	0	1	0	0	1	1	1	0	1
20/200	0	30	5	35	0	30	9	39	20	3	23
20/160	0	0	1	1	0	0	0	0	0	1	1
20/200	0	34	8	42	0	24	8	32	23	0	23
20/080	0	2	2	4	0	0	2	2	1	1	2
20/070	1	58	24	82	1	58	15	73	42	13	55
20/060	0	2	1	3	0	8	1	9	5	2	7
20/050	0	57	21	78	0	59	24	83	57	22	79
20/040	0	83	35	118	0	76	41	117	78	31	109
20/030	1	133	86	219	1	138	85	223	119	83	202
20/025	1	69	54	123	0	72	34	106	68	35	103
20/020	0	278	206	484	1	277	216	493	309	225	534
20/015	0	117	91	208	0	126	98	224	154	129	283
Total	5	1121	547	1668	5	1121	547	1668	1121	547	1668

V.A. = visual acuity; M = Missing; unc = uncorrected; cor = corrected; Bet = better eye; 90 = Unable to assess; 70 = Fixates and follows; 60 = No Light perception; 50 = Light perception; 40 = Light projection; 30 = hand motion.

Visual acuity of less than 20/30 was found in 395 (23.6%) right and 383 (22.9%) left eyes.

Visual acuity of 20/200 or less was found in 66 (3.96%) right and 66 (3.96%) left eyes. These eyes are blind according to U.S. standards.

When the better eye was considered, 1124 (67.2%) persons had a distant visual acuity higher than 20/40. 239 persons were impossible to assess or showed only fixation and following movements.

Visual acuity of 20/200 or less in the better eye was found in 31 persons. According to U.S. standards, these people are bilaterally blind. By the World Health Organisation standards, 7 persons were bilaterally blind.

Table 4.2 shows the presenting visual acuity of the better eye for Alaskan Natives of both sexes.

Among the Alaskan Natives (99.7% Eskimos), 21.5% of those who could be examined had a visual acuity of less than 20/30 in the better eye.

4.3.2. Distant visual acuity after refraction

Refraction was performed on both eyes of 523 of the 1673 Alaskan Natives and on either the right or the left eye of 20 patients in each case. Monocular blindness was in some cases the reason that only one eye was refracted, and in other cases only one eye had a presenting visual acuity of less than 20/30. Cycloplegic refraction was carried out on both eyes of 10 persons, and on either the right or the left eye of one person in each case. For 1 patient, this information was missing. Table 4.3. gives the best distant visual acuity for both sexes after refraction.

Of the Alaskan Natives, 4 patients (0.3%), 1 male and 3 females, were

Table 4 2 Presenting distant visual acuity of the better eye of Alaskan Natives

best visual acuity	male	female	total	per cent
impossible to assess or unknown	11	8	19	1 1
fixation and following	97	125	222	13 3
20/400 or less	3	4	7	0 4
20/300 - 20/200	7	17	24	1.4
20/160 - 20/070	38	44	82	4 9
20/060 - 20/040	83	112	195	11 7
20/030 or higher	603	521	1124	67 2
total	842	831	1673	100

Table 4 3 Distant visual acuity after refraction of the better eye among Alaskan Natives

best visual acuity	male	female	total	per cent
missing or unable to assess fixation and following	10	8	18	1 1
20/400 or less	97	125	222	13 3
20/300 - 20/200	1	3	4	0 2
20/160 - 20/070	3	1	4	0 2
20/060 - 20/040	5	9	14	0 9
20/030 or better	33	34	67	4 0
total	693	650	1343	80 3
	842	831	1673	100

bilaterally blind according to the World Health Organisation standards (20/400 or less). Before refraction, this figure was 7.

According to U.S. standards (20/200 or less), 8 patients (0.6%), 4 males and 4 females, were bilaterally blind. Before refraction, this figure was 31 (2.2%)! Three quarters of all the bilaterally blind people according to U.S. standards only had a refractive error!

Severely diminished visual acuity in the better eye (visual acuity 20/70-20/160) was found in 14 patients (1.0%). Before performing refraction, there were 82 patients (5.7%) in this group. Giving glasses reduced this group by almost five sixths!

Decreased visual acuity (20/40-20/60) remained in 67 patients (4.7%); there were 195 (13.6%) patients in this group before refraction.

The group of Alaskan Natives with a visual acuity, higher than 20/40 increased from 1124 to 1343 : from 78.4% to 93.7% of all the members of the group whose visual acuity could be examined properly.

The relationship between age and best distant visual acuity is given in table 4.4.

It is clear that most people with a visual acuity of 20/40 or less are found in the 60+ age group.

4.3.3. Causes of blindness

4.3.3.1. Monocular blindness

Monocular blindness, according to U.S. standards, was found, among Alaskan Natives who could be adequately examined, in 44 cases: 28 men and 16 women. The mean age of the monocularly blind Native women was

Table 4.4. Best visual acuity of the better eye according to age among Alaskan Natives.

age	missing	fixates + follows	20/400 or less	20/300 20/200	20/160 20/070	20/060 20/040	20/030 or higher
0- 4	13	207	0	0	0	0	7
5-19	0	14	0	0	5	10	552
20-39	0	0	0	0	0	10	484
40-59	0	0	0	0	1	6	230
60+	5	1	4	4	8	41	70
total	18	222	4	4	14	67	1343

47.4 years, of the men 42.8 years. The youngest patient was 6, the oldest 78. In 16 patients the right eye was the blinded eye, in 28 patients the blinded eye was the left. Table 4.5. gives the etiology of the blindness.

The most important cause of monocular blindness was corneal scarring, seen in 9 patients. Amblyopia and cataract were the cause of blindness in 7 patients . All 5 cases of monocular blindness due to trauma were in males, and were caused by accidents with a snowmobile or a shotgun, while chopping wood, etc. Retinal detachment and glaucoma were the cause of blindness in 4 cases. It was remarkable that only 1 patient's blindness was due to macular degeneration. In 5 patients (11.4%), the loss of one eye was noted: in two cases this was due to trauma, in the other cases to chorioretinitis, glaucoma and evisceration after a corneal ulcer respectively.

Table 4.5. Causes of monocular blindness according to U.S. standards (visual acuity 20/200 or less) among Alaskan Natives.

causes of blindness	eyes	per cent
corneal scarring	9	20.5
strab/refr amblyopia	7	15.9
cataract	7	15.9
trauma	5	11.4
glaucoma	4	9.1
retinal detachment	4	9.1
corneal ulcer	1	2.3
chorioretinitis	1	2.3
phthisis bulbi	1	2.3
high myopia	1	2.3
macular degeneration	1	2.3
uncertain	3	6.8
total	44	100

4.3.3.2. Bilateral blindness

Bilateral blindness was found in 8 patients (0.6%). All the blind patients were Alaskan Natives, 4 were male and 4 female. All were over the age of 70 years.

Table 4.6. gives the etiology of the blindness in this group. The leading cause, responsible for 62.5% of all blindness, was age-related macular degeneration in 5 cases. Corneal scarring was in 2 cases the cause of blindness (25%), glaucoma in 1 case (12.5%). In all 8 patients, the cause of blindness was the same for both eyes.

Table 4 6 Causes of bilateral blindness among Alaskan Natives

etiology	cases	per cent
macular degeneration	5	62 5%
corneal scarring	2	25 %
glaucoma	1	12 5%
total	8	100%

4.4. Discussion

Most Alaskan Natives of the Norton Sound and Bering Straits region are found to have good visual acuity (with or without correction) at their first examination. Before refraction 21.5% had a visual acuity lower than 20/30 in the better eye, but after refraction this was only the case in 6.3%. These findings are in good agreement with those of Arkell and Lightman (1985). These investigators found in 16.9% of all examined eyes before refraction a visual acuity lower than 20/30 (these figures do not include the unassessable cases and those who only show fixation and following), but their material also included other races After refraction they found a visual acuity lower than 20/30 in the better eye in 3.6% (all races).

Woodruff and Samek (1976) found a visual acuity lower than 20/30 in the better eye after refraction in only 0.7% of cases.

Monocular blindness was found in this study in 3.0% of the Alaskan Natives. The principal causes were corneal scars (20.5%), amblyopia (15 9%), cataract (15.9%), trauma (11 4%) and glaucoma (9.1%).

Wyatt (1973) found monocular blindness, according to the U S. criteria, in 1.26% of the group he examined (63.7% Eskimos).

Johnson et al. (1984) found monocular blindness in 4.0% of the population they examined (49% Eskimos).

Arkell and Lightman (1985) found monocular blindness in 2.9% of their material. The most important causes of blindness were cataract (22.7%), macular degeneration (14.7%), amblyopia (12.8%) and trauma (12.8%).

During our investigation 0.6% bilateral blindness according to the U.S. criteria was found. The causes of blindness were macular degeneration (62.5%), corneal scars (25%) and glaucoma (12.5%).

Cass (1973) gives as the main causes of (bilateral?) blindness found by her in Eskimos: tuberculosis, trauma and congenital anomalies. In our study congenital anomalies were not encountered as a cause of blindness.

Wyatt (1973) also found 0.6% bilateral blindness in his study.

Johnson et al. (1984) found blindness in both eyes in 1.2% of the population during their investigation.

Arkell and Lightman (1985) found bilateral blindness, according to the U.S. criteria, in 0.6% of the Alaskan Natives they examined. Cataract and macular degeneration were each responsible for 20% of the blind eyes, glaucoma for 15% and corneal scars for 10%.

Comparison of the figures found during this study with those of other investigators is hampered by a number of discrepancies.

In the first place the Eskimo population of the Norton Sound and Bering Straits region is very young, a fact which has a favourable influence on the prevalence of blindness.

Furthermore there are various definitions of blindness, countries use different criteria. In some publications the criteria used have not been given.

The source of the data is very variable; for example, epidemiological studies, figures from social services, ophthalmological clinics, etc.

The social services provided by different countries are very variable. It is probable that, in countries where there are good services for the blind, blindness wil be registered more accurately than in countries where registration of the patient has no consequences.

Finally, the classification of the cause of blindness is dependent on the expertise of the examiner and on the instruments he has at his disposal.

Goldstein (1980) has reported very extensively on this problem.

4.5. Conclusion

Monocular blindness is found in 3.0% and bilateral blindness in 0.6% of Alaskan Natives in the Norton Sound and Bering Straits region. Visual acuity lower than 20/30 in the better eye after refraction was found in 6.3%.

Three quarters of all the people who were blind according to U.S. criteria had a refractive error only. This fact shows how essential a good optometric service is. As the result of tuberculosis prevention, phlyctenulosis due to tuberculosis now seldom occurs in Alaskan Natives; it is therefore probable that corneal scars, which are now an important cause of blindness, will be less frequent in the future. Regular eye examinations can reduce the number of amblyopes through early recognition and treatment of the condition. Experience shows that occlusion therapy in children with amblyopia, with regular checks by the health aide and thanks to the good social control, has a good chance of succeeding in this remote area. Glaucoma (primary angle-closure glaucoma) can also be treated if it is discovered in time. Cataract can be removed surgically. For age-related macular degeneration, in this study the cause of bilateral blindness in 62.5% of cases, therapy is unfortunately seldom possible. For the occasional case of a subretinal neovascularization, the distance to the nearest ophthalmological centre will probably make the chance that the right diagnosis is made and therapy given in time very small.

A regular optometric service which provides, in addition to refraction, the screening of primary angle-closure glaucoma and cataract, regular checking of the visual acuity of small children and the treatment of amblyopia, and the provision of glasses, seems at present what is needed to achieve maximum visual acuity for the people of the Norton Sound and Bering Straits region. These requirements can be fulfilled by the permanent presence of an optometrist in the Norton Sound regional hospital at Nome, who visits all the clinics in the villages once a year.

4.6. Literature

1. Arkell S and Lightman D (1985) Alaska eye survey I The Maniilaq region. Report to the State of Alaska: 1-79.
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5. Woodruff ME and Samek MJ (1976) The refractive status of Belcher Island Eskimos. Can J Public Health 67: 314-320.
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CHAPTER 5

Refractive errors and axial length

5.1. Introduction

In the last twenty years, reports of refractive errors among Eskimos in Alaska, Canada and Greenland have been published by several authors (Young et al., 1969; Morgan and Munro, 1973; Cass, 1973; Morgan et al., 1975; Woodruff and Samek, 1976; Alsbirk, 1979; Johnson et al., 1979; Alward et al., 1985; Arkell and Lightman, 1985). An increasing rate of myopia among young Eskimos was observed by most of them. Environmental factors such as school attendance have been suggested as explanations for this 'epidemic of myopia'.

What seems to be a simple solution to the refractive problems, i.e. wearing glasses, is not so simple in rural Arctic villages. When patients have refractive errors, they often have to travel great distances to get a prescription for their glasses. Then, these glasses must be bought from an optician, or by post-order. Most Eskimo families have a low income and many of them can hardly afford the glasses they need. Finally, the extreme cold causes plastic frames to break like eggshells and chills metal frames enough to burn the skin, in addition to the nuisance of fogging, which gives problems when hunting, fishing and driving snowmobiles.

5.2. Patients and methods

During the survey, the refractive errors were measured in each patient with a presenting visual acuity of less than 20/30 in one or both eyes and in those whose visual acuity did not decrease with the plus one test. The plus one test, however, was not performed in the first 4 villages because the trial lens set was not available at that moment, but in our data on persons without the plus one test it appears that the rate of hyperopia is even somewhat higher than in the rest of the material. The protocol used limited the precision of the definition of myopia, emmetropia and hyperopia in this study. The way

the refractions were performed is described in Chapter 3. Refractive errors were not determined in children under the age of 4 years and in others in whom assessement was not possible. Cycloplegic refraction was done in only 12 cases because of the high incidence of angle-closure glaucoma among Eskimos reported by Alsbirk (1976) and Arkell et al. (1987). In addition it was to be expected that cycloplegia would be found inconvenient by the village population and that this would have a negative influence on the response rate. Lensometry measurements were recorded for those wearing glasses. All cylinders were recorded in minus diopters. Keratometry was not performed because of the limited amount of medical equipment that could be carried. As definition of the refractive error in spherical equivalents, the sum of the spherical error and half the cylindrical error was taken.

In a randomly selected group of patients above the age of 14 years, the axial length of the eyes was measured with the Bio-1 ultrasound. After topical anesthesia, the measurement was made twice for each eye, in order to avoid false information caused by inadequate fixation. When necessary a third measurement was made.

After the examination, all patients who had a refractive error or who wanted to buy a new pair of glasses were given a prescription.

As a service to the local population, sample frames were demonstrated by the ophthalmic assistant. Those who wanted to buy glasses could order them on non-profit basis from the Norton Sound Health Corporation.

5.3. Results

5.3.1. Spherical refractive errors

From the 1673 Alaskan Natives examined during the survey, information on refractive errors was available for 1395 (83.4%) right and 1394 (83.3%) left eyes. Fixation and following was found in 222 (13.3%) patients, predominantly under the age of 4 years. 19 patients (1.1%) could not be assessed. For 37 (2.2%) patients the refractive error of the right eye and for 38 (2.3%) patients the data for the left eye were missing, either because the eye was blind or enucleated or because there was no information noted on the form.

Of the 1395 right eyes examined 627 (44.9%) were myopic, 610 (43.7%) were emmetropic and 158 (11.3%) were hyperopic.

Of the 1394 left eyes examined 613 (44.0%) were myopic, 616 (44.2%) were emmetropic and 165 (11.8%) were hyperopic.

The average refractive error of the right eyes was S-0.91 (s.d. 2.23 D) and of the left eyes S-0.84 (s.d. 2.07 D).

Table 5.1. gives the types of refractive errors for the right and the left eyes.

In total, 585 persons (44.7%) were classified as myopic, 587 (44.9%) as emmetropic and 136 (10.4%) as hyperopic. The remaining 365 persons could not be put in one of these 3 categories, either because information was missing or because the two eyes belonged in different categories.

Table 5.2. shows the classification of refraction by sex. The subdivision into refractive categories made in Table 5.1. is used here.

Myopia was seen more often in women (48%) than in men (41%) and emmetropia was less common in women (40%) than in men (49%).

Table 5.3. specifies the refractive errors in diopters in the right eyes and Table 5.4. in the left eyes. The age is given in decades, except for the first decade in which only the 5–9-year-olds are represented. For the dioptric power, 0 represents S−0.25 – S+0.25; −1 = S−0.26 – S−1.0; −2 = S−1.01 – S−2.0 etc. On this account S−1 and S+1 are relatively under-represented in these tables.

Figure 5.1. shows the percentages of myopia, emmetropia and hypermetropia for all eyes of both sexes in the various age-groups. An increase in myopia with age is seen up to a maximum of 67.2% in the age group 30–39 years; after this myopia decreases markedly. The percentage of hyper-

Table 5.1. Frequency of refractive errors in the eyes of Alaskan Natives with classification of individuals in myopic (m), emmetropic (e) or hyperopic (h).

Refraction (left)	missing	myopic	emmetropic	hyperopic (right)
missing	261	5 (m)	8 (e)	4 (h)
myopic	3 (m)	577 (m)	27	20
emmetropic	11 (e)	18	568 (e)	13
hyperopic	4 (h)	13	13	128 (h)

Table 5.2. Refractive errors by sex (Alaskan Natives).

Refraction	Male	Female	Total
Myopic	41.3%	48.3%	44.7%
Emmetropic	49.3%	40.3%	44.9%
Hyperopic	9.4%	11.4%	10.4%

Table 5 3 Distribution of the refractive errors of right eyes (Alaskan Natives)

Dptr	5-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
>−10	0	0	0	0 4	0	0 9	0	2 4	0
−10	0	0 6	0 4	0	0 9	0 9	0	2 4	0
−8	0	0 6	4 2	5 3	0 9	0	1 5	0	0
−6	0	0 3	4 2	4 3	1 7	0 9	1 5	0	0
−5	0	1 7	6 7	9 2	1 7	3 5	1 5	0	0
−4	0 5	2 5	9 9	9 2	7 7	0 9	4 5	0	0
−3	1 0	8 5	12 7	8 2	7 7	5 3	1 5	16 7	14 3
−2	5 4	18 0	14 5	18 4	18 8	7 9	3 0	7 1	14 3
−1	4 9	11 8	9 5	12 6	17 1	8 8	4 5	14 3	0
0	85 2	52 4	34 3	29 0	32 5	29 8	22 4	16 7	0
+1	0 5	1 7	2 5	0 5	7 7	17 5	20 9	19 1	0
+2	0	0 3	0 4	1 5	1 7	16 7	22 4	9 5	28 6
+3	1 0	0 3	0 4	0	0 9	3 5	10 5	7 1	14 3
+4	0 5	0 3	0	0 5	0	0 9	3 0	2 4	14 3
+5	0 5	0 6	0	0 5	0	0 9	0	2 4	0
+6	0	0	0 4	0	0	0 9	0	0	0
+8	0	0 3	0	0	0	0	0	0	0
+10	0 5	0 3	0	0 5	0	0 9	0	0	0
>+10	0	0	0	0	0 9	0	3 0	0	14 3

Table 5 4 Distribution of the refractive errors of left eyes (Alaskan Natives)

Dptr	5-9	10-19	20-29	30-39	40 49	50-59	60-69	70-79	80+
>−10	0	0	0 4	0	0	0 9	0	0	0
−10	0	0 6	0	1 4	0 9	0	0	0	0
−8	0	0 3	3 6	1 9	0 9	2 6	3 0	0	0
−6	0	0 3	4 3	4 8	1 7	0 9	0	0	0
−5	0	2 3	7 8	6 3	0 9	2 6	0	0	0
−4	0	1 7	9 6	9 6	5 1	2 6	1 5	4 9	0
−3	0 5	7 6	10 6	9 6	11 9	3 4	4 5	7 3	0
−2	7 0	18 3	15 6	18 8	14 4	11 1	6 0	12 2	14 3
−1	4 0	10 4	11 7	13 0	19 5	6 0	3 0	12 2	0
0	84 9	53 8	33 3	30 3	35 6	28 2	25 4	14 6	14 3
+1	1 5	1 4	1 1	1 9	5 9	17 1	17 9	19 5	14 3
+2	0 5	1 4	0 4	1 9	1 7	13 7	22 4	7 3	28 6
+3	1 0	0 3	0 7	0 5	0 9	6 0	9 0	7 3	0
+4	0	0 3	0 4	0	0	2 6	6 0	9 8	14 3
+5	0	0 6	0 4	0	0	0 9	0	0	0
+6	0	0	0 4	0	0	0 9	0	2 4	0
+8	0 5	0 6	0	0	0 9	0	0	0	0
+10	0	0 3	0	0	0	0 9	0	0	0
>+10	0	0	0	0	0	0	1 5	2 4	14 3

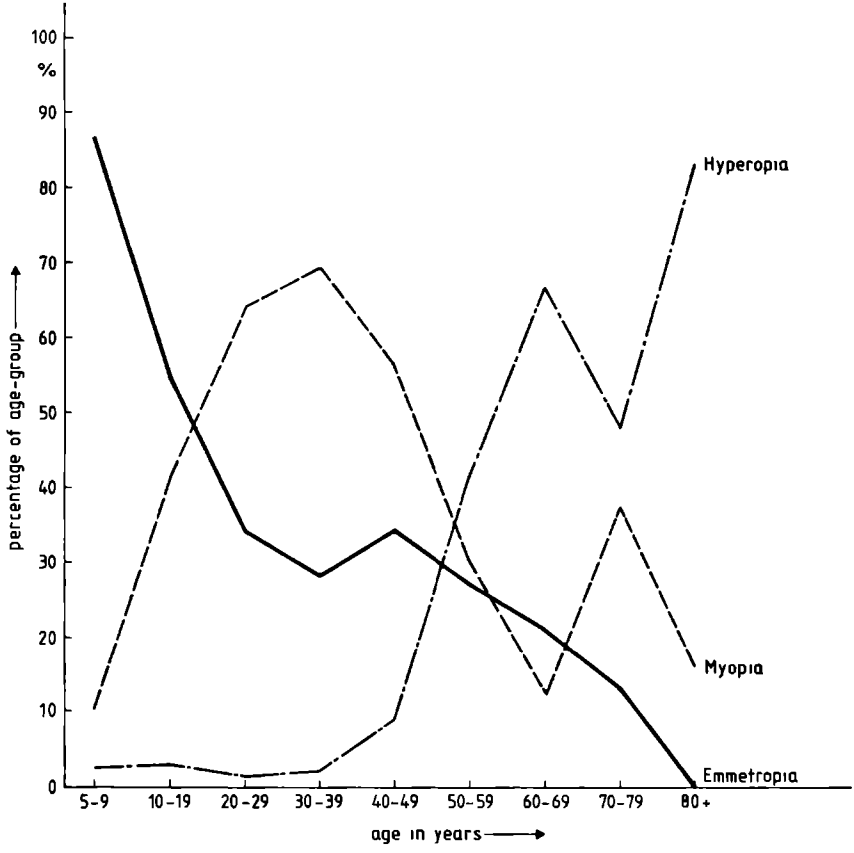

Figure 5.1. Refractive errors by age among Alaskan Natives.

metropia is low up to the age group 40–49 years, after that there is a marked increase. In the group above the age of 80 years 71.5% is hypermetropic. The percentage of emmetropia decreases from 82.5% by the 5–9-year-olds to 7.2% by persons above 80 years of age.

Figure 5.2. gives the distribution of myopia by age and sex. Below the age of 50 years myopia is more often seen in women.

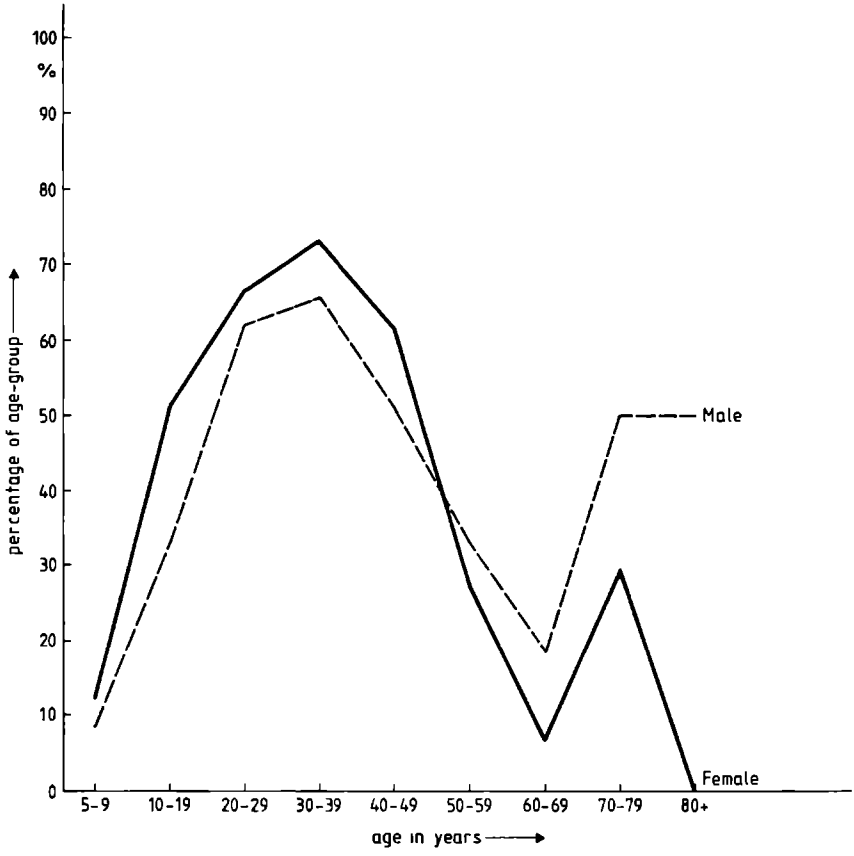

Figure 5 2. Myopia by age and sex among Alaskan Natives

5.3.2. Anisometropia

The difference in refractive error between the two eyes is given in Table 5.5. Anisometropia is of little importance in the population under examination, 84% had not more than 0.5 D difference between the two eyes, while a difference of more than 2 D was only found in 4%.

5.3.3. Cylindrical refractive errors

The frequency of cylindrical refractive errors is shown in Table 5.6. Astig-

matism was found in 46.9% of right eyes and 46.1% of left eyes. A cylindrical error greater than 2.00 D was only found in 3.5% of right eyes and 3.3% of left eyes.

5.3.4. Ultrasound examination, axial length and refraction

In 112 randomly selected persons above the age of 15 years the axial length of 108 right and 110 left eyes was measured with the Bio-1 Ultrasound. The average axial length of the right eyes was 23.8 mm (s.d. = 1.24 mm) and of the left eyes 24.0 mm (s.d. = 1.26 mm). The minimum length was: right, 20.4 mm; left 21.8 mm, and the maximum length: right, 27.6 mm; left, 29.0 mm.

Table 5 5 Anisometropia among Alaskan Natives

difference in diopters between eyes		cumulative frequency
0	702	51 0%
0 25 or less	306	73 2%
0 5 or less	148	84 0%
1 0 or less	109	91 9%
2 0 or less	56	95 9%
4 0 or less	40	98 8%
10 0 or less	11	99 6%
more than 10	5	100 0%
Total	1377	

Table 5 6 Frequency of cylindrical errors

Diopters	Right eye	Left eye
0	554 53 1%	561 53 9%
0 25-0 50	184 17 6%	187 18 0%
0 75-1 00	173 16 6%	143 13 7%
1 25-1 50	69 6 6%	77 7 4%
1 75-2 00	28 2 7%	39 3 7%
2 25-3 00	21 2 0%	21 2 0%
3 25-4 00	7 0 7%	7 0 7%
4 25-5 00	7 0 7%	4 0 4%
5 25 or more	1 0.1%	2 0 2%
Total	1044	1041

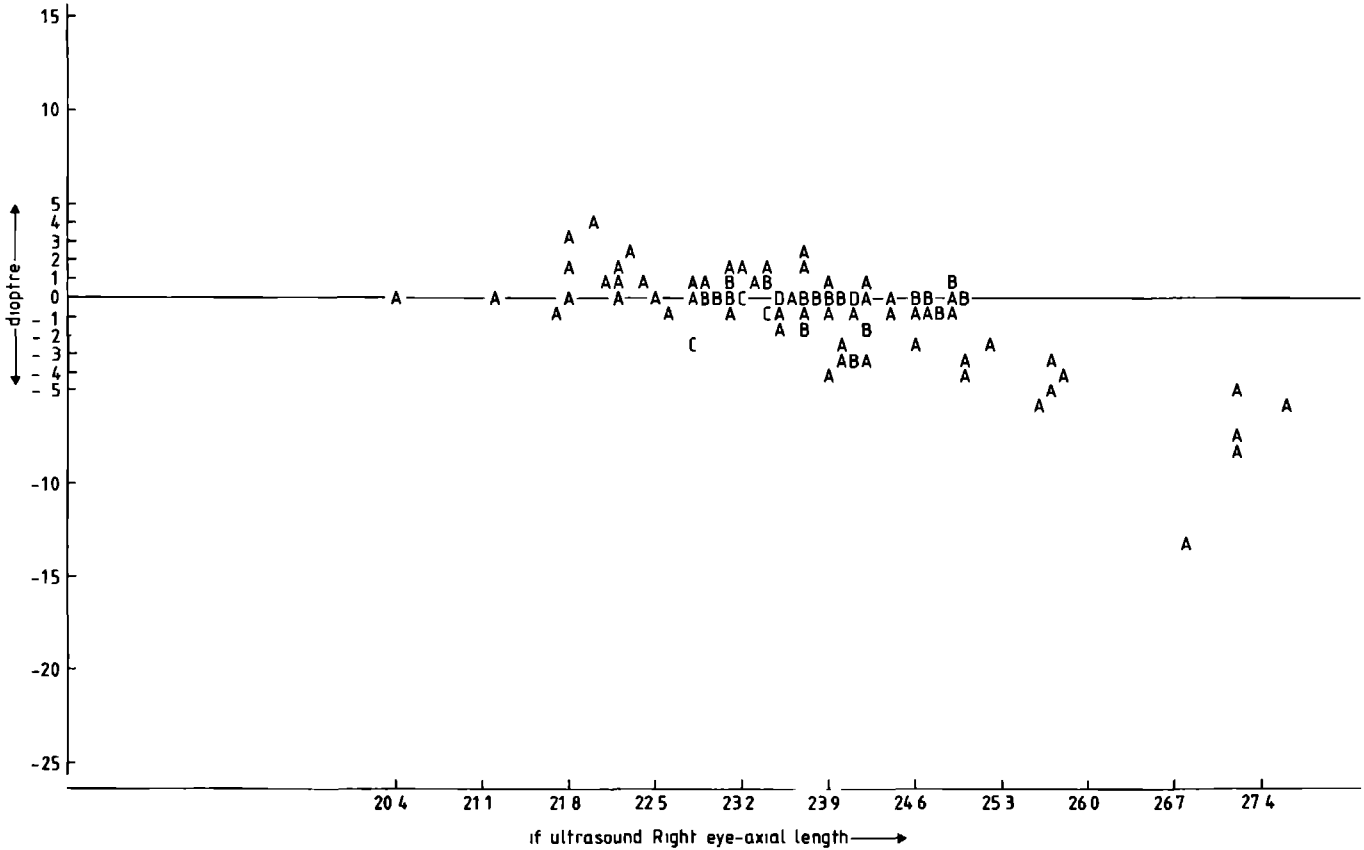

Figure 5 3 Correlation between refractive errors and axial length of right eyes in which ultrasound examination was performed
A means 1 observation, B 2 observations etc

Table 5 7 Axial length and refractive error of 218 eyes (112 individuals above 14 years of age)

Axial length	<22	22-22 9	23-23 9	24-24 9	≥25 mm	Total
myopic	1	5	24	31	23	84
emmetropic	4	15	30	26	8	83
hyperopic	3	16	22	8	2	51
Total	8	36	76	65	33	218
perc myopia	12 5%	13 9%	31 6%	47 7%	69 7%	38 5%
perc emmetr	50 0%	41 7%	39 5%	40 0%	24 2%	38 1%
perc hyper	37 5%	44 4%	28 9%	12 3%	6 1%	23.4%

Table 5.7. shows the distribution of the axial lengths and the spherical refractive errors.

As the axial length increases the percentage of myopic eyes rises and the percentage of hyperopic eyes falls. As the ultrasound examination gives practical problems in children this group is underrepresented, so that the figure for hypermetropia is relatively too high. These figures are represented graphically in Figure 5.3.

The relationship between age and the axial length of the right eye is shown in Figure 5.4. There seems to be no clear relationship between axial length and age.

5.4. Discussion

Since Young et al. (1969) made their publication, various authors have reported on the increasing myopia in young Eskimos. The set-up, however, of these studies varies greatly. Young et al. (1969) did not examine randomly selected groups of patients. Alsbirk (1979) and Alward et al. (1985) did not include all age-groups in their investigation. In the studies of Morgan and Munro (1973), Johnson et al. (1979), Arkell and Lightman (1985) and ourselves a randomly selected group of patients from all age-groups was examined.

The definition of myopia used by the authors is also variable. Young et al. and Johnson et al. define myopia as all refractive errors of −0.25 D or more, while Morgan and Munro record myopia of between S−1.00 and S−5.00 D and higher than −5.00 in their publication. Alsbirk uses both these definitions in order to be able to compare his work with these two studies and Alward et al. define myopia as all refractive errors of −0.50 D and higher.

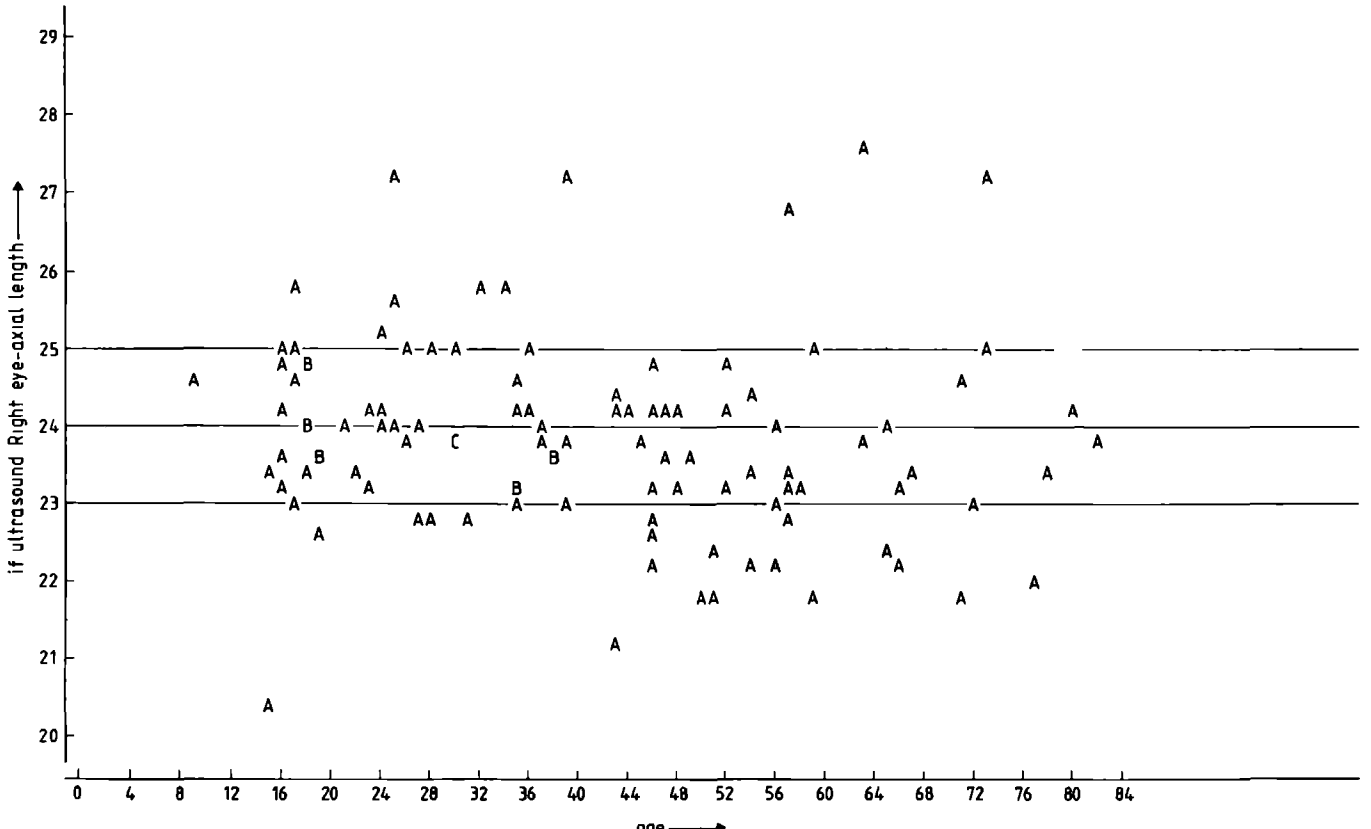

Figure 5.4. Correlation between age and axial length in right eyes.
A means 1 observation, B 2 observations etc.

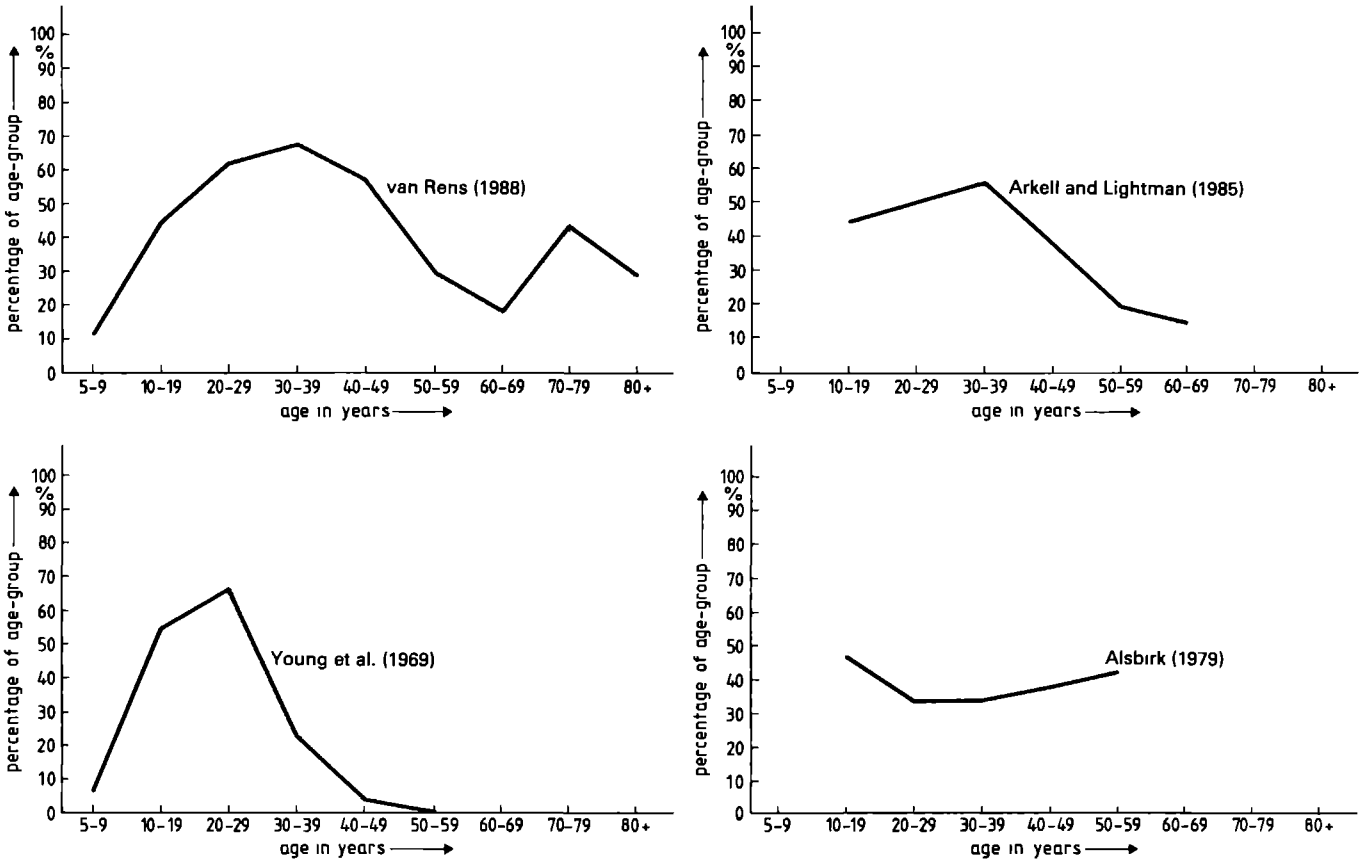

Figure 5.5. Myopia by age in right eyes among Eskimos, found in different studies.

Finally, the way in which the refractive error was determined differs. In the studies of Alsbirk, Arkell and Lightman and ourselves cycloplegia was not used, but refractive errors were determined by the subjective method. In the present study the plus 1 test was used in 4 villages. Young et al., Morgan and Munro, Johnson et al. and Alward et al. used cycloplegia and retinoscopy (skiascopy) to determine the refraction. It is obvious that all these differences make it difficult to compare the results of various investigations with each other and with the results of this study, a problem which has been pointed out by several authors.

Figure 5.5. shows the percentage of myopia of S−0.25 D or higher, classified by age, found by Young et al., Alsbirk, Arkell and Lightman and ourselves, all for the right eye. Some conversion of data into 10-year age-groups was necessary, as Young et al. classified their refractive errors in 5-year age-groups and Arkell and Lightman in 20-year age-groups.

The curve from Young et al.'s study (1969) is similar to ours up to the age of 30 years, but above this age Young et al. found less myopia. This cannot be explained by the omission of cycloplegia in our study, as the power of accommodation decreases with age, so that a higher percentage of myopia in young persons would be more understandable. Young et al. found an average refractive error of S+0.58 D, while in this study S−0.91 was found, a difference of no less than 1.49 D.

The curve from Alsbirk's study (1979) differs greatly from ours, despite the fact that he also determined the refraction by the subjective method. The average refractive error was −0.07 D for men and +0.25 D for women, 40.3% of the men and 33.1% of the women were myopic, in contrast with our figures of 41% myopia in men, but 48% myopia in women.

Arkell and Lightman (1985) found 44% myopia between 12 and 19 years, 55.4% between 20 and 39 years, 18% between 40 and 59 years and 14% above the age of 60 years; although the age-groups are different the results correspond well with the results of our study. The average refractive error for Alaskan Natives is not given in their report. Myopia was found in 43% of women and 34% of men. The set-up of their study was identical to ours, with the exception of the choice of villages.

Morgan and Munro (1973) determined the refractive error of 2042 Eskimos in cycloplegia, but only give in their report a graph of the percentage of persons with myopia between −1 and −5 D. They found about 30% 'moderate myopia' in the 15–25-year age-group, but above the age of 30 years not more than 0–10%. The average refractive error is not given and any difference between the sexes is not reported.

Morgan et al. (1975) found myopia in 10% of men and 25% of women in the age-group 15–29 years; above 29 years the figures were 3% and 5% respectively. The definition of myopia is not given. Study of pedigrees did not suggest a genetic cause of the increase in myopia in young people.

Cass (1973) reports in her publication that myopia in Eskimo students increased from 6.5% in 1958 to 65% in 1970. The refractive error was determined in cycloplegia.

Woodruff and Samek (1976) found myopia of more than −0.01 D in 23.7% of the Eskimos they examined; the average refractive error was +0.53 D, but was greater for women (+0.70) than for men (+0.35). There was little difference in prevalence of myopia between the various age-groups. It is not clear how the refraction was determined in this study.

Johnson et al. (1979) found myopia of 0.25 D or more in 17.8% of Eskimos examined in cycloplegia; 9.6% were emmetropic and 72.6% hypermetropic. Myopic eyes had a significantly greater axial length than emmetropic and hyperopic eyes. A genetic component for the refractive error could not be demonstrated, although this appeared to be present in the case of axial length.

Alward et al. (1985) examined the right eyes of Eskimos between the ages of 20 and 23 years. Using retinoscopy, they found myopia of 0.50 D or more in 68% of the population. The average refractive error was −1.91 D for women and −1.36 D for men.

To summarize, comparison of the findings in this study with other studies on Eskimos is only possible in the case of Alsbirk and Arkell and Lightman. The findings of Alsbirk in Greenland Eskimos differ considerably from the findings in this study. Arkell and Lightman found in the inhabitants of the Maniilaq region about 10% more hypermetropia than was found in this study, but the distribution of myopia showed a high degree of similarity.

Much has been published about the distribution of myopia in other races. Unfortunately most studies only cover selected patient populations, such as schoolchildren, students, recruits, patients in Eye Departments, etc.. When making comparisons with these studies the same problems are encountered as were noted in connection with comparisons with other Eskimo studies. A few of these studies wil be reviewed.

Dzen (1921), in a mixed population, found 52.4% myopia in the Chinese and 22% myopia in the Caucasian people.

Rasmussen (1936) reported that 65% of all glasses sold by traditional Chinese opticians had negative lenses and only 3% of glasses were sold to hyperopic persons younger than 40 years. However, he also observed that the traditional test-sets only contained negative lenses. In addition, it was

unseemly for young persons to wear glasses with positive lenses, especially if the parents did not wear glasses. In modern hospitals analysis of 120,000 refractions showed that 70% of the prescribed glasses had negative lenses, 10% were for presbyopia and 10% for hyperopia.

Takahashi (1939) found myopia in 31% of the population of Japan.

Baldwin (1964), in schoolchildren in Hawaii, found 7% myopia among Caucasians, 12% in Japanese and Koreans and 17% in Chinese children.

It thus appears that myopia in the past was also frequently encountered in other Mongoloid races.

Richler and Bear (1980) investigated the refraction of the white inhabitants of Western Newfoundland. The set-up of the study and the response were almost the same as in the present survey, except that persons with higher myopia than S−6.00 D (about 1% of the material) were excluded. The distribution of myopia in age-groups is very simular to the results obtained in this study, except that the top of the curve comes earlier, in the 15–20-year age-group.

Sperduto et al. (1983) published the findings of a study carried out in 1971-1972 on 14,147 persons in the U.S.A. In 5197 forms with usable information they found figures for whites of 25.8% myopia in the age-group 12–17 years, 29.7% between 18 and 24 years, 25.6% between 25 and 34 years, 24.9% between 35 and 44 years and 25,5% between 45 and 54 years. For blacks these figures were 12.0%, 10.4%, 12.3%, 14.8% en 17.3% respectively. All figures are for right eyes. In both whites and blacks more myopia was found in right (26.3% and 13.0%) than in left (25.6% and 12.2%) eyes. In both races more myopia was seen in women below the age of 35 years than in men of the same age. It is not clear by which method the refraction was measured.

Mäntyjärvi (1983) examined schoolchildren between the ages of 7 and 15 years after their check-up by the school doctor. The author made a cumulative curve from his data and came to the conclusion that 22.8% would be myopic at the age of 15 years. Boys were less myopic than girls.

Fledelius (1983) studied the refractive error of hospital patients above the age of 16 years, who had been admitted for other than ophthalmological reasons. The highest prevalence of myopia (± 40%) was found in the 26–35-year age-group, but in the case of diabetics this was ± 55% in the 36–45-year age-group.

Garner et al. (1985) examined schoolchildren between 6 and 17 years of age in Vanuatu by means of retinoscopy but without cycloplegia. Only 7.5% had a refractive error of −0.25 D or more, and only 0.77% higher than −0.50 D.

The axial length of the eye is considered to be the principal determinant of the refraction (Curtin, 1985). The average axial length found in this study, 24.0 mm OD en 23.8 mm OS, is in agreement with the findings of others (Curtin, 1985). In this study we also found more hypermetropia in association with a short axial length and more myopia with a long axial length.

A genetic cause for the increasing myopia in Eskimos has not been demonstrated (Young et al., 1969; Young and Leary, 1972; Morgan et al., 1975; Alsbirk, 1979; Johnson et al., 1979; Alward et al., 1985). Another view, the use-abuse theory, asserts that myopia is a result of how people use their eyes (Angle and Wissmann, 1980). Environmental factors, such as schooling (Young et al., 1969; Morgan and Munro, 1973; Morgan et al., 1975) and changed dietary habits (Morgan and Munro, 1973; Cass, 1973; Johnson et al., 1979) have been suggested as explanations of the 'epidemic of myopia'. The answer to the question, why myopia is more frequent in young Eskimos than in the older generation, cannot be given from the findings of this study and was not the aim of this investigation. It is noteworthy that in the present study, as well as in the studies by Arkell and Lightman (1985) and Young et al. (1969), the increase in myopia begins in the generation of Eskimos who were born between 1935 and 1945. Through the increasing Western influence, school attendance increased markedly after this period. Western food also became more readily available. As the increase in myopia, however, is not only seen in Eskimos, as appears from Richler and Bear's (1980) study of the white inhabitants of Western Newfoundland, the increasing school attendance appears to be the most probable cause of the 'epidemic' of myopia in young Eskimos.

5.5. Conclusion

During this study the average refractive error found in the Alaskan Natives examined was −0.91 D for the right eye and −0.84 D for the left eye. Myopia was seen in 41.3% of the male population and 48.3% of the females. Emmetropia was seen in 49.3% of the men and 40.3% of the women, while only 9.4% of the men and 11.4% of the women was hyperopic. With increasing age myopia first becomes more frequent, but decreases again after the age of 40 years. Hypermetropia increases markedly after the age of 50 years, while emmetropia decreases steadily with age. Anisometropia of more than 2 D was only seen in 4.1% of the examined persons; astigmatism of more than 2 D in only 3.5% of the right eyes and 3.3% of the

left eyes. There was a clear correlation between the axial length and the refractive error.

The Norton Sound Health Corporation employs a full-time optometrist who, in addition to his normal office hours in the hospital in Nome, also visits all the villages in the region once a year.

The inhabitants of the Norton Sound and Bering Straits region can also buy glasses at cost price from the Norton Sound Health Corporation.

Our findings during this study emphasize the importance of a permanent optometric service for the inhabitants of this region. In view of the findings of other authors among Eskimos in other areas of Alaska, in Canada and in Greenland, it is advisable to offer an optometric service to the population of other regions, where this is not already present.

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CHAPTER 6

Corneal diseases

6.1. Introduction

A number of diseases of the cornea have been frequently observed in Eskimos. In the past, phlyctenular keratoconjunctivitis in connection with tuberculosis was reported as an important ophthalmological problem by various authors (Fritz et al., 1951; Fritz and Thygeson, 1951; Thygeson and Fritz, 1951; Duggan and Hatfield, 1958; Reed and Hildes, 1959; Farson, 1961; Philip et al., 1965; Gillan, 1970; Wyatt, 1973a and 1973b; Clemmesen, 1976). The same condition was probably described by Mould (1940) but it was not recognized as such.

Now that, thanks to intensive campaigns, tuberculosis seldom occurs, it is the corneal scars in older Eskimos which still form a problem, because these are often the cause of visual disturbances. Corneal grafts in Eskimos with corneal scars due to phlyctenulosis have been performed with good results (Smith et al., 1975a and 1975b).

Climatic droplet keratopathy, also called Labrador keratopathy or spheroid degeneration, was first described by Freedman (1965) and has subsequently been observed by others in Eskimos (Forsius, 1972; Freedman, 1973a; Garner et al., 1973; Wyatt, 1973b; Young and Finlay, 1975; Norn, 1978, 1979). This condition is probably caused by too much ultraviolet radiation. The use of sunglasses is therefore advised (Young and Finlay, 1975).

In view of these reports in the literature, all persons involved in this study were specially examined for corneal scars and diseases. The results of this examination are given.

6.2. Methods

All persons were examined for corneal disease according to the protocol given in Chapter 3. Climatic droplet keratopathy was graded as described

by Freedman (1965). Corneal scars were specified as traumatic, inflammatory-tubercular (phlyctenulosis), inflammatory-nontubercular or other causes. Only those scars which were very specific for phlyctenular keratoconjunctivitis were noted as such in this study. The presence, size and location of pterygia was also noted. Any other corneal lesions were coded according to the International Classification of Diseases (I.C.D.-9). Although in Form I special attention was paid to a history of tuberculosis these particulars were not further analysed; it appeared that the history was often unreliable. Even patients who, according to their medical reports, had spent years in a sanatorium with tuberculosis, denied having had the disease.

6.3. Results

6.3.1. Phlyctenular keratoconjunctivitis and corneal scarring

Corneal scarring was seen in 85 Alaskan Natives (5.1%). Table 6.1 shows the prevalence of corneal scarring according to age and sex. It is clear that corneal scarring in both sexes becomes more common with age.

Table 6.2 gives the location of the corneal scar and the affected eye. In 49 persons only one eye was affected, the right eye 26 times and the left eye 23 times. In 36 patients both eyes had corneal scars.

The affected eyes were subdivided according to the etiology of the scars, into traumatic, tuberculous inflammatory, nontuberculous inflammatory and other. In Table 6.3 these causes of corneal scarring are listed according to age and sex. Tuberculous scars were seen in both sexes 17 times. Traumatic scars, on the other hand, were seen 4 times as frequently in men (20 persons) as in women (5 persons). Many of these traumatic scars were the result of accidents associated with work, such as snowmobile and shotgun

Table 6.1. Prevalence of corneal scarring by age and sex among Alaskan Natives.

Age	Male	Female	Total
0–19	0.5%	1.0%	0.7%
20–39	6.4%	3.3%	4.8%
40–59	12.9%	12.4%	12.7%
60+	21.5%	16.2%	18.8%
Total	5.7%	4.5%	5.1%

accidents while hunting, splinters while chopping wood, or ice particles or metal splinters.

6.3.2. Climatic droplet keratopathy and pterygia

Climatic droplet keratopathy (CDK) was seen in 10 Alaskan Natives (0.6%), 6 men (0,7% of the total male population) and 4 women (0.5% of all females). All the patients with CDK were older than 50 years. In 8 patients one eye was affected and in 2 cases both eyes. In all cases the CDK was both nasal and temporal.

Pterygia were seen in 16 persons (1.0%), 9 males (1.1%) and 7 females (0.8%). Ten patients had unilateral and 6 bilateral pterygia. Only one

Table 6.2. Location of corneal scarring.

		Scarring left eye				
		periph	central	per + centr	none	total
Scarring right eye	periph	9	0	1	10	20
	central	2	8	0	5	15
	per + centr	1	0	15	8	24
	none	19	4	3	–	26
	total	31	12	19	23	85

Table 6.3. Etiology of corneal scarring classified by age and sex among Alaskan Natives.

	MALES					FEMALES				
Age	number of cases*	trauma	TB	nonTB	other	number of cases	trauma	TB	nonTB	other
0–19	2	0.2%	0 %	0 %	0.2%	4	0.2%	0.2%	0.7%	0 %
20–39	16	3.6%	2.0%	1.2%	0.4%	8	0%	2.0%	0.8%	0.4%
40–59	16	5.6%	3.2%	2.4%	0.8%	14	1.8%	5.3%	5.3%	0 %
60+	14	4.6%	12.3%	4.6%	0 %	11	2.9%	7.7%	4.4%	1.5%
Total	48	2.4%	2.0%	1.1%	0.4%	37	0.6%	2.0%	1.7%	0.2%

* In some cases more than one cause of scarring was recorded or different causes for right and left eye.

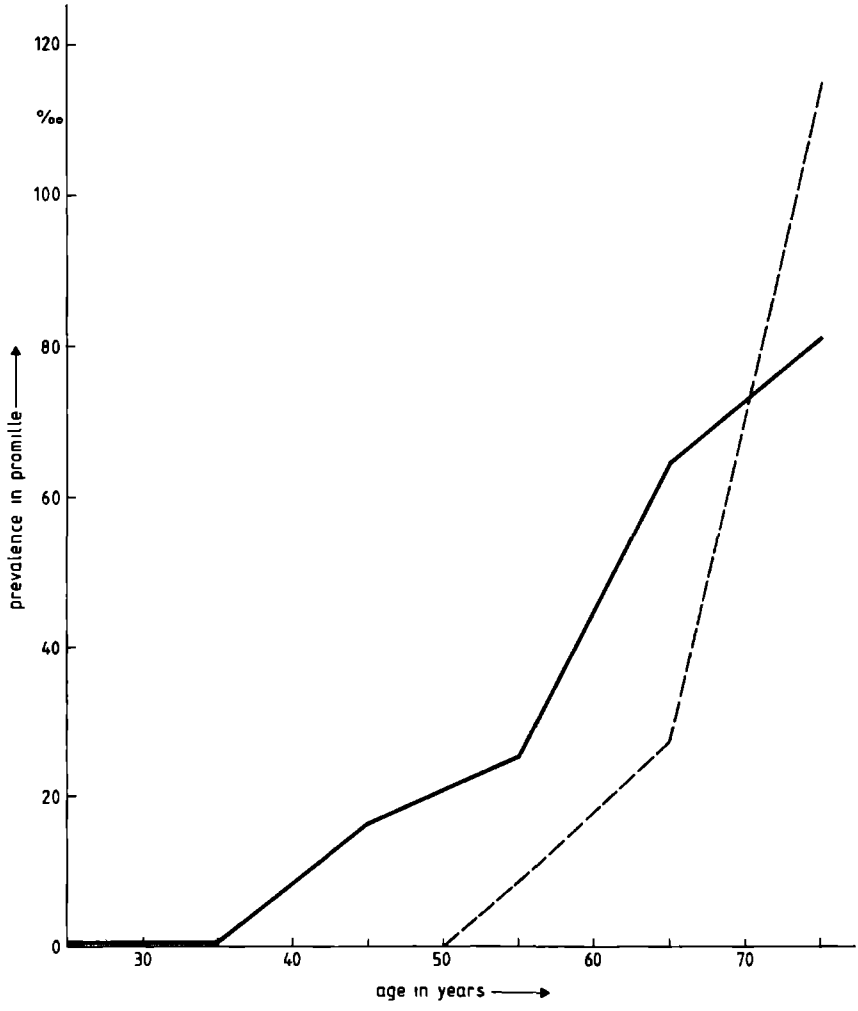

Figure 6.1. Age-related prevalence of pterygium (———) and CDK (----).

pterygium was temporal. One patient with a pterygium was in the age-group 10-19 years, two in the group 40-49 years and the rest (13) were older than 50 years.

Figure 6.1. shows the prevalence of pterygia and CDK by age per mille.

6.4. Discussion

Phlyctenulosis or phlyctenular keratoconjunctivitis is frequently due to sensitivity to tuberculoprotein or tuberculin antigen. The condition is an example of purely cellular immunity. Phlyctenulosis is often associated with bad hygienic conditions and poor nutrition, and is thought to be more common in women than in men (Grayson, 1983). The disease is usually self-limiting and is characterized by acute, painful nodules (phlyctenules) on the cornea and conjunctiva, which can ulcerate. Although these phlyctenules only last for 14 days they give rise to scars, thinning and neovascularization of the cornea.

Conjunctival phlyctenules cause mild irritation. They have a vascularized, hyperemic base and a small, white central ulcer. They heal spontaneously without trace.

Phlyctenular keratoconjunctivitis, on the other hand, is associated with severe pain, lacrimation, photophobia and blepharospasm. Two forms can be distinguished, one form with local infiltration and ulceration and one form with diffuse infiltration and pannus. The ulceration can be fascicular and spread over the whole cornea (Vastine, 1980).

Phlyctenulosis is treated with topical steroids (Thygeson and Fritz, 1951). If scars have formed which disturb vision, the results of a corneal graft in patients without corneal neovascularization are good (Smith et al., 1975a and 1975b). As the result of intensive campaigns against tuberculosis this disease has seldom been found since the sixties; this has also resulted in a dramatic decrease in the incidence of phlyctenulosis. Thus Clemmesen (1973) reported that the percentage of patients seen in his office with phlyctenulosis decreased from 39% in 1948 to 0.8% in 1971!

During the present study scars which were probably due to phlyctenulosis were seen in 2% of the population examined. Although this condition is usually seen in school children it was only found in one patient (0.1%) in the age group 0-19 years. Scars were seen in 2% of the age group 20-39 years. In the males of the age group 40-59 years scars were found in 3.2% and in the females in 5.3%. In the age group above 60 years scars attributed to phlyctenulosis were seen in 12.3% of the men and 7.7% of the women.

Consideration of the facts, that the treatment of phlyctenulosis with topical steroids has been possible since the first publication on the subject in 1951, and also that the treatment of tuberculosis was started in the same period, explains why few scars are seen in patients younger than 40 years of age.

When we consider that corneal scars, probably caused by phlyctenular

keratoconjunctivitis, were found by Fritz and Thygeson (1951) in 10.6-27.4% of the Eskimos and Indians they examined, by Duggan and Hatfield (1958) in 17.2%, by Reed and Hildes (1959) in 7%, by Philip et al. (1965) still in 40% and by Wyatt (1973a) in 7%, it is clear that, on the one hand, the symptomatic treatment of the cornea and, on the other hand, the prevention of tuberculosis, have produced the result that active phlyctenulosis is no longer one of the most important eye diseases found in Eskimos.

Corneal scarring was still the cause of monocular blindness in 9 patients (0.6%) and bilateral blindness in 2 patients (0.1%), or 25% of all cases of bilateral blindness.

Climatic droplet keratopathy is now called spheroid degeneration, a name which covers a score of corneal degenerations, which were formerly regarded as separate entities. Grayson describes the clinical picture as 'spherical, golden-brown, translucent, droplike deposits situated in the subepithelial layer of the cornea and conjunctiva, mainly in the 3 and 9 o'clock meridians' (Grayson, 1983). The condition is usually bilateral and can be caused by the degenerative effect of chronic actinic radiation, probably ultraviolet light, or may be secondary to other corneal disease.

Histologically, the granules are situated in the superficial stroma and round Bowman's membrane. Garner et al. (1973) considered them to be composed of keratin-like material of epithelial origin, but electromicroscopic investigation has shown them to be extracellular material formed by abnormal fibrocytes (Johnson and Ghosh, 1975). This condition has been encountered, not only in Eskimos, but also in other races outside the polar region (Rodger, 1973; Freedman, 1973b).

Johnson et al. (1984) found spheroidal degeneration of the cornea in 19% of their material consisting of 330 Eskimos, 236 mixed Eskimos and whites and 80 whites.

Johnson and Ghosh (1975) found spheroidal degeneration in 56% of the men they examined and 16% of the women above the age of 40 years. At an equivalent latitude there appeared to be no difference between Eskimos, Indians and Caucasians.

Freedman (1965) also found 'Labrador keratopathy' in Eskimos, Indians and Caucasians.

Wyatt (1973b) found, in inhabitants of Northern Canada, in the age group 0-19 years 0.2% pterygia or Labrador keratopathy, in the 20-39 year group 1.4%, 40-59 years 7.5% and above 60 years 16.5%

Arkell and Lightman (1985) found climatic droplet keratopathy in 1.4% of the Eskimos they examined. The condition was hardly ever seen below the age of 40 years.

In the present study climatic droplet keratopathy or spheroidal degeneration of the cornea was found in 0.6% of the Alaskan Natives, all cases were both nasal and temporal and all patients were above 50 years of age.

In comparison with other studies on Eskimos, therefore, few cases of climatic droplet keratopathy, or spheroidal degeneration, were observed. Furthermore, in no case was spheroidal degeneration the cause of reduced visual acuity, so that we may say that this condition cannot be considered as an important ophthalmological problem in the Norton Sound and Bering Straits region.

Grayson describes pterygia as 'fibrovascular connective tissue overgrowths of the bulbar conjunctiva onto the cornea. They are usually horizontally located in the palpebral fissure and on the nasal side of the cornea, but may occur on the temporal side. It is believed that pterygia are the result of actinic degeneration from ultraviolet energy' (Grayson, 1983).

Forsius (1972) found pterygia in 8.8% of male, and 2.6% of female Skolt-Lapps above the age of 20 years. The figures for Eskimos were 8.6% and 1.2% respectively, while 4.6% of the Cheremisses he examined in the U.S.S.R. had pterygia.

Wyatt (1973a) found pterygia in 0.7% of the inhabitants of Northwest Canada he examined (63.6% Eskimo).

Clemmesen (1976) reports in a retrospective study that a pterygium operation was known among Eskimos as early as 1741.

Arkell and Lightman (1985) found pterygia during their study in 0.5% of the Eskimo population, 0.7% of the men and 0.3% of the women.

During the present study pterygia were found in 1.0% of the people examined, 1.1% of the men and 0.8% of the women. Only one patient with a pterygium was younger than 40 years. In no case did the pterygium cause reduced vision.

6.5. Conclusion

In agreement with the literature, a number of corneal diseases were observed among the Alaskan Natives of the Norton Sound and Bering Straits region. Pterygia (1.0%) and climatic droplet keratopathy or speroidal degeneration (0.6%) did not give rise to decreased visual acuity. Scars resulting from phlyctenular keratoconjunctivitis (2.0%) were mainly seen in the age group above 40 years and to an equal extent in both sexes. Scars due to trauma were seen in males (2.4%) four times as often as in females (0.6%). In men trauma was the most important cause of corneal scars.

As it is to be expected that phlyctenulosis due to tuberculosis will be rare or nonexistent in the younger generations, measures for the prevention of injuries to the eye seem now to be the best way of combatting corneal disease

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CHAPTER 7

Anterior chamber depth, gonioscopy and angle-closure glaucoma

7.1. Introduction

The relatively frequent occurrence of angle-closure glaucoma in Eskimos in Greenland, Canada and Alaska has been reported by various authors (Clemmesen and Alsbirk, 1969; Alsbirk, 1970; Clemmesen and Alsbirk, 1971; Cass, 1973; Alsbirk, 1973; Clemmesen, 1973; Drance, 1973; Alsbirk and Forsius, 1973; Drance et al., 1973; Alsbirk, 1975a; Alsbirk, 1976; Cox, 1984; Arkell and Lightman, 1985; Alsbirk, 1986; Arkell et al., 1987). Particularly in women above the age of 40 years a narrow angle and primary angle-closure glaucoma have frequently been found.

In Western countries at the present time the treatment of angle-closure glaucoma is usually no problem. Medical treatment with miotics, if necessary combined with a carbonic anhydrase inhibitor (acetazolamide), is effective in chronic or subacute glaucoma, or in checking an attack of acute glaucoma. The surgical treatment of angle-closure glaucoma, peripheral iridectomy, was described by Von Graefe as early as 1857. This operation is often performed on the second eye as well after an attack of acute glaucoma (Krupin et al., 1978; Playfair and Watson, 1979). The most important late complications of this operation are postoperative rise in intraocular pressure and cataract formation (Bobrow and Drews, 1981). A more recent method is treatment with the Argon laser, but the risk that the iridotomy made this way will close within 6 weeks of the operation is 30% (Beckman et al., 1971; Abraham, 1976; Pollack, 1979; Robbin and Pollack, 1984). The most recent development is the Q-switched Neodymium-YAG laser, with which an iridotomy can be made with a few bursts, even in blue irises. The risk of the iridotomy closing is also less than when the Argon laser is used. (Robbin and Pollack 1984). The small, portable, battery-fed Q-switched Neodymium-YAG laser now makes it possible to treat patients in remote areas (Robbin et al., 1986).

All these treatments, however, are useless if the patient applies for medical help too late, as irreversible damage or even blindness can then

have developed in the glaucomatous eye. It is therefore extremely important that an angle-closure glaucoma should be recognized and treated in time. The distance of the villages in the Norton Sound and Bering Straits region from the nearest ophthalmological clinic in Anchorage is at least 600 miles or 1000 km. This journey by airplane in ideal conditions takes a whole day, and in bad weather it can take several weeks, because flying is not possible.

An investigation into the occurrence of angle-closure glaucoma in the area is important, but screening of the population to discover which patients have a narrow chamber angle with increased risk of glaucoma, and registration of them, is more important. Persons known to be at risk can receive the right medication from the local health aides in the case of an attack of acute glaucoma. One might also consider treating persons with a high risk of acute glaucoma prophylactically with a Nd-YAG laser iridotomy.

7.2. Methods

During this study the depth of the chamber angle was determined in all persons by Van Herick's method (1969), as described in Chapter 3. In patients with a grade I angle, and in some of those with a grade II angle, gonioscopy was performed in order to assess the depth of the chamber angle more precisely and to decide if there was a risk of closure. The narrowest portion of the chamber angle was noted. Contrary to the protocol, gonioscopy was not performed in 75% of the persons with a grade II angle, because in the first grade II group examined, not one occludable angle was found. As gonioscopy is a time-consuming examination and relatively tedious for the patient, the criteria were altered in the course of the study. If a surgical iridectomy or laser iridotomy was present, this was noted. In all patients above the age of 14 years the intra-ocular pressure was determined in both eyes by means of a hand applanation tonometer. The optic disc was assessed for the presence of a glaucomatous excavation.

If a glaucoma or the results of a surgical iridectomy or a laser iridotomy were observed, the condition was analysed with the help of the presenting condition, the patient's history and any available information in the patient's medical record. The glaucoma was specified as chronic, subacute or acute angle-closure glaucoma, or as primary open-angle glaucoma or another type of glaucoma.

Finally, an attempt was made to measure the depth of the anterior

chamber with the Bio-1 ultrasound. It became apparent, however, that the apparatus always produced two echo-waves on the monitor at approximately 2 and 3 mm, which made it impossible in a number of eyes to measure the distance between the anterior surface of the cornea and the anterior and posterior capsule of the lens correctly.

7.3. Results

7.3.1. Angle-closure glaucoma

In 14 of 1673 Alaskan Natives (0.8%) some form of angle-closure glaucoma was found. One patient (0.06%) had in one eye and one patient (0.06%) had in both eyes another type of glaucoma. Primary open-angle glaucoma was not encountered.

Table 7.1. gives the classification of the various types of glaucoma by age and sex. Angle-closure glaucoma was found in 4 men and 10 women. In 10 cases it was bilateral and in 4 cases unilateral.

Table 7.2. shows the prevalence of angle-closure glaucoma in Alaskan Natives classified by age and sex.

Angle-closure glaucoma was seen in 0.5% of the men and 1.2% of the women. In the age-group above 40 years these figures were 2.1% and 5.5% respectively. In total, 3.8% of this age-group had some form of angle-closure glaucoma in at least one eye. *In women above 60 years of age 11.8% of the examined persons had some form of angle-closure glaucoma!* All the

Table 7.1. Angle-closure glaucoma and other glaucomas among Alaskan Natives.

right eye	left eye	men	women	total
acute	acute	–	1	1
acute	chronic	–	2	2
chronic	acute	–	1	1
subacute	none	–	2	2
chronic	chronic	3	3	6
chronic	none	–	1	1
none	chronic	1	–	1
SUBTOTAL		4	10	14
other	none	–	1	1
other	other	–	1	1
TOTAL		4	12	16

patients with angle-closure glaucoma were above the age of 50 years at the time of examination.

Thirteen of the 14 patients with angle-closure glaucoma were known to have this disease beforehand. Six patients showed the result of a peripheral iridectomy in both eyes, 1 patient a laser iridotomy in both eyes and 1 patient an iridectomy in one eye. The other 5 patients used pilocarpine eye drops. One patient with a subacute angle-closure glaucoma was referred to the ophthalmologists in Anchorage.

7.3.2. Visual acuity and angle-closure glaucoma

Five of the 14 patients with angle-closure glaucoma were blind in one eye by U.S. standards: their visual acuity was 20/200 or less. None of the patients were blind in both eyes. Visual acuity better than 20/40 was found in 6 glaucomatous eyes. The other 13 eyes had a visual acuity between 20/200 and 20/30.

For practical reasons visual field examination was not included in this study, as this cannot be performed without perimetry accurately enough to allow any conclusions to be drawn.

One patient with secondary glaucoma was blind in both eyes.

7.3.3. Depth of the anterior chamber angle

The depth of the chamber angle was determined in 1407 Alaskan Natives, 718 women (51%) and 689 men (49%); it was not determined in 266 persons, mainly because they were too young to make this possible. Subdivision by depth in grades I to IV is given in Table 7.3. Patients are

Table 7.2. Prevalence of angle-closure glaucoma by age and sex.

age	men		women		total	
≤49 years	0/714	0 %	0/690	0 %	0/1404	0 %
50–59	2/63	3.1%	2/55	3.6%	4/118	3.4%
60–69	1/38	2.6%	4/34	11.8%	5/72	6.9%
70+	1/27	3.7%	4/34	11.8%	5/61	8.2%
Total	4/842	0.5%	10/831	1.2%	14/1673	0.8%

classified according to the group in which the eye with the narrowest chamber angle belongs.

In women a narrow chamber angle (grades I and II) was found twice as often as in men, a grade I angle 2.8 times as frequently.

Classification of the depth of the chamber angle by age and sex is given in Table 7.4.

The frequency of occurrence of a narrow chamber angle increases with age in both sexes. Considering the relation between age and angle-grade, the Mantel-Haenzsel test was chosen to study a possible difference in the prevalence of a narrow angle between men and women. Above the age of 30 years a narrow angle is seen more frequently in women than in men (Mantel-Haenszel test, $p < 0.01$).

In Table 7.5. the relationship between the prevalence of angle-closure glaucoma and the depth of the chamber angle is given per sex.

Angle-closure glaucoma was almost exclusively found in eyes with a grade I angle. In men and women with a grade I angle, angle-closure glaucoma is seen about equally frequently.

Table 7 3 Angle grades in Alaskan Natives

Angle grade	Male		Female		Total	
I	17	2 4%	46	6 7%	63	4 5%
II	27	3 8%	43	6 2%	70	5 0%
III	37	5 2%	52	7 5%	89	6 3%
IV	637	88 7%	548	79 5%	1185	88 4%
Total	718	100 %	689	100 %	1407	100 %

Table 7 4 Narrow angles (grade I and II) classed by age and sex (Alaskan Natives).

Age-group	Male	Female	Ratio % Female/Male
5–19*	0 %	0 %	1 (by definition)
20–29	1 5%	1 4%	0 9
30–39	1 0%	5 1%	5 1
40–49	5 0%	26 3%	5 3
50–59	25 8%	40 0%	1 6
60–69	35 1%	69 7%	2 0
70+	40 9%	63 6%	1 6

* angle-grading was not done under the age of 5 years.

7.3.4. Depth of chamber angle and refraction

In order to see whether there was a relationship between refractive errors and the depth of the chamber angle, the prevalence of myopia was determined in persons with a grade I or II angle and in persons with a grade III or IV angle. Table 7.6. shows the prevalence of myopia classified by depth of angle, sex and age.

Corrected for age and sex, myopia is less frequent in persons with grade I or II chamber angles than in persons with grade III and IV angles.

7.3.5. Gonioscopy and occludable angles

Gonioscopy was performed on 73 Alaskan Natives, 19 men and 54 women. In 55 of these persons the narrowest chamber angle was grade I and in 18 it was grade II. In 8 persons with a grade I angle gonioscopy was not performed because a glaucoma operation had already been carried out. Gonioscopy

Table 7 5 Angle-closure glaucoma and angle grade by sex among Alaskan Natives

Angle grade	Prevalence of angle-closure glaucoma		
	Male	Female*	Total
I	17 6%	17 4%	17 5%
II	0 %	2 3%	1 4%
III	2 7%	0 %	1 1%
IV	0 %	0 %	0 %
Total	0 5%	1 2%	0 8%

* in 1 female glaucoma case angle grading was not performed.

Table 7 6 Myopia by angle grade, age and sex

age-group	MALES		FEMALES	
	grade I–II	III–IV	grade I–II	III–IV
5–19	–	24 2%	–	38 8%
20–49	40 0%	62 7%	33 3%	70 4%
50–59	20 0%	36 6%	9 5%	40 0%
60–69	11 1%	22 2%	5 0%	12 5%
70+*	100 %	25 0%	26 7%	16 7%

* In the age-group 70+ information on refractive error was missing in 40% of the patients

was performed on 25% of the persons in whom a grade II angle was found. In 27 persons, 6 men and 21 women, the angle was assessed as occludable. Table 7.7. shows the distribution of occludable angles by age and sex. Gonioscopy was not performed below the age of 30 years; in this age-group no narrow or occludable angles were found. In men no occludable angles were seen below the age of 50 years. Above the age of 50 years considerably more occludable angles were found in women than in men, above the age of 30 years 3.8 times as many. In all, an occludable angle was found in 4.7% of the examined persons above the age of 30 years, 2.0% of the men and 7.5% of the women.

7.3.6. Intra-ocular pressure in Alaskan Natives

The intra-ocular pressure was determined in 929 persons above the age of 14 years, 467 men and 462 women, by means of a hand applanation tonometer. Table 7.8. shows the distribution by sex of the intra-ocular pressure in right and left eyes.

The average intra-ocular pressure in men was: right eye 11.7 mm Hg (s.d. 3.3), left eye 11.7 mm Hg (s.d. 3.1); and in women: right eye 12.0 mm Hg (s.d. 3.4), left eye 11.9 mm Hg (s.d. 3.0).

The intra-ocular pressure was analysed separately for the eyes with an occludable chamber angle. The average intra-ocular pressure in persons with an unilateral occludable angle was: right eye 13.7 mm Hg (s.d. 8.7); left eye 10.7 mm Hg (s.d. 2.5). In persons with a bilateral occludable angle the average intra-ocular pressure was: right eye 12.1 mm Hg (s.d. 6.8); left eye 10.1 mm Hg (s.d. 2.0).

Table 7.7. Occludable angles by age and sex (Alaskan Natives).

Age	Unilateral	Bilateral	Male	Female
30–39	0	1	–	1.0%
40–49	2	1	–	5.2%
50–59	5	4	3.2%	12.7%
60–69	3	5	5.3%	17.6%
70–79	1	5	9.1%	15.4%
Total	11	16	2.0%	7.5%

Table 7.8. Intra-ocular pressure (Alaskan Natives).

IOP mm Hg	Male		Female	
	Right	Left	Right	Left
1– 2	1	–	–	–
2– 4	3	2	4	4
5– 6	24	24	17	17
7– 8	45	47	42	45
9–10	101	97	95	81
11–12	137	141	124	135
13–14	74	75	84	89
15–16	50	50	72	65
17–18	24	26	17	20
19–20	5	5	5	4
21–22	1	–	–	–
23–24	–	–	–	1
30	1			
35			1	
38			1	

7.4. Discussion

Reports about the prevalence of angle-closure glaucoma among the different races are sparse.

Among whites, angle-closure glaucoma appears to be much less common than primary open-angle glaucoma. In two surveys in Great Britain, angle-closure glaucoma was found in 0.08% and 0.17% in persons above the age of 40 years compared to 0.43% and 0.71% for open-angle glaucoma. The ratio female to male is generally 4:1 (Wilensky, 1980).

Data on the prevalence of angle-closure glaucoma among blacks are contradictory. Some authors even report the absence of this disease in blacks but others report the same prevalence as in whites (Wilensky, 1980).

The findings of other authors that angle-closure glaucoma frequently occurs in Eskimos were corroborated by this study of the inhabitants of the Norton Sound and Bering Straits region in Alaska. In Table 7.9. our data are compared with those of Clemmesen and Alsbirk (1969), Drance (1973), Alsbirk (1975a), Cox (1984) and Arkell et al. (1987). The various studies were, however, set up differently. Thus Cox's work was a retrospective study of the clinical data of a hospital population. In Alsbirk's population study he made use of provocative tests to establish the diagnosis of angle-closure glaucoma.

Our study and that of Arkell et al. were set up in exactly the same way.

The only differences are the areas under investigation and the fact that the ophthalmologist who examined the patients in Arkell's study was trained in the U.S.A., whereas in this study he was trained in The Netherlands. The size of the population examined was almost the same: 1686 as against 1673 persons. The response was also nearly identical, 84% for Arkell et al. and 83.7% for this study. The Norton Sound and Bering Straits region lies just south of the Arctic Circle and is adjacent to the Kotzebue region where Arkell and her co-workers carried out their investigation.

Angle-closure glaucoma in Eskimos was found by the various investigators in 0.4–0.8% of the population examined, and in 2.1–3.8% of persons above the age of 40 years. Both in the total population and in the 40+ age-group the highest percentage of angle-closure glaucoma was found during the present study. In men above 40 years of age the percentages of angle-closure glaucoma found vary between 0.8% and 2.5%, the present figure of 2.1% falls between these values. Angle-closure glaucoma was found during this study in 5.5% of the women above the age of 40 years, the highest of all the percentages found. Alsbirk found 5.1%, but used provocative tests to establish the diagnosis, while in this study only persons with an iridectomy or iridotomy, or raised intra-ocular pressure with a narrow chamber angle (1 patient), were diagnosed as having angle-closure glaucoma.

A very narrow chamber angle, grade I, was found in 2.4% of men and 6.7% of women. Arkell et al. found a grade I angle in her study in 2.3% of men and 4.6% of women. We found a grade II angle in 3.8% of men and 6.2% of women, Arkell's figures were 1.1% and 2.7% respectively. A narrow angle was often seen in women above the age of 40 years, whereas in men this was not the case until they were 50 years old or older. Above the

Table 7.9. Prevalence of angle-closure glaucoma among Eskimos in this study compared with previous reports.

Author	Prevalence of angle-closure glaucoma				
	Total	Older than 40:	Total	Men	Women
Clemmesen + Alsbirk	–		–	0.9%	2.1%
Drance	0.4 %		2.9%	2.5%	3.3%
Alsbirk	–		–	1.6%	5.1%
Cox	0.44%		2.1%	1.0%	3.3%
Arkell et al.	0.6 %		2.7%	0.8%	3.0%
van Rens	0.8 %		3.8%	2.1%	5.5%

age of 30 years, a narrow angle is seen in all age-groups more frequently in women than in men. An occludable angle, seen with the help of gonioscopy, was also in all age-groups found more often in women than in men. This is in agreement with Alsbirk's and Arkell's findings.

The average intra-ocular pressure recorded during this study was 11.7 mm Hg ± 3.2 for men, and for women 12.0 mm Hg ± 3.4 for the right eye and 11.9 mm Hg ± 3.0 for the left eye. Arkell et al. found 13.6 mm Hg ± 3.0 for men and 13.8 mm Hg ± 2.9 for women.

Alsbirk (1970) found in Eskimos in Greenland 15.2 mm Hg ± 3.0 in men and 16.1 mm Hg ± 3.0 in women. In his study, however, all persons under the age of 20 years were excluded and also 75% of those under the age of 40 years. Furthermore, a Schiotz tonometer was used, so that the data are not really comparable. In the group of Eskimos examined in the Norton Sound and Bering Straits region the average intra-ocular pressure found was lower than that found in other studies on Eskimos, the standard deviation was in all cases approximately 3.0 mm Hg.

In the past a number of explanations have been offered for the frequent occurrence of angle-closure glaucoma in Eskimos. Drance et al. (1973) measured the depth of the anterior chamber with Jaeger's instrument; they found that the depth of the anterior chamber decreased with age. Alsbirk (1975b), working among Eskimos in Greenland, found an average corneal diameter of 11.1 mm in men and 10.9 mm in women, this was for both sexes 0.5 mm less than the figure for a Caucasian control group. The diameter of the cornea and the depth of the anterior chamber were found to be positively related. A hereditary component seemed to be involved. From the data from his study Alsbirk (1976) conceived the theory that a narrow palpebral fissure and small eyes formed a protection for the Eskimos against the influence of extreme weather conditions on the eyes. This type of eye, however, has a greater risk of angle-closure glaucoma. The natural selection of this particular anatomy of the eye will have led, at the same time, to an increased risk of angle-closure glaucoma in the whole population.

The frequent occurrence of angle-closure glaucoma has, however, also been reported in other Mongoloid races. Loh (1968) reports that primary angle-closure glaucoma was seen 4.5 times as often in a hospital in Singapore than primary open-angle glaucoma. His finding was noteworthy in that this was only true for Chinese patients; in persons of Indian, Malaysian or other origin more open-angle glaucoma was seen. Wang et al. (1985) found in a district in China a prevalence of angle-closure glaucoma of 0.96%. Hu (1987) reported that the prevalence of glaucoma in people over

30 years old in China was 1%. In China angle-closure glaucoma was more common than open-angle glaucoma.

It is therefore possible that the fact that Eskimos are a Mongoloid race is a causative factor in the frequent occurrence of angle-closure glaucoma in these people.

One of the main causes of angle-closure glaucoma appears to be a disproportion between the size of the lens and the size of the anterior chamber. In particular, a lens which has increased in size with age in a small hypermetropic eye with a cornea which is smaller than normal, could form the basis of an angle-closure glaucoma (Epstein, 1986). Especially eyes with a shallow anterior chamber (Törnquist, 1956; Lowe, 1969, 1970 and 1977), or with a thickened lens (Markowitz and Morin, 1984) appear to be suspectible to angle-closure glaucoma. The lens thickness/axial length factor is a parameter for angle-closure glaucoma (Markowitz and Morin, 1985, 1986), but the high values found in angle-closure glaucoma patients lie within the range of values found in normal controls, so that little significance can be attached to an individual value.

Hypermetropia, however, was only found in 10.4% of the population examined during this study; the average refraction was S-0.91, although older Eskimos were less myopic. The myopia was found to be positively related to the axial length (Chapter 5). Less myopia (corrected for age and sex) was seen in eyes with grade I and II angles, however, than in eyes with grade III and IV angles, with the exception of the 70+ age-group.

Some authors attach significance to weather conditions, seasonal influences and sunspot activity (David et al., 1985; Tupling and Junet, 1977; Hillman and Turner, 1977).

Commenting on Hillman and Turner's publication, Docherty suggests that all these correlations with weather and seasonal conditions can actually be reduced to the fact that one is forced to stay indoors in certain weather conditions, so that the situation resembles one lengthy dark room provocative test; in Arctic regions there are very long nights in autumn and winter. Dark provocation in this period could be a factor leading to the onset of an attack of acute glaucoma in the eyes of Eskimos which are susceptible because of their anatomy.

7.5. Conclusion

During this study angle-closure glaucoma was observed in 0.8% of the population, women were affected 2.4 times as frequently as men. Above

the age of 60 years 11.8% of all women had angle-closure glaucoma. Primary open-angle glaucoma, on the other hand, was not observed.

In whites, the prevalence of angle-closure glaucoma in persons above the age of 40 years is 0.08% to 0.17%. Considering the fact that angle-closure glaucoma, in contrast to open-angle glaucoma, often has a sudden onset, it is not to be expected that routine screening of the eye pressure will reveal many new cases of angle-closure glaucoma in white people.

The prevalence of angle-closure glaucoma among Eskimos above the age of 40 years is 2.1% to 3.8%, and among women even 5.5%! It is possible that the small anterior segment of the eye, especially in hyperopic persons, and an increasing lens thickness with age, causes this disease to be more frequent in Eskimos and other Mongoloid persons than in white people.

An explanation of this high frequency of angle-closure glaucoma in Eskimos, has no practical consequences.

In view of the great distance between the Norton Sound and Bering Straits region and the nearest ophthalmological clinic, preventive measures are of the greatest importance. Possibilities are:

1. Annual screening of persons at risk (women above the age of 50 years) by examination of the intra-ocular pressure and depth of chamber angle by the local optometrist during his visit to the villages.
2. The provision of a Schiotz tonometer to all the clinics and instruction of the health aides as to how and when to use it. In practice, the latter measure was found to present no problems (van Rens, 1976). Pilocarpine eye drops and Diamox should be available in each clinic.
3. After long-term evaluation of the results of the Nd-YAG laser study in the Kotzebue region (Robbin et al., 1986), the possible introduction of prophylactic Nd-YAG laser iridotomy for all persons with a very high risk of developing angle-closure glaucoma.

As final remark, the increasing myopia in young Eskimos may lead in the future to a spontaneous decrease in the occurrence of angle-closure glaucoma in this population.

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CHAPTER 8

Iris and Lens

8.1. Introduction

Cataract is one of the most important eye diseases in older people. Although at the present time a cataract extraction affords a 90% chance of a visual acuity of 20/40 or more (Léonard, 1983; de Vries-Knoppert and van der Heijde, 1985; Nijman et al., 1985), this condition still remains one of the chief causes of blindness, not only in developing countries but also in the Western world (Goldstein, 1980; Dawson and Schwab, 1981).

A few authors have reported on the prevalence of cataract in Eskimos (Wyatt, 1973; Johnson et al., 1984; Arkell and Lightman, 1985).

The population of the Norton Sound and Bering Straits region is dependent on the Native Medical Center in Anchorage for cataract operations. Patients having a cataract extraction are not admitted to hospital, so that in addition to the journey to Anchorage there is the problem of where to stay. Postoperative checks are only possible when ophthalmologists are seeing patients in the hospital in Nome, an occurrence which takes place once every three months. If complications arise in between times the only help available is the general practitioner or the optometrist in Nome.

Some ophthalmologists who work in the polar area have observed frequent iritis in Eskimos (Farson, personal communication). In the case of iritis the patient in the Norton Sound and Bering Straits region is usually dependent on the judgment of the health aide, who either gives medicines herself or asks advice by telephone or radio from the general practitioner or the optometrist in Nome.

8.2. Patients and methods

In this study the anterior segment and media of all patients were examined for signs of a former iritis and for cataract. Small children were examined with a penlight, children above the age of 3 years and adults with the Kowa slitlamp.

The lens was examined for the presence of cataract, pseudo-exfoliation, dislocation, glaukomflecken, aphakia, pseudophakia and after-cataract. In the case of a cataract, this was classified by location as cortical, nuclear, posterior subcapsular or other, and further by etiology as senile, traumatic, congenital or other. Patients whose cataract was causing poor vision were referred to the next Eye Clinic to be held in the hospital in Nome.

The following signs were taken to be indications of a former iritis: atrophy of the iris, posterior synechiae and a cyclitis membrane in the pupillary opening. Other abnormalities of the iris, such as the results of iridectomy or iridotomy, have been mentioned elsewhere in this thesis.

8.3. Results

8.3.1. Cataract

Cataract was found in 74 Alaskan Natives (4.4%), 38 men (4.5%) and 36 women (4.3%). Unilateral cataract was seen in 17 men and 13 women, bilateral cataract in 21 men and 23 women. Aphakia without a lens implant was seen in 11 persons. Pseudophakia was observed in 5 persons, in all cases only one eye had a lens implant.

Table 8.1. shows the various abnormalities of the lens.

Forty-eight of the 118 eyes with a cataract had a nuclear cataract, 40 a cortical cataract and 25 nuclear and cortical. In 5 cases the nature of the cataract was not further specified, either because it had been discovered with a penlight during a home visit or because the location was not noted on the form.

Table 8.2. shows the location of the cataracts.

Table 8.3. gives the etiology of the cataracts; age is seen to be the most important factor.

Table 8.1. Abnormalities of the lens among Alaskan Natives.

		1-sided	2-sided
Cataract	: males	17	21
	females	13	23
Aphakia	: males	3	1
	females	5	2
IOL	: males	1	–
	females	4	–

In the case of senile cataract the relationship with age was studied. Above the age of 40 years senile cataract was seen in 13.8% of the men and 16.2% of the women.

Table 8.4. shows the occurrence of senile cataract in the age groups in numbers and in percentages of the age group.

Finally, the best visual acuity achieved by persons with lens abnormalities was noted.

Table 8.5. tabulates the lens abnormalities (cataract and aphakia) and the visual acuity.

In 77% of the patients with lens abnormalities the visual acuity was reduced and nearly one third of them was blind by U.S. standards. The

Table 8.2. Location of cataracts.

Cataract	eyes	per cent
cortical	40	33.9
nuclear	48	40.7
nuclear + cortical	25	21.2
unknown	5	4.2
Total	118	100

Table 8.3. Etiology of cataracts among Alaskan Natives.

etiology	male	female
senile	27 36.5%	30 40.5%
traumatic	3 4.5%	1 1.4%
congenital	1 1.4%	1 1.4%
other or unknown	7 9.5%	4 5.4%
total	38 51.4%	36 48.6%

Table 8.4. Prevalence of senile cataract among Alaskan Natives classified by age and sex.

Age	male	female
20–39 year	1 0.4%	0 0 %
40–49 year	1 1.6%	2 3.4%
50–59 year	4 6.3%	0 0 %
60–69 year	7 18.4%	7 20.6%
70+	14 51.9%	20 58.8%

blindness, however, was not always the result of the lens condition. Of the 25 patients with cataract and visual acuity of 20/200 or less, the lens condition was taken to be the primary cause of the poor vision in only seven cases.

8.3.2. Iritis

In 23 Alaskan Natives (1.4%) abnormalities of the iris were found, which may have been the result of a former iritis. The patients were 15 men and 8 women.

Table 8.6. shows the subdivision of this group by age and sex.

Nineteen patients (82.6%) had a visual acuity above 20/40 in the better eye. In 2 patients the visual acuity in the better eye was 20/50. Two patients were blind by U.S. standards: one had a visual acuity in the better eye of 20/200, the other 5/200.

8.4. Discussion

Wyatt (1973) found abnormalities of the lens in 2.9% of all the Eskimos he examined. These abnormalities were mainly seen above the age of 49 years (31%), below the age of 50 years only 1% of the Eskimos had lens ab-

Table 8.5. Visual acuity of Alaskan Natives with lens abnormalities.

visual acuity	males	females
≤20/200	15	10
20/160–20/40	14	23
≥20/30	11	8

Table 8.6. Signs of former iritis among Alaskan Natives classified by age and sex.

age	male	female
20–49	5	3
49–59	5	1
60–69	3	2
70+	2	2
total	15	8

normalities. In this study the cause of cataract (in all races) was found to be: senile 66%, traumatic 16%, congenital 12%, uveitis 6%. Separate figures for Eskimos (65.1% of the material) were not given. Visual acuity higher than 20/50 for both eyes, in association with a lens abnormality, was found in 53% of patients (of all races). 27% had reduced vision in one eye as the result of a lens condition. 9% were visually handicapped, defined as a visual acuity below 20/50, and 12% were blind by U.S. standards. As Wyatt's findings were not subdivided by race, they cannot be compared with those of the present study.

Johnson et al. (1984) found in their study senile cataract in 41% of Eskimos between 52 and 85 years of age.

Arkell and Lightman (1985) found abnormalities of the lens in 0.7% of persons below 30 years of age, but in 39.2% of persons above this age. An abnormality of the lens which caused reduced vision (less than 20/30) was seen in 2.25% of the population. The etiology of the cataract was: 79.7% senile (77.0% in the present study); 7.1% unknown; 4.8% traumatic (5.9% in this study); 3.6% congenital (2.8% in this study); 4.8% other causes. Senile cataract was seen in 0.8% of the 40-49 year old group, 2.9% of the age group 50-59 years, 8.0% of the group 60-69 years and 38.8% above the age of 70 years. In the present study cataract was more frequently seen in the age group above 60 years.

In the Framingham eye study Kini et al. (1978) found senile cataract in 4.6% of persons aged between 52 and 64 years, 18% in the age group 65-74 years and 46% between 75 and 84 years. The criterion used was that, in addition to abnormalities of the lens, the visual acuity had to be 20/30 or lower. The response to this investigation was 67%. These figures are in agreement with those of the present study.

In the HANES study (Klein and Klein, 1982) the figures for cataract in white Americans were: for men between 45 and 64 years 5.6% of the population and for women of the same age 2.1%. In the age group from 65 to 75 years the figures were 21.6% and 26.8% respectively. The figures for blacks were: for men 8.3% and 38.3%, for women 8.5% and 39.1%. All lens opacities with visual acuity of 20/25 or less, and also aphakia, were defined as cataract.

Indications of a former iritis were found in 23 persons, two of these were blind in one eye by U.S. standards. It is impossible to determine how many people have actually had iritis as, if it has been properly treated, it leaves no trace. It is therefore pointless to make comparisons with data from other studies.

8.5. Conclusion

During this investigation senile cataract was found in Alaskan Natives in 18.4% of the men and 20.6% of the women between the ages of 60 and 70 years. Above the age of 70 years cataract was seen in 51.9% of the men and 58.8% of the women. These findings are in good agreement with data from the rest of the United States.

In the past, little attention has been paid to the prevalence of cataract in Eskimos. It appears, however, that cataract is one of the most important causes of blindness in Eskimos (Chapter 4). In view of the age distribution in the population of the Norton Sound and Bering Straits region, a great increase in the number of patients with a senile cataract can be expected in the next decennia.

Although scars were found in 23 patients which might be the result of a former iritis, it seemed pointless to draw further conclusions from this observation.

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CHAPTER 9

Disorders of the retina

9.1. Introduction

Little has been written about the occurrence of retinal disorders in Eskimos (Wyatt, 1973; Johnson et al., 1984; Arkell and Lightman, 1985). Possibly little interest has been shown because the Eskimo population is young, so that age-related retinal disorders are not often to be expected. Furthermore, the diagnosis of many retinal conditions, in particular dry age-related macular degeneration, has no therapeutic consequences.

9.2. Methods

In this study all persons were examined for disorders of the retina by means of direct and indirect funduscopy. In persons of 30 years and older this examination was generally carried out in mydriasis, in patients with a very narrow angle and those who objected to dilatation of the pupil mydriatic drops were not used.

The macula was assessed as normal, abnormal or unknown. If macular anomalies were found these were classified as: atrophy of the retinal pigment epithelium, drusen, disciform scars, diabetic retinopathy, hypertension fundus or other anomalies. Retinal pigment epithelial atrophy (RPE atrophy) was subdivided on subjective grounds into minimal or significant. Drusen were here defined as small colloid-like yellow spots or large, soft yellow spots appearing as defects in the pigment epithelium. Less than 10 drusen was defined as minimal, ten or more as significant. The diagnosis of diabetic retinopathy could only be made in persons who were known diabetics; patients with a fundus picture suggestive of diabetic retinopathy could be referred for further examination. Retinopathy could be subdivided into background retinopathy, preproliferative retinopathy and proliferative retinopathy.

The peripheral retina was also assessed. Anomalies found were coded according to the International Classification of Diseases (I.C.D-9).

9.3. Results

9.3.1. Mydriasis

During the study 222 men and 199 women were examined with both pupils dilated. In 3 men and 7 women only one pupil was dilated. In 617 men and 625 women funduscopy without mydriasis was performed. These figures are shown in Table 9.1.

In total 431 persons (Alaskan Natives) were examined with a dilated pupil, 415 of these were older than 29 years. 71.7% of the total age-group above 29 years (579 persons) could be examined in mydriasis. In persons younger than 30 years the pupil was dilated for skiascopy when unexplained poor vision was found, or when pathology of the retina was anticipated.

Most retinal disorders are age-related and dilated examination was only carried out as a rule above the age of 29 years. Certain patients above the age of 29 were not examined in mydriasis (some patients with a very narrow angle and persons who objected to dilatation). In patients who are not dilated, the examination of the retina is hampered by the small pupil and the diagnosis of retinal disorders is less reliable. For these reasons in this chapter only the retinal disorders in Alaskan Natives above the age of 29 years with dilated pupils were analysed.

9.3.2. Retinal pigment epithelial atrophy (RPE-atrophy)

RPE-atrophy was seen in 22 men and 26 women, 10.1% and 13.3% respectively of all persons older than 29 years who were examined in mydriasis. Table 9.2. shows the classification of RPE-atrophy by age and sex.

It is seen that the prevalence of RPE-atrophy increases with age. Above the age of 70 years 50% of all persons examined in mydriasis were affected. In 6.9% of men and 9.6% of women the condition was bilateral. Severe atrophy was seen in 2.3% of men and 3.0% of women.

Table 9.1 Alaskan Natives examined with or without mydriasis.

sex	no mydriasis	mydriasis		total
		unilateral	bilateral	
male	617	3	222	842
female	625	7	199	831
total	1242	10	421	1673

9.3.3. Drusen

Drusen were seen in 15 persons (3.6%) above the age of 29 years, 10 men (4.6%) and 5 women (2.0%). Table 9.3. shows the classification by age and sex.

The prevalence of drusen also increases with age. 18.8% of all persons of 70 years and older examined in mydriasis showed this anomaly.

9.3.4. Age-related macular degeneration (AMD)

The presence of RPE-atrophy and/or drusen was used as criterion for the diagnosis of age-related macular degeneration. AMD was found in 52 persons (12.5%) above the age of 29 years, 25 men (11.5%) and 27 women (13.7%). Table 9.4. shows the classification of AMD by age and sex.

With increasing age, AMD occurred more frequently in the persons

Table 9 2 Frequenty of RPE-atrophy among Alaskan Natives by age and sex

age	male	female	total
30–49	4 0%	3 2%	3 6%
50–69	10 4%	25 9%	17 0%
70+	52 9%	46 7%	50 0%
total	10 1%	13 3%	11 6%

Table 9.3 Frequency of drusen among Alaskan Natives by age and sex

age	male	female	total
30–49	0 %	0 8%	0 4%
50–69	7 8%	3 4%	5 9%
70+	23 5%	13 3%	18 8%
total	4 6%	2 0%	3 6%

Table 9 4 Age-related macular degeneration among Alaskan Natives by age and sex

age	male	female	total
30–49	4 0%	3 2%	3 6%
50–69	14 3%	25 9%	19 3%
70+	52 9%	53 3%	53 1%
total	11 5%	13 7%	12 5%

examined in mydriasis. Above the age of 70 years 53.1% of the population has AMD.

The relationship between AMD and the best corrected visual acuity was studied. Visual acuity better than 20/40 was found in 27 persons (52%), while 25 persons with AMD had a visual acuity of less than 20/30. Five persons (9.6%) were blind according to U.S. standards. Table 9.5. gives the relationship between AMD and visual acuity.

9.3.5. Diabetic retinopathy

Fifteen persons (0.9%), 14 women and one man, had a history of diabetes mellitus. The youngest patient was 25 years old, the oldest 72 years; the average age was 46 years. The duration of the diabetes was known in 12 cases, the average was 14.5 years. None of these 15 patients had signs of diabetic retinopathy in the fundus! Only one person (66 years old) had a visual acuity of less than 20/30 (20/40) in the better eye; the cause of this was age-related macular degeneration.

9.3.6. Peripheral retinal anomalies

Anomalies of the retina outside the macula were also only analysed for persons who were examined in mydriasis. In 22 patients (5.1%), 12 men (5.3%) and 10 women (4.6%), disorders of the peripheral retina were found. Table 9.6. lists the peripheral retinal abnormalities.

A peripheral retinal defect was the most frequent anomaly found, followed by peripheral retinal scars and chorioretinal scars. Other anomalies

Table 9.5. Age-related macular degeneration and best corrected visual acuity among Alaskan Natives.

visual acuity	cases	male	female
<20/400	1	0	1
20/400	2	1	1
20/300–20/200	2	1	1
20/160–20/70	3	1	2
20/60 –20/40	17	9	8
≥20/30	27	13	14
total	52	25	27

included peripheral drusen, a retinal detachment, rupture of the choroid and a venous branch occlusion.

9.4. Discussion

In his study, Wyatt (1973) found retinal anomalies in 1% of Eskimos younger than 50 years of age and in 18% of persons of 50 years and older. These summary data are hardly comparable with the present study. The most important retinal disorder was age-related macular degeneration (51%). Diabetic retinopathy was not seen. In the present study also, no diabetic retinopathy was found. All Wyatt's patients were examined in mydriasis.

Johnson et al. (1984) found AMD in 18% of Eskimos above the age of 50 years. They also failed to find a single case of diabetic retinopathy (the prevalence of diabetes mellitus was 0.6%).

Arkell and Lightman (1985) found RPE-atrophy in 6.7% of all persons above the age of 29 years, 7% in men and 5.5% in women. In the present study more RPE-atrophy was found in both sexes, 10.1% in men above the age of 29 years and 13.3% in women. On the other hand drusen were found more often by Arkell and Lightman: in 16.4% of the population above the age of 29 years (7% of the men and 13.6% of the women, which must indicate an error in calculation), whereas in this study drusen were found in 3.6% of the examined persons, 4.6% in men and 2.0% in women. It should, however, be noted that Arkell and Lightman analysed data from all races, whereas the data in the present study only relate to Alaskan Natives (99.7% Eskimos).

Age-related macular degeneration (AMD) was also found more frequently by Arkell and Lightman in the Maniilaq region than in the present study. They found AMD in 21.4% of the population above the age of 29 years (all races), 20.3% of the men and 22.6% of the women. In the present

Table 9.6. Peripheral disorders of the retina among Alaskan Natives.

diagnosis	number •	per cent
retinal defect	5	23%
peripheral scars	4	18%
chorioretinal scars	3	14%
degenerative myopia	2	9%
other	8	36%

study AMD was found in 12.5%, 11.5% of the men and 13.7% of the women. These differences might perhaps be explained by the differences between the two populations examined, but they might also be due to a different assessment of the macula by the two ophthalmologists who carried out the examinations. The protocol used by the two ophthalmologists for their fieldwork was the same. It is also possible that drusen and RPE atrophy were more often seen together in the present study than in Arkell and Lightman's investigation.

In the Framingham eye study AMD was found in 1.6% of men between the ages of 52 and 64 years and in 1.2% of women. Between 65 en 74 years these figures were respectively 8.8% and 12.6% and between 75 and 85 years 24% and 30.1% (Kini et al., 1978). AMD, however, in this study was defined as pigment abnormalities of the macula associated with a visual acuity of 20/30 or less.

In the HANES study (Klein and Klein, 1982) 2.3% AMD was found in both white men and white women between the ages of 45 and 64 years and 9.6% and 6.9% respectively in the age-group 65 - 75 years. In blacks 3.8% AMD was found in men and 2.4% in women aged 45 - 64 years and 9.3% and 11.4% respectively in the older group.

It is remarkable that diabetic retinopathy is completely absent in this study. Because there were only 15 diabetics, this can be a coincidence, but Wyatt (1973) and Johnson et al. (1984) did not find any cases of diabetic retinopathy (DRP) either. Arkell and Lightman found 2 cases of DRP; in their report a figure is given for the prevalence of diabetes in persons above the age of 18 years (2%), and for DRP in persons above the age of 29 years (0.39%).

It appears from reports of studies on other races, that the absence of DRP in the group of diabetici examined during this study is remarkable.

Constable et al. (1984), screening 1006 patients with diabetes mellitus in Australia, found 29.5% DRP.

Klein and Beer (1986), in Eastern Germany, found in a group of 960 newly diagnosed patients with type II diabetes mellitus, after 1 year 58.6% DRP and after 5 years 91%.

In Sweden, Jerneld and Algvere (1987) found in 365 persons with a type I diabetes (average age 54 years, average duration of the diabetes 13 years) 47% DRP and 13% proliferative DRP.

In the Framingham eye study in the U.S.A., Kini et al. (1978) found DRP in 2% of the population between 52 and 64 years of age, 3% between 65 and 75 years and 7% between 75 and 85 years.

The low occurrence or absence of DRP in Eskimos may be associated

with their traditional diet, consisting mainly of fish and the meat and oil of the seal, whale and walrus. In an editorial in The Lancet (May 1983) on 'Eskimo diets and diseases', after an extensive study of the literature, the following conclusion is reached: 'There is no doubt now that fatty fish, such as mackerel or herring, can greatly lower plasma triglycerides and VLDL, lower LDL, usually raise HDL, and decrease platelet aggregation probably by altering the fatty acids in platelet membranes and by decreasing platelet production of thromboxanes. But fish oils contain little vitamin E and peroxidise easily: and they are rich in cetoleic acid which (unless adaptation occurs as in Eskimo) is oxidised with difficulty by the mitochondria of cardiac muscle, causing myocardial fibrosis and death in lower animals'.

In diabetics there is a positive correlation between LDL concentration and cardiovascular disease, while there is a negative correlation with the HDL concentration (Reckless et al., 1978; Schonfeld, 1985).

Diminno et al. (1986), found that the platelets of diabetics both with and without retinopathy were hyperaggregable and showed abnormally high fibrinogen binding, this binding could be normalised in patients without retinopathy by inhibiting the prostaglandin-tromboxane formation (with Aspirin and apyrase), but not in patients with diabetic retinopathy.

Popp-Snijders et al. (1987) found that in non-insulin-dependent diabetic patients dietary supplementation with 3 g omega-3 polyunsaturated fatty acids (cod-liver oil) improves insulin sensitivity and lowers plasma triglyceride levels.

It is therefore possible, that the low occurrence of diabetic retinopathy in Eskimos is due to their fish diet, causing on the one hand lowering of the LDL level and raising of the HDL level, and on the other hand lowering of the tromboxane level, leading to reduced trombocyte aggregation.

Peripheral abnormalities of the retina were seen by Arkell and Lightman in 8.2% of the persons they examined in mydriasis. The figure in this study was 5.1%. Peripheral defects were the most frequent abnormality of the peripheral retina.

9.5. Conclusion

In this study retinal pigment epithelial atrophy was seen in 10.1% of men and 13.3% of women above the age of 29 years. Drusen were seen in 4.6% of the men and 2.0% of the women. Age-related macular degeneration was found in 11.5% of men and 13.7% of women above the age of 29 years who could be examined in mydriasis. As treatment of dry age-related macular

degeneration is not possible, the age distribution in the population will lead in the future to an increase in the absolute number of patients with this condition.

A remarkable finding was that not one of the patients with diabetes mellitus had retinopathy. There is a possible connection with the fish diet of the population.

Peripheral retinal defects, retinal scars and chorioretinal scars were the most common abnormalities found in the peripheral retina.

9.6. Literature

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CHAPTER 10

Conclusions and recommendations

10.1. The response to the survey

During the present study on the occurrence of eye diseases in the Native population of the Norton Sound and Bering Straits region of Alaska, 1668 (83.7%) persons present in the villages at that moment could be examined.

The Alaskan Native population is a young population, 48.3% of the examined persons was younger than 20 years. This is in agreement with the official figures.

10.2. Aims of this study

In view of the good response it was possible to analyse the information obtained. With respect to the aims of the study it was possible to arrive at the following conclusions and recommendations.

1. Identifying the major causes of visual impairment by age and sex.

   The definition of blindness used in this study was the American criterion of visual acuity of 20/200 or less. Accurate visual field examination was not possible and was not used as a criterion, so that persons who may have a reduced visual field of less than 20 degrees have not been regarded as blind.
   During the study it was possible to determine the visual acuity of 85.3% of the persons examined. The main cause of lack of success in the remaining cases was that they were too young.
   Of the total number of eyes examined, 3.96% right eyes and 3.96% left eyes were blind by U.S. standards before refraction; this was 4.6% of the persons in whom the visual acuity could be determined. Thirty-one persons were bilaterally blind (2.16% of persons whose visual acuity was measured).

After refraction, however, only 44 persons, 28 men and 16 women (3.0% of the persons who could be evaluated), were found to be blind in one eye. The most important causes of monocular blindness were: corneal scarring, amblyopia, cataract, trauma, glaucoma and retinal detachment. The average age of the women with monocular blindness was 47.4 years and of the men 42.8 years.
After refraction 8 persons (0.6%), 4 women and 4 men, were found to be bilaterally blind. Age-related macular degeneration was the leading cause, responsible for 62.5% (5 persons) of all bilateral blindness. Corneal scarring was in 2 cases (25%) and glaucoma in 1 case (12.5%) the cause of bilateral blindness. All patients were over 70 years of age.

2. To assess the extent of the ophthalmic needs in the community and the existing resources for meeting these needs.

This study demonstrates, in the first place, the great importance of a good optometric service for the inhabitants of the villages in the Norton Sound and Bering Straits region. Before refraction 21.5% of the population had a visual acuity of less than 20/30 in the better eye; after refraction this was only the case in 6.3%!
A second important need is to be able to buy glasses for a reasonable price. The population of the villages is small, so that there is no livelihood for an optician. Glasses can be ordered at the Nome Hospital, but the journey to Nome is by air and expensive, especially for the ± 42% of the population who live below the poverty line. An additional problem is that the glasses are easily damaged because of the extreme climate and the way of life. Contact lenses can be fitted by the optometrist in the hospital in Nome, but this is expensive because several visits to the optometrist are necessary and the cleansing fluids are also expensive. In view of the distance between the villages and Nome and the low income of most Alaskan Natives, contact lenses are only possible for a few persons.
Recently an optometrist has started to work full-time in the Nome Hospital. He visits all the villages at least once a year and gives the population the opportunity to order glasses at cost price, which are later delivered by post. This service seems to satisfy the population's most urgent need.

3. To define, where appropriate, intervention strategies in the treatment and prevention of ocular disorders that address the needs identified.

For the prevention of ocular disorders in the population of the Norton Sound and Bering Straits region, the following measures can be taken:

- Annual screening of the visual acuity of all school children with examination of stereovision, which should preferably take place a few weeks before the optometrist's annual visit. This is already organized in some villages.
- Complete examination of all children with a visual acuity of less than 20/30 in one eye or without stereoscopic vision, to be performed by the optometrist at his annual visit. Glasses can be prescribed if necessary, amblyopia treatment applied, or the patient can be referred to the ophthalmologist in the Nome Hospital.
- Annual screening by the optometrist of all women above the age of 50 years to determine the depth and occludability of the chamber angle or the presence of angle-closure glaucoma. Patients with raised intra-ocular pressure can be treated with pilocarpine eyedrops or referred for further treatment to the ophthalmologist. The chance of finding an angle-closure glaucoma by this screening, however, is small, as the intra-ocular pressure before and after an attack of raised pressure is usually normal. Persons with a shallow anterior chamber and an angle which is thought to be occludable, who therefore have an increased risk of angle-closure glaucoma, can be registered as such in their personal medical records.
- Instruction of the health aides on the clinical picture, symptoms and treatment of angle-closure glaucoma, and instruction in the measurement of the intra-ocular pressure with a Schiotz tonometer.
- The provision of each village clinic with a Schiotz tonometer, pilocarpine eye drops and Diamox tablets, so that when acute angle-closure glaucoma is suspected the diagnosis can be verified and medical therapy given.
- After evaluation of the results of prophylactic treatment of persons at risk by laser iridotomy with the portable Q-switched Neodymium-YAG laser in the Kotzebue area, if it appears that this has led to a reduction in the number of cases of acute angle-closure glaucoma, the introduction of this treatment for persons with an occludable angle in the Norton Sound and Bering Straits region can be considered. This treatment can be given in the villages by the ophthalmologist.
- Instruction, especially of male workers and high-school students, on the importance of wearing safety goggles during work with a high risk of injury to the eyes.

4. To provide a baseline against which future intervention programmes can be evaluated.

This aim is partially fulfilled by the appearance of this thesis. As the data in this thesis will be kept for reference it will be possible to study changes in the prevalence of eye diseases in this population in the future.

5. To investigate specific disorders of importance to Alaskan Natives, such as changes in the frequency of phlyctenular disease, the frequency and distribution of uveitis, angle-closure glaucoma and myopia.

   In this thesis the results of the study of a number of eye diseases are given, which in the literature are reported as occurring frequently in the Eskimo population.
   The finding of other authors was confirmed, that myopia is frequently seen in young Eskimos. Myopia was found more frequently in women than in men.
   Climatic droplet keratopathy was only found in 0.6% of the persons examined and in no case caused reduction in visual acuity.
   Scars due to phlyctenulosis were seen in 2% of the men and 2% of the women. Although this disease usually occurs in school children, in the population examined scars were only seen in one person below the age of twenty years. This is probably the result of the intensive campaign for tuberculosis prevention which has been in force since the nineteen-fifties.
   Although signs suggesting a previous iritis were found in 23 persons, conclusions could not be drawn from this finding.

6. To provide additional data of interest to the study of arctic ophthalmology.

   In addition to the ocular disorders of Eskimos which aroused interest in the past, a number of other diseases have been analysed.
   Special attention was paid to the prevalence of cataract, because this is one of the main causes of blindness which are treatable. In view of the age distribution of the population, it is to be expected that the number of patients needing a cataract operation will increase greatly in the future.
   Age-related macular degeneration was the most important cause of bilateral blindness. Unfortunately this condition is not treatable, with the exception of an occasional case of subretinal neovascularization. The prevalence of this disease may be expected to rise as the number of older Eskimos increases.
   Although diabetes mellitus was found in 14 persons (0.9%), diabetic

retinopathy was not observed. This can be a coincidence, but there may perhaps be a relationship between the absence of diabetic retinopathy and the fish diet eaten by the population, which contains many omega-3 polyunsaturated fatty acids.

7. To provide an ophthalmic service for the inhabitants of the Norton Sound and Bering Straits region, including the prescribing of glasses and referral, when necessary, of patients with ophthalmic problems to the Nome Hospital or the Eye Clinic of the Alaskan Native Medical Center in Anchorage.

   The final aim of the study was to provide a service to the local population. The fulfilment of this aim appears from the following facts:
   For most of the inhabitants of the villages of the Norton Sound and Bering Straits region, this was the first time they had been examined by an ophthalmologist.
   Although an optometrist has been working in the area for the past few years, a prescription for glasses was given to 466 persons (25.4% of the total population). Many people took the opportunity of ordering these glasses via the Norton Sound Health Corporation.
   Forty-seven persons (2.6% of all persons examined) were referred for further examination and treatment to one of the ophthalmologists in the Alaska Native Medical Center. Two cases were emergencies: one patient with a total hyphaema and one patient with sub-acute angle-closure glaucoma.
   In 27 persons the chamber angle was considered to be occludable. These persons may in the future be taken into consideration for a prophylactic laser iridotomy.
   Eight persons were referred for a cataract operation.
   Three patients had strabismus and asked for an operation.
   Two patients were referred for a blocked tear duct.
   Seven persons were referred with other conditions, including the patient with the total hyphaema and one person with a retinal defect.

10.3. Conclusion

A large proportion of the population of the Norton Sound and Bering Straits region was prepared to take part in this study, so that statistical analysis of the information obtained was possible.

The causes of blindness were analysed.

In view of the fact that a large percentage of the population with a refractive error did not have correct glasses, it would seem that a good optometric service and the opportunity to acquire reasonably priced spectacles would satisfy a primary need of the inhabitants.

A number of suggestions were made for the future prevention of avoidable causes of blindness.

The results are given of a study of a number of eye conditions which, according to the literature, are commonly found in the Eskimo population.

Special attention was paid to refractive errors, corneal conditions, the prevalence of angle-closure glaucoma and the depth of the anterior chamber, and the possible after-effects of iritis. In addition, the prevalence of some other eye diseases, such as cataract and age-related macular degeneration, were analysed.

Finally, a prescription for glasses was given to 466 persons and 47 patients were referred for further examination to the ophthalmologists in the Alaska Native Medical Center.

The conclusion may be drawn that the aims formulated at the beginning of this study were achieved.

CHAPTER 11

Summary

In this thesis the results of an investigation into the prevalence of eye diseases in the Eskimo population of the Norton Sound and Bering Straits region of Alaska are presented. This study took place in the winter of 1986-1987.

In the Introduction the aims of this study are given. These aims were:

1. To identify the major causes of visual impairment in the Eskimo population by age and sex.
2. To assess the extent of the ophthalmic needs in the community and the existing resources for meeting these needs.
3. To define, when appropriate, intervention strategies in the treatment and prevention of ocular disorders that address the needs identified.
4. To provide a baseline against which future intervention programs can be evaluated.
5. To investigate specific disorders of importance to Alaskan Natives, such as changes in the frequency of phlyctenular disease, the frequency and distribution of uveitis, angle-closure glaucoma, and myopia.
6. To provide additional data of interest to the study of arctic ophthalmology.
7. To provide an ophthalmic service for the inhabitants of the Norton Sound and Bering Straits region, including the prescribing of glasses and referral, when necessary, of patients with ophthalmic problems to the Nome Hospital or the Eye Clinic of the Alaska Native Medical Center in Anchorage.

In Chapter 1 a summary is given of the literature in English on eye diseases among Eskimos in Greenland, Canada and Alaska. In this literature particular attention is paid to refractive errors, corneal diseases and reports on the frequent occurrence of angle-closure glaucoma.

In Chapter 2 the region of the study is described. The Norton Sound and Bering Straits region lies just south of the Arctic Circle on the Bering Straits coast of Alaska, and covers an area of about 67,000 square kilometers (approximately 1.5 times the area of the Netherlands). The population

comprises about 8150 people and consists chiefly of Eskimos, who live either in the town of Nome or in one of the 15 villages in the area. The population is young, 50% of the inhabitants is younger than 20 years of age. Many people have a government job. As 42% of the families live below the poverty line, however, the population is still very dependent on the traditional sources of income, such as hunting and fishing.

Because of the limitations imposed by the territory, the climate and the sparse population, a special public health system has been set up. Each village has a well-equipped clinic, where a specially trained health aide provides a primary health service. There is a small hospital in Nome, in which 5 general practitioners, 3 dentists, a few nurses and an optometrist work.

Specialized ophthalmological care is available at the consultations held 4 times a year in the hospital in Nome by ophthalmologists from the Alaska Native Medical Center in Anchorage. In between times, or in the case of an operation, the hospital in Anchorage is the only facility.

Finally, the optometrist gives consultations daily in the hospital in Nome and visits all the villages at least once a year.

In Chapter 3 the set-up of the study is described. In small, two-engined airplanes eight randomly selected villages were visited by a team consisting of an epidemiologist, an optometrist, an ophthalmic assistant and an ophthalmologist. The nature of the transport meant that the amount of equipment that could be taken along was limited.

The response of the population was high: 83.7% of the inhabitants present at that time in the villages could be examined. Of these 90% were Eskimos.

Only the data relating to the Eskimo population (1668 persons) and Indians and Aleuts (5 persons) are recorded in this study.

In Chapter 4 the visual acuity and causes of blindness are discussed. In 15% of the examined persons it was not possible to determine the visual acuity. In 67% of all the Eskimos the presenting visual acuity without correction was measured, 33% wore glasses or contact lenses. Before refraction 21.5% of the examined persons was found to have a visual acuity in the better eye of less than 20/30, but after refraction this was only the case in 6.3%. Before refraction also, 2.2% were bilaterally blind by U.S. standards, after refraction this figure was 0.6%. It is thus clear that a good optometric service is of great importance to the population. An additional factor of importance for the improvement of the visual acuity of the population is the possibility of obtaining glasses at a reasonable price, if necessary with financial assistance.

The most important causes of monocular blindness were corneal scars, amblyopia, cataract, trauma, glaucoma and retinal detachment. The main cause of bilateral blindness was age-related macular degeneration.

In Chapter 5 the refractive errors and the axial length of the eyes are recorded. In all persons with a visual acuity of less than 20/30, or whose visual acuity did not decrease with the plus-one test, the subjective refraction was determined. In persons with glasses the strength of the lenses was noted. It was possible to determine the refraction in 83.4% of the persons examined: 44.7% were myopic, 44.9% emmetropic and 10.4% hyperopic. Myopia was seen more often in women (48.3%) than in men (41.3%), while emmetropia was found more often in men (49.3%) than in women (40.3%). 9.4% of the men were hyperopic and 11.4% of the women. The prevalence of myopia increased with age, with a maximum of 67.2% in the age-group between 30 and 40 years, subsequently the number of myopes decreased rapidly. Little hyperopia was seen before the age of 50 years, it then increased rapidly, up to 71.5% for persons above the age of 80 years. Emmetropia, on the other hand, decreased with age.

Astigmatism of more than 2 D was found in 3.5% of right and 3.3% of left eyes.

Anisometropia of more than 0.5 D was seen in 16% of the population examined, and of more than 2 D in 4%.

Ultrasound examination showed that an increasing axial length was associated with more myopia. There was no correlation between age and axial length.

The reason why more myopia occurs in young Eskimos than in the older generation cannot be given on the grounds of this study. It is possible that the increase in school attendance in the younger generation may play a role.

In Chapter 6 the corneal abnormalities are considered.

Climatic droplet keratopathy or spheroid degeneration was seen in 0.6% of the population and pterygia in 1.0%. Neither of these conditions led to decreased visual acuity.

Corneal scars were seen in 5.1% of the examined persons. The prevalence of scars increased with age in both sexes. Scars due to phlyctenular keratoconjunctivitis were seen in 2% of both men and women, but were not found in persons younger than 20 years. Scars due to trauma were seen four times as frequently in men as in women. Corneal scars were the cause of monocular blindness in 0.6% of the population and of binocular blindness in 0.1%.

Tuberculosis is the main cause of phlyctenular keratoconjunctivitis. As tuberculosis is no longer found among Eskimos, it is to be expected that

scars due to phlyctenules will continue to be absent in the younger generations in the future.

Measures for the prevention of injury to the eyes, especially in males, seem now to be the most important way of decreasing the number of corneal scars.

In Chapter 7 the prevalence of angle-closure glaucoma, the depth of the chamber angle and gonioscopic findings are discussed.

In 0.8% of the examined population, 0.5% of the men and 1.2% of the women, some form of angle-closure glaucoma was found. Above the age of 60 years 11.8% of women had angle-closure glaucoma.

A narrow chamber angle was seen in women twice as frequently as in men.

Gonioscopy was performed on persons with a narrow angle. In 2% of the men and 7.5% of the women the angle was assessed as occludable.

The average intra-ocular pressure, as measured in all persons above the age of 14 years, was low: 11.7 mm Hg (s.d. 3.3) for men and 12.0 mm Hg (s.d. 3.4) for women (right eyes)

In view of these findings, annual measurement of the intra-ocular pressure and depth of the chamber angle in all women above the age of 50 years would be desirable. It would also be advisable to provide all the village clinics with a Schiotz tonometer, and to instruct the health aides in its use, so that the intra-ocular pressure could be measured in persons showing the signs or symptoms of an attack of acute glaucoma.

In Chapter 8 the anomalies of the lens and iris are described. Cataract was seen in 4.2% of the population; senile cataract was the most common form. Above the age of 40 years this condition was found in 13.8% of men and 16.2% of women. In 7 persons (0.4%) cataract was the cause of monocular blindness, if the U.S. criteria for blindness are applied.

In 1.3% of the population examined posterior synechiae, atrophy of the iris or a cyclitic membrane were found, possibly indicating a previous iritis.

In Chapter 9 the abnormalities of the retina are considered.

Retinal pigment epithelial atrophy was seen in 10.1% of men and 13.3% of women above the age of 29 years. Drusen were seen in 4.6% of the men and 2.0% of the women in this age-group. Age-related macular degeneration was found in 11.5% of the men and 13.7% of the women in the group. All these conditions were more frequently found as age increased.

Diabetic retinopathy was not found in the population examined. The prevalence of diabetes mellitus in the population was 0.9%, the average duration of the disease was 14.5 years. It is possible that the fish diet of Eskimos affords them protection against the development of retinopathy.

Further investigation of the reason for the absence of diabetic retinopathy appears desirable.

Abnormalities of the peripheral retina were found in 5.1% of the examined population, peripheral defects were the most common lesions.

In Chapter 10 the conclusions from this study are given. These conclusions have already been given in the summary of Chapter 4-9.

As a result of this study, the following measures for the prevention and treatment of ocular disorders in the Eskimo population of the Norton Sound and Bering Straits region (and possibly the total Eskimo population) are suggested:

- Annual screening of the visual acuity of all school children with examination of stereovision, which should preferably take place a few weeks before the optometrist's annual visit. This is already organized in some villages.
- Complete examination of all children with a visual acuity of less than 20/30 in one eye or without stereoscopic vision, to be performed by the optometrist at his annual visit. Glasses can be prescribed if necessary, amblyopia treatment applied, or the patient can be referred to the ophthalmologist in the Nome Hospital.
- Annual screening by the optometrist of all women above the age of 50 years to determine the depth and occludability of the chamber angle or the presence of angle-closure glaucoma. Patients with raised intra-ocular pressure can be treated with pilocarpine eye drops or referred for further treatment by the ophthalmologist. The chance of finding an angle-closure glaucoma by this screening, however, is small, as the intra-ocular pressure before and after an attack of raised pressure is usually normal. Persons with a shallow anterior chamber and an angle which is thought to be occludable, who therefore have an increased risk of angle-closure glaucoma, can be registered as such in their personal medical records.
- Instruction of the health-aides on the clinical picture, symptoms and treatment of acute angle-closure glaucoma, and instruction in the measurement of the intra-ocular pressure with a Schiotz tonometer.
- The provision of each village clinic with a Schiotz tonometer, pilocarpine eye drops and Diamox, so that when acute angle-closure glaucoma is suspected the diagnosis can be verified and medical therapy given.
- After evaluation of the results of prophylactic treatment of persons at risk by laser iridotomy with the portable Q-switched Neodymium-YAG laser in the Kotzebue area, if it appears that this had led to a reduction in the number of cases of acute angle-closure glaucoma, the introduction of

this treatment for persons with an occludable chamber angle in the Norton Sound and Bering Straits region can be considered. This treatment can be given in the villages by the ophthalmologist.

- Instruction, especially of male workers and high school students, on the importance of wearing safety goggles during work with a high risk of injury to the eyes.

CHAPTER 11

Samenvatting

In dit proefschrift worden de resultaten van een onderzoek naar het voorkomen van oogziekten onder de Eskimo bevolking van de Norton Sound en Bering Straat regio in Alaska besproken. Dit onderzoek vond plaats in de winter 1986-1987.

In de Inleiding worden de doelstellingen van dit onderzoek vermeld. Deze doelstellingen waren:

1. Opsporen van de voornaamste oorzaken van een verminderde gezichtsscherpte bij de te onderzoeken bevolking per geslacht en naar leeftijd.
2. De omvang van de vraag naar oogheelkundige hulp onder de bevolking te bepalen en na te gaan hoe met de bestaande voorzieningen aan deze vraag kan worden voldaan.
3. Waar nodig aanbevelingen te geven hoe oogziekten te behandelen en te voorkomen.
4. Zorg dragen voor basale gegevens zodat toekomstige interventie programma's kunnen worden geevalueerd.
5. Onderzoek doen naar de specifieke oogziekten bij de Eskimo bevolking, zoals veranderingen in de frequentie van phlyctenulosis en het voorkomen van uveitis, gesloten kamerhoek glaucoom en myopie.
6. Verschaffen van verdere gegevens welke van belang zijn voor de bestudering van de oogheelkunde in het poolgebied.
7. Bieden van oogheelkundige zorg aan de bevolking van het Norton Sound en Bering Straat gebied, inclusief het voorschrijven van brillen en verwijzen van patienten met oogziekten naar het oogartsen spreekuur in het ziekenhuis te Nome, of naar de afdeling oogheelkunde van het Alaskan Native Medical Center in Anchorage.

In hoofdstuk 1 wordt een samenvatting gegeven van de bestaande Engelstalige literatuur over oogziekten bij Eskimos in Groenland, Canada en Alaska. Deze literatuur betreft met name de refractie afwijkingen, ziektes van het hoornvlies en berichten over het frequent voorkomen van gesloten-kamerhoek glaucoom.

In hoofdstuk 2 wordt het gebied waarin het onderzoek plaatsvond be-

sproken. De Norton Sound en Bering Straat regio ligt juist ten zuiden van de poolcirkel aan de kust van de Bering Straat in Alaska, en bestrijkt een oppervlakte van ca 67.000 vierkante kilometer (dit komt ongeveer overeen met anderhalf maal de oppervlakte van Nederland). De bevolking telt ongeveer 8150 personen en bestaat voornamelijk uit Eskimos, welke wonen in de stad Nome of in een van de 15 dorpen die het gebied telt. De bevolking is jong, 50% van de inwoners is jonger dan 20 jaar. Veel mensen hebben een baan bij de overheid. Aangezien echter 42% van de gezinnen beneden de armoede grens leeft, is men nog steeds sterk afhankelijk van de traditionele bronnen van inkomst zoals jacht en visvangst.

Daar de gesteldheid van het terrein, het klimaat en de geringe bevolkingsdichtheid beperkingen oplegt heeft men gekozen voor een byzondere opzet van het gezondheidssysteem. Ieder dorp heeft een goed geoutilleerd kliniekje waar een speciaal hiertoe opgeleidde verpleegkundige de primaire geneeskundige zorg verleent. In Nome is een klein ziekenhuis waar 5 huisartsen, 3 tandartsen, enkele verpleegkundigen en een optometrist werkzaam zijn.

Voor specialistische oogheelkundige zorg is de bevolking aangewezen op de spreekuren welke 4 maal per jaar door een van de oogartsen uit het Alaskan Native Medical Center in Anchorage in het ziekenhuis te Nome worden gehouden. Tussentijds, of voor operatieve ingrepen, is men aangewezen op het ziekenhuis in Anchorage.

Verder heeft de optometrist dagelijks spreekuur in het ziekenhuis in Nome en worden door hem alle dorpen tenminste éénmaal per jaar bezocht.

In hoofdstuk 3 wordt vermeld op welke wijze het onderzoek plaatsvond. Met kleine, tweemotorige vliegtuigjes werden 8 ad random geselecteerde dorpjes bezocht door een team bestaande uit een epidemiologe, optometrist, assistente en een oogarts. Door deze vorm van transport was de hoeveelheid instrumentarium welke kon worden meegenomen beperkt.

De respons van de bewoners voor het onderzoek was hoog, 83,7% van de op dat moment in de dorpen aanwezige inwoners kon worden onderzocht. Hiervan was 90% Eskimo.

Alleen de bevindingen bij de Eskimo bevolking (1668 personen) en Indianen en Aleuten (5 personen) worden in dit proefschrift vermeld.

In hoofdstuk 4 worden de gevonden visus en oorzaken van blindheid besproken. Bij 15% van de onderzochten bleek een bepaling van de visus niet mogelijk. Bij 67% van alle Eskimos werd de visus bij presentatie zonder correctie opgenomen, 33% droeg een bril of contactlenzen. Vóór refractie bleek bij 21,5% van de onderzochten de visus voor het beste oog

minder dan 20/30, doch na refractie was dit nog slechts bij 6,3% het geval. Eveneens vóór refractie was 2,2% beiderzijds blind volgens de V.S. maatstaven, doch na refractie nog 0,6%. Het moge derhalve duidelijk zijn dat een goede optometrische service voor de bevolking van groot belang is. Hiernaast speelt de mogelijkheid tot het verkrijgen van betaalbare brillen, eventueel met een financiele steun bij de aanschaf hiervan, een rol om tot het verbeteren van de visus van de bevolking te komen.

De belangrijkste oorzaken voor monoculaire blindheid waren littekens van de cornea, amblyopie, cataract, traumata, glaucoom en ablatio retinae.

De voornaamste oorzaak voor bilaterale blindheid was leeftijdsgebonden macula degeneratie.

In hoofdstuk 5 worden de refractie afwijkingen en lengte van de oogas besproken. Bij alle personen met een visus van minder dan 20/30, of bij wie de visus met de plus-1 test niet verminderde, werd de subjectieve refractie bepaald. Verder werd bij personen met een brilcorrectie de sterkte van de bril genoteerd. Bij 83,4% van de onderzochten was het mogelijk de refractie te bepalen. Van hen was 44,7% myoop, 44,9% emmetroop en 10,4% hypermetroop. Myopie kwam meer voor bij vrouwen (48,3%) dan bij mannen (41,3%), terwijl emmetropie meer bij mannen (49,3%) dan bij vrouwen (40,3%) voorkwam. Hypermetroop was 9,4% van de mannen en 11,4% van de vrouwen. Er bleek een toename van het aantal myopen met de leeftijd, met een maximum van 67,2% tussen het 30ste en 40ste levensjaar, hierna nam het aantal myopen weer sterk af. Tot het 50ste levensjaar werd weinig hypermetropie gezien, hierna nam dit sterk toe, tot 71,5% van de personen, ouder dan 80 jaar. Emmetropie daarentegen nam met het toenemen van de leeftijd steeds meer af.

Astigmatisme van meer dan 2 D kwam voor bij 3.5% van de rechter en 3.3% van de linker ogen.

Anisometropie, meer dan 0,5 D kwam bij 16%, en meer dan 2 D bij 4% van de onderzochte populatie voor.

Bij echografie bleek bij een toenemende lengte van de oogas meer myopie voor te komen. Er bestond geen relatie tussen de leeftijd en de lengte van de oogas.

De vraag waarom bij de jongere Eskimos meer myopie voorkomt dan bij de oudere generatie kan na dit onderzoek niet beantwoord worden. Mogelijk speelt het toegenomen schoolbezoek door de jongere generatie een rol.

In hoofdstuk 6 worden de afwijkingen van het hoornvlies besproken.

Climatic droplet keratopathy of spheroide degeneratie kwam voor bij 0,6% van de bevolking en pterygiae bij 1,0%. Deze beide aandoeningen gaven geen aanleiding tot een verminderde visus.

Corneale littekens werden bij 5,1% van de onderzochten waargenomen. In beide geslachten kwamen meer littekens voor naarmate de leeftijd toenam. Littekens als gevolg van phlyctenuleuse keratoconjunctivitis kwamen in beide geslachten bij 2,0% voor, doch werden bij personen beneden de leeftijd van 20 jaar niet waargenomen. Littekens als gevolg van traumata werden bij mannen 4 maal zo frequent waargenomen als bij vrouwen.

Corneale littekens waren bij 0,6% van de bevolking de oorzaak van monoculaire blindheid en bij 0,1% van binoculaire blindheid.

Tuberculose dient te worden beschouwd als belangrijkste oorzaak van phlyctenuleuse keratoconjunctivitis. Daar tuberculose thans bij de Eskimos niet meer voorkomt, valt te verwachten dat bij de jongere generatie ook in de toekomst littekens als gevolg van deze ziekte niet meer zullen optreden.

Preventieve maatregelen zoals het voorkómen van oogletsel, met name bij de mannen, lijken thans de belangrijkste bijdrage te kunnen leveren tot het verminderen van het aantal corneale littekens.

In hoofdstuk 7 wordt het voorkomen van gesloten-kamerhoek glaucoom, de diepte van de kamerhoek en de bevindingen bij gonioscopie besproken.

Bij 0,8% van de onderzochte bevolking, 0,5% van de mannen en 1,2% van de vrouwen, kwam een vorm van gesloten-kamerhoek glaucoom voor. Boven de 60 jaar had 11,8% van de vrouwen een gesloten-kamerhoek glaucoom.

Een ondiepe kamerhoek werd bij vrouwen 2 maal zo vaak gevonden als bij mannen.

Bij personen met een nauwe kamerhoek werd gonioscopie gedaan. Bij 2,0% van de mannen en 7,5% van de vrouwen werd de kamerhoek hierbij als afsluitbaar beoordeeld.

De gemiddelde oogdruk, gemeten bij alle personen boven de 14 jaar, was laag, namelijk 11,7 mm Hg (sd 3,3) voor de mannen en 12,0 mm Hg (sd 3,4) voor de vrouwen (rechter ogen).

Gezien deze bevindingen is het wenselijk alle vrouwen boven de 50 jaar jaarlijks te screenen op oogdruk en diepte van de kamerhoek. Daarnaast is het zinvol om alle kliniekjes in de dorpen uit te rusten met een Schiotz tonometer en de aldaar werkzame health aides te instrueren hoe deze te gebruiken, zodat zij bij personen met klachten of symptomen die wijzen op een aanval van acuut glaucoom, de oogdruk kunnen meten.

In hoofdstuk 8 worden de afwijkingen van de lens en iris besproken. Cataract kwam bij 4,2% van de bevolking voor. De meest voorkomende vorm van cataract was het seniele cataract. Boven de leeftijd van 40 jaar

had 13,8% van de mannen en 16,2% van de vrouwen deze aandoening. Bij 7 personen (0,4%) was volgens de criteria van de V.S. het cataract de oorzaak van monoculaire blindheid.

Bij 1,3% van de onderzochte bevolking werden senechiae posteriores, irisatrofie of een cyclitismembraan geconstateerd, welke mogelijk een gevolg kunnen zijn van een doorgemaakte iritis.

In hoofdstuk 9 worden de afwijkingen van de retina besproken.

Retinale pigment epitheel atrofie kwam bij 10,1% van de mannen en 13,3% van de vrouwen boven de 29 jaar voor. Drusen werden bij 4,6% van de mannen en 2,0% van de vrouwen boven de 29 jaar waargenomen. Leeftijds gebonden macula degeneratie kwam in dezelfde leeftijdsgroep bij 11,5% van de mannen en 13,7% van de vrouwen voor. Al deze aandoeningen kwamen vaker voor naarmate de leeftijd toenam.

Diabetische retinopathie werd bij de onderzochte populatie in het geheel niet waargenomen. De prevalentie van diabetes mellitus onder de bevolking was 0,9%, met een gemiddelde ziekteduur van 14,5 jaar. Mogelijk biedt het visrijke dieet van de Eskimos bij de diabeten een bescherming tegen het ontstaan van een retinopathie. Het is zinvol nader onderzoek naar de oorzaak van het ontbreken van diabetische retinopathie te verrichten.

Afwijkingen van de periferie van het netvlies werden bij 5,1% van de onderzochte populatie waargenomen. De meest voorkomende afwijkingen van de perifere retina waren perifere defecten.

In hoofdstuk 10 worden de conclusies van deze studie weergegeven. Deze zijn in de samenvatting van hoofdstuk 4-9 reeds vermeld.

Naar aanleiding van deze studie zouden ter voorkoming van oogziekten bij de Eskimo bevolking van de Norton Sound en Bering Straat regio (en mogelijk bij de totale Eskimo bevolking) de volgende maatregelen kunnen worden genomen:

- Jaarlijks screenen van de visus van alle schoolkinderen door de healthaides met een bepaling van het stereozien. Dit onderzoek zou bij voorkeur plaats dienen te vinden enkele weken voor het jaarlijkse bezoek door de optometrist. In sommige dorpen gebeurt dit al.
- Volledig onderzoek van alle kinderen met een visus kleiner dan 20/30 in één oog of met ontbreken van dieptezien door de optometrist tijdens zijn jaarlijks bezoek aan de dorpen. Zo nodig kan een bril worden voorgeschreven, amblyopie behandeling worden toegepast of kan het patientje worden verwezen naar het oogartsen spreekuur in het ziekenhuis te Nome.
- Jaarlijkse screening door de optometrist van alle vrouwen boven de 50

jaar op de aanwezigheid van een gesloten kamerhoek glaucoom en de diepte en afsluitbaarheid van de kamerhoek. Patienten met een verhoogde oogboldruk kunnen worden behandeld met Pilocarpine oogdruppels of worden verwezen voor verdere behandeling naar de oogarts. De kans dat bij deze screening een gesloten kamerhoek glaucoom wordt gevonden moet overigens klein worden geacht. De oogboldruk is immers voor en na een aanval van verhoogde oogboldruk veelal normaal. Patienten met een ondiepe voorste oogkamer met een als afsluitbaar geachte kamerhoek, die dus een verhoogde kans op gesloten-kamerhoek glaucoom hebben, kunnen als zodanig worden geregistreerd in hun medisch dossier.

- Geven van voorlichting aan de health-aides over het ziektebeeld van het acute glaucoom, de symptomen en behandeling. Verder het geven van instructies hoe met behulp van een Schiotz tonometer de oogdruk kan worden gemeten.
- Ieder kliniekje in de dorpen uit te rusten met een Schiotz tonometer, Pilocarpine oogdruppels en Diamox tabletten, zodat bij verdenking op de diagnose acuut glaucoom deze diagnose verder kan worden onderbouwd en medicamenteuse therapie kan worden gegeven.
- Indien na evaluatie van het resultaat van de profylactische behandeling door middel van een laser iridotomie met behulp van de draagbare Q-switched Neodymium-YAG laser bij risico personen in de Kotzebue area blijkt dat dit heeft geleid tot een daling van het aantal gevallen van acuut glaucoom, kan worden overwogen ook in de Norton Sound en Bering Straat regio bij personen met een afsluitbaar geachte kamerhoek deze behandeling toe te passen. Deze behandeling zou door de oogarts in de dorpen kunnen plaatsvinden.
- Geven van voorlichting, met name aan de manlijke beroepsbevolking en aan de leerlingen van de high schools, over het nut van het dragen van een veiligheidsbril tijdens werkzaamheden waarbij een verhoogde kans op het krijgen van oogletsel bestaat.

Supplement

FORM 1

DATE __ __/ __ __/ __ __

ALASKA EYE SURVEY II

PATIENT INTERVIEW

ID # __-__ __ __ __

PART I DEMOGRAPHIC DATA

1 _

NAME (Last, First, Middle)

2 Sex (0) (1)
M F

3 Race
Esk (1)
Ind (2)
Alu (4)
Wht (8)
Oth (16)
DK (99)

4 _____ __ __

Resident village village code

5 Birthdate __ __/ __ __/ __ __
Mon Day Year

PART II MEDICAL HISTORY

6 Have you ever had any of these diseases?

	No	Yes	DK	IF Yes, how long?
a diabetes	(0)	(1)	(9)	_____ yrs
b high blood pressure	(0)	(1)	(9)	_____ yrs
c thyroid disease	(0)	(1)	(9)	_____ yrs
d heart disease	(0)	(1)	(9)	_____ yrs
e stroke	(0)	(1)	(9)	_____ yrs
f TB	(0)	(1)	(9)	_____ yrs

7 Do you take any medicines now? No (0) Yes (1) specify _____

PART III OPHTHALMIC HISTORY

8 Have you ever been prescribed glasses? No (0) Yes (1)

IF YES, a when did you get your last prescription? ____ yrs ago

b do you currently wear glasses? No (0) Yes (1)

if NO, specify reason
they don t help)
I don t need them)
can t afford them(3)
never got them (4)
lost or broken (5)
other (6)

9 Have you ever had any diseases in your eyes ? RE No (0) Yes (1) DK (9)
LE No (0) Yes (1) DK (9)

10 Have you ever injured either eye? RE No (0) Yes (1) DK (9)
LE No (0) Yes (1) DK (9)

11 Have you ever used any medicines or drops for your eyes? NO (0) Yes (1) DK(9
specify type and when _____

12 Have you ever had an operation on your eyes? NO (0) Yes (1)
specify type, eye, and when _____

13 COMMENTS ON BACK NO (0) Yes (1)

FORM 2

Date __ __ __ __/__ __

Examiner Code __ __

ALASKA EYE SURVEY II
VISION AND REFRACTION

ID# __-__ __ __

Name: _____

Acuity Codes			
Hand Motion	30	Fixates and Follows	70
Light Projection	40	No Fixates and Follows	80
Light Perception	50	Unable to Assess	90
No Light Perception	60	Near Worse Than 20/800	95

PART I	Right Eye	Left Eye
1) Lensometry Distance Rx No Classes. . .(1) Glasses . . . .(2)	Sphere: __ __ __.__ __ Cylinder: - __ __.__ __ Axis: __ __ __ Add +__.__ __	Sphere: __ __ __.__ __ Cylinder: - __ __.__ __ Axis: __ __ __ Add +__.__ __
2) Lensometry Reading Rx No Glasses. . .(1) Glasses . . . .(2)	Sphere: __ __ __.__ __ Cylinder: -__ __.__ __ Axis: __ __ __	Sphere: __ __ __.__ __ Cylinder: -__ __.__ __ Axis: __ __ __
3) Presenting Distance VA 3A) Uncorrected . .(1) Corrected . . .(2)	__ __/__ __ __	__ __/__ __ __
3B) IF SUBJECT BETTER than 20/30 "Plus 1.00 Test"	VA decreases. .(1) VA same . . . .(2)	VA decreases. .(1) VA same . . . .(2)
4) Presenting Near VA Uncorrected . .(1) Bifocals. . . .(2) Reading Rx. . .(3) Contact Lenses.(4)	__ __/__ __ __	__ __/__ __ __

Examiner Code __ __

ID# __-__ __ __

Acuity Codes			
Hand Motion	30	Fixates and Follows	70
Light Projection	40	No Fixates and Follows	80
Light Perception	50	Unable to Assess	90
No Light Perception	60	Near Worse Than 20/800	95

PART II

	R	L	Right Eye	Left Eye
1) Manifest Refraction			Sphere: __ __ __.__ __	Sphere: __ __ __.__ __
Not done	(0)	(0)	Cylinder - __ __.__ __	Cylinder - __ __.__ __
Done	(1)	(1)	Axis __ __ __	Axis __ __ __
			VA __ __/__ __ __	VA __ __/__ __ __
2) Cycloplegic Refraction	R	L	Sphere: __ __ __.__ __	Sphere: __ __ __.__ __
Not Done.....	(0)	(0)	Cylinder - __ __.__ __	Cylinder - __ __.__ __
Subjective.....	(1)	(1)	Axis __ __ __	Axis __ __ __
Retinoscopic....	(2)	(2)	VA __ __/__ __ __	VA __ __/__ __ __
3) Near Add	R	L	+__.__ __	+__.__ __
Not done	(0)	(0)		
Done	(1)	(1)	VA __ __/__ __ __	VA __ __/__ __ __

4) Was the patient given a glasses prescription?

No . . . . . (0)
Yes. . . . . (1) ⟶

If yes,
Rx given
OL _____
OS _____

5) Comments:

No . . . . . (0)
Yes. . . . . (1)

Date __/__/__

ALASKA EYE SURVEY II
OCULAR EXAMINATION

FORM 03
Page 1 of 3

ID __-__ __ __ __

Name _____

PART I - EXTERNAL, PUPILS, MOTILITY

1 External? Nl (1) Abn (2) DK (9) → _ _ _ _ _

2 Motility?
Orthotropic (1)
Heterotropic (2) →
DK (9)

2A If Heterotropic
Idio/Refrac (1)
Other (2)

3 Fixation Nl (1) Abn (2) DK (9) → _ _ _ _ _

PART II - ANTERIOR SEGMENT

4 Slit Lamp (1) Penlight (2)

5 Conjunctiva
Nl (1) Abn (2) →
DK (9)

5a IF ABNORMAL	No	R	Yes	No	L	Yes
a) Conjunctivitis	(0)		(1)	(0)		(1)
b) Pinguec Nasal	(0)		(1)	(0)		(1)
Temp	(0)		(1)	(0)		(1)
c) Active Phlyct	(0)		(1)	(0)		(1)
d) Other _ _ _ _ _						

6 Anterior Chamber
R Nl (1) Abn (2) DK (9)
L Nl (1) Abn (2) DK (9) →

6a IF ABNORMAL	R	L
a) Cells	(0) (1) (2) (3) (4)	(0) (1) (2) (3) (4)
b) Flare	(0) (1) (2) (3) (4)	(0) (1) (2) (3) (4)
c) KP	(0) (1) (2) (3) (4)	(0) (1) (2) (3) (4)
d) Other _ _ _ _ _		

7 Cornea?
Nl (1) Abn (2) DK (9) →

7a IF ABNORMAL	R	L
a) Pterygium Nasal	___	___
(mm onto cornea) Temporal	___	___
b) CDK (0) (1) (2) (3) (4)	(0) (1) (2) (3) (4)	
c) Scarring	No Yes	No Yes
Central	(0) (1)	(0) (1)
Peripheral	(0) (1)	(0) (1)
d) Krukenberg Spindle	(0) (1)	(0) (1)
e) Active Phlyctenule	(0) (1)	(0) (1)
f) Other _ _ _ _ _		

7b IF SCARRING	R	L
	NO YES	NO YES
a Trauma	(0) (1)	(0) (1)
b Inflam-TB	(0) (1)	(0) (1)
c Infl-nonTB	(0) (1)	(0) (1)
d Other	(0) (1)	(0) (1)
e Specify _____		

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8. Iris?
R: Nl (1) Abn (2) DK (9)
L: Nl (1) Abn (2) DK (9)

9. Slitlamp Estimation of Angle Depth
R (__) L (__)
Not done = 8

8A. IF ABNORMAL:
(Check one for each eye)

	R	L
a. Iridectomy: None	(0)	(0)
w/aphakia	(1)	(1)
laser	(2)	(2)
surgical	(3)	(3)
b. Post synech: Hours	____	____
c. atrophy present: No	(0)	(0)
Yes	(1)	(1)
d. other abnormality:	____.____	____.____

10. Tonometry:

	R	L
a. Type	(__)	(__)
b. mm Hg	(__ __)	(__ __)

11. Ultrasound: Done (1) Not done (0)
If Done:

	R	L
a. Axial length	__ __.__	__ __.__
b. AC Depth	__.__	__.__

12. Gonioscopy: Done (1) Not Done (0)

12.A.

	R	L
a) Shallowest Angle	Gr. (__) hrs (__ __)	Gr. (__) hrs (__ __)
b) PAS	hrs (__ __)	hrs (__ __)
c) Occludable	No (0) Yes (1)	No (0) Yes (1)
d) Other	__ __ __.__ __	

PART III - LENS, VITREOUS, FUNDUS:

13. Dilation? No (0) R (1) L (2) Both (3)

14 Lens:
R: Nl (1) Abn (2) DK (9)
L: Nl (1) Abn (2) DK (9)

14a. IF ABNORMAL:

	No	R Yes	No	L Yes
a) Cataract	(0)	(1)	(0)	(1)
b) Pseudoexfoliation	(0)	(1)	(0)	(1)
c) Dislocation	(0)	(1)	(0)	(1)
d) Glaukomflecken	(0)	(1)	(0)	(1)
e) Aphakia	(0)	(1)	(0)	(1)
f) After cataract	(0)	(1)	(0)	(1)
g) PC/AC IOL	(0)	(1)	(0)	(1)

14b. IF CATARACT

	R No	R Yes	L No	L Yes
a. cortical	(0)	(1)	(0)	(1)
b. nuclear	(0)	(1)	(0)	(1)
c. PSC	(0)	(1)	(0)	(1)
d. other	(0)	(1)	(0)	(1)
e. etiology:				
Senile		(1)		(1)
Traumatic		(2)		(2)
Congenital		(3)		(3)
Other		____.____		

15. Vitreous? R: Nl (1) Abn (2) DK (9) ____.____
L: Nl (1) Abn (2) DK (9)

16. Disc? R: Nl (1) Abn (2) DK (9) ____.____
L: Nl (1) Abn (2) DK (9)

16a. If adequate view, describe (in tenths)

	R	L
a) Horizontal cup/disc	(0.__)	(0.__)
b) Vertical cup/disc	(0.__)	(0.__)
c) Thinnest neural rim	(0.__)	(0.__)

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17. Macula. R NI (1) Abn (2) DK (9)
L: NI (1) Abn (2) DK (9)

17A. IF ABNORMAL.	R	L
a) RPE Atrophy	No (0) Min (1) Sig (2) DK (9)	No (0) Min (1) Sig (2) DK (9)
b) Drusen	No (0) Min (1) Sig (2) DK (9)	No (0) Min (1) Sig (2) DK (9)
c) Disciform Scar	No (0) Yes (1) DK (9)	No (0) Yes (1) DK (9)
d) Diab. Retin.	No (0) Bdg (1) PP (2) Pro (3)	No (0) Bdg (1) PP (2) Pro (3)
e) hypertensive	No (0) Min (1) Mod (2) Sig (3)	No (0) Min (1) Mod (2) Sig (3)
f) Other	__ __ __.__ __,	__ __ __.__ __

18. Peripheral Fundus? R: NI (1) Abn (2) DK (9) __ __ __.__ __
R: NI (1) Abn (2) DK (9)

PART IV - VISUAL FIELDS:

19. R (__) L (__) __ __ __.__ __, __ __ __.__ __

PART V - DIAGNOSES

20. Glaucoma?

	R	L
None	(0)	(0)
Primary Open angle	(1)	(1)
Acute angle closure	(2)	(2)
Sub-acute ang closure	(3)	(3)
Chronic angle closure	(4)	(4)
Other	(5)	(5)

Specify _____

21. If presenting VA worse than 20/40 in either eye, what is etiology?

	R	L
Not applicable	(8)	(8)
Refractive	(1)	(1)
Corneal Scarring	(2)	(2)
Lens	(3)	(3)
Age-Related Macular Degeneration	(4)	(4)
Diabetic Eye Disease	(5)	(5)
Glaucoma	(6)	(6)
Strabismus/Refractive Amblyopia	(7)	(7)
Uncertain	(9)	(9)
Other __ __ __.__ __,	__ __ __.__ __	

Coments: _____

22. Comments No (0) Yes (1) _____

23. Disposition:

Normal exam, no Rx (1)
Rx for glasses only (2)
Pathology noted, no Rx (3)
Referred for further Rx (4)

Curriculum vitae

The author of this thesis was born in Meijel on 5 September 1955. After completing his school education at the State High School in Venlo (H.B.S.-b) he studied medicine at the Catholic University of Nijmegen. He passed his preclinical examinations in 1977 and qualified in 1979. He then performed his military service as medical officer. On 6 February 1981 he began his training as ophthalmologist in the Royal Dutch Eye Hospital in Utrecht, working under Prof. J.E. Winkelman and Prof. R.W.J.N. Hoppenbrouwers. On 6 February 1985 he was registered as qualified ophthalmologist. Since then he has been working as ophthalmologist in the Lambertus Hospital in Helmond.

Stellingen

I

De belangrijkste oorzaak van sociale blindheid en slechtziendheid bij de Eskimos in de Norton Sound en Bering Straat regio in Alaska is het ontbreken van een juiste brilcorrectie.

II

In Alaska komt myopie bij jonge volwassen Eskimos aanzienlijk meer voor dan bij ouderen.

III

Traumata zijn bij de mannelijke Eskimos in de Norton Sound en Bering Straat regio de belangrijkste oorzaak van corneale littekens.

IV

Bij vrouwelijke Eskimos boven de 50 jaar dient periodiek onderzoek op de aanwezigheid van een afsluitbare kamerhoek plaats te vinden.

V

Het feit dat bij Eskimos slechts zelden diabetische retinopathie wordt waargenomen verdient nader onderzoek.

VI

Er dient ook in Nederland meer epidemiologisch onderzoek te worden verricht naar het vóórkomen van oogziekten.

VII

Bij verdenking op een subretinale neovascularisatie in de maculastreek dient niet alleen direct fluorescentie angiografie plaats te vinden, doch ook de beslissing tot een eventuele lasertherapie en beoordeling van de foto's binnen 24 uur te worden genomen.

VIII

Bij iedere jeugdige patiënt met een éénzijdige therapie resistente follliculaire keratoconjunctivitis dienen de oogleden te worden geïnspecteerd op een molluscum contagiosum als oorzaak.

IX

Otitis media komt bij Eskimos in Alaska zeer frequent voor.

X

Cholecystectomie is vooralsnog de therapie van keuze voor de behandeling van symptomatische galblaasstenen bij overigens gezonde patiënten.

XI

Gezien de lage jodide concentratie in het drinkwater te Helmond dienen de inwoners van deze stad gejodeerd keukenzout te gebruiken.

XII

Eskimos wonen niet in Iglo's!

XIII

Anno 1988 kan de naam vuilnisbakkeras beter worden gewijzigd in vuilniszakkenras of containerras.

XIV

De kunst van het inrichten is het weglaten.

XV

Dit is één van de laatste, niet door de industrie bekostigde, medische proefschriften.

Nijmegen, 9 september 1988

Druk: Mennen Asten bv