

Aetiology of keratoconus

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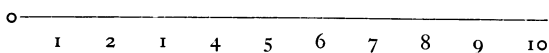
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The diverse associations of keratoconus suggest that it is the end result of a number of different pathological processes. It may therefore be regarded as a heterogeneous group of conditions with identical clinical signs but with a varied pathogenesis. The present study is concerned with an analysis of the general medical and psychological associations of 75 keratoconus patients who attended the contact lens department of Moorfields Eye Hospital. Their psychological and behavioural characteristics were studied because Copeman (1965) reported that a number of patients with keratoconus had an 'odd mentality'. Sisters nursing keratoconus patients after corneal grafting had also remarked on the unusual personalities of several of them.

Patients and methods

Data collected in an identical fashion from 75 patients with keratoconus and a control group of 231 randomly selected (one in five) outpatients from the same hospital included (1) sex, (2) age, (3) occupation, (4) history of psychoneurosis, (5) family history of psychoneurosis, (6) completion of the Middlesex Hospital questionnaire, and (7) completion of an analogue scale for the subjective assessment of total life stress.

The Middlesex Hospital questionnaire (MHQ) is an inventory giving a total score for psychoneurotic manifestations based on subscores of anxiety, phobic anxiety, depression, obsessionalism, extrovert qualities commonly associated with hysteria, and somatic symptoms commonly of psychogenic origin. In the analogue scale the patient is asked to mark along a line of 10 digits in proportion to his subjective assessment of life stress.



After the first 20 patients in the keratoconus group had been studied particular inquiry was made of the remaining patients about the amount and purpose of eye-rubbing; a history of hay fever, asthma, eczema, or vernal catarrh; and a history of recurrent styes, cysts, blepharitis, or irritating eyes. Subgroups were isolated on a basis of associated systemic or local factors and their MHQ scores compared. All patients were interviewed and assessed for the presence of psychosis or overt psychopathic personality. Twenty keratoconus patients allowed free discussion of a possible association between deviant sexual behaviour and the eyes.

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Results

The 75 keratoconus patients resolved themselves into five main groups, comprised as follows.

Group 1, 26 patients with asthma or hay fever. A history of recurrent episodic wheezing or distressed respiration was taken as indicating asthma and seasonal sneezing and itchy eyes as indicating hay fever. Not all of these patients were aware of their clinical status.

Group 2, 14 patients with a dermatological disorder (13 eczema, one psoriasis), of whom 11 also had asthma or hay fever. Thus 37 out of 75 patients gave a history of likely atopy.

Group 3, 10 patients with a history of recurrent styes or cysts or chronically irritable eyes associated with blepharitis. All admitted that they habitually rubbed their eyes.

Group 4, 22 patients with no distinguishing features. Only five volunteered or acknowledged that they rubbed their eyes. They stated that they did so because the eyes were tired or ached.

Group 5, three patients with a family history of keratoconus. In one there was a family history of arachnodactyly and in another a family history of asthma.

Out of the 55 patients closely questioned about eye-rubbing 40 gave a positive response. Some of these denied any personal knowledge of eye-rubbing but remembered mothers or others reprimanding them for it. One patient with eczema denied eye-rubbing or skin-scratching, yet there were obvious scratch marks on facial eczematous lesions.

OTHER FINDINGS

There were more males among the keratoconus group (71 per cent) than among the controls (47 per cent) ($P < 0.001$). The mean age (\pm SD) of the keratoconus patients was 27.3 ± 8.7 years (oldest 57 years) and that of the controls 46.9 ± 13 years. As judged by the Registrar General's classification based on occupation, most of the keratoconus patients were from social classes I and II (Fig. 1) whereas half of the total general population was from social class III. There was no significant difference in the number of keratoconus patients and the number of controls with a history of

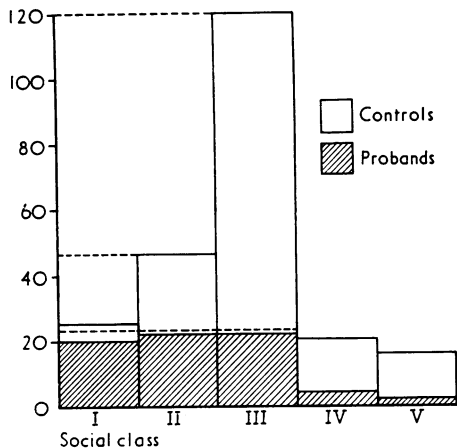


FIG. 1 Social class of 75 keratoconus patients and of random sample of ophthalmic outpatients

psychoneurosis. This was assessed from a history of frequent visits to the general practitioner, taking appropriate medicaments, or admission to hospital (χ^2 analysis). By the same criteria there was no significant difference between the number of patients and controls with a family history of psychoneurosis. The average total MHQ score of neuroticism for all the keratoconus patients (three patients with a family history of keratoconus were excluded from this comparison) compared with the total MHQ score of the controls did not reach significance (χ^2 analysis). The value for 'life stress', as assessed by the analogue scale, was lower in the keratoconus patients (3.68, SD 2.24) than in the controls (4.63, SD 2.83) ($P < 0.003$). The components of the MHQ—*anxiety, depression, phobia, obsessionalism, psychosomatism, and hysteria*—were subjected to the F-test of significance for each keratoconus patient subgroup. There was no significant difference for any of these variables in the subgroups. In particular, the scores in the idiopathic group 4 were similar to the other subgroups.

Discussion

Keratoconus has been recorded in association with a variety of local and general disorders (Duke-Elder and Leigh, 1965). Many of these may be chance associations with no important pathogenetic implications. The outstanding clinical observation in the present study is the prevalence of atopic conditions. A history of hay fever was elicited in 23 patients (32.6 per cent) and of asthma in 25 patients (33.3 per cent). The incidence of asthma in the general population is in the region of 0.59 per cent (Boland, 1963).

Ridley (1956) first drew attention to the wide

variety of atopic conditions associated with keratoconus, and observed that the association was much closer than could be explained by chance. Copeman (1965) also found this. Our study confirms these findings. The incidence of atopy in our patients with keratoconus was much higher than observed by Ridley, but we saw no cases of vernal catarrh as reported by Bietti and Terraboschi (1958). Like Copeman (1965), we found a high incidence of eczema in keratoconus patients. The incidence of keratoconus in asthma and hay fever has not been studied, but clearly it is not an infrequent complication. Brunsting, Reed, and Bair (1955) found that out of 1158 patients with atopic dermatitis six had keratoconus. The 1.5 per 1000 hospital eye patients with keratoconus found by Franceschetti and Caronnes (1960) must be considerably higher than the incidence of keratoconus in an unselected population. The incidence of keratoconus in patients with atopic eczema is thus considerably greater than in the general population.

Within a short time of starting the present study it became clear that many of the patients rubbed their eyes excessively, particularly those with an associated atopic condition. A detailed history of the incidence and nature of eye-rubbing was therefore obtained in the final 55 patients. Forty of them admitted to an abnormal amount of eye-rubbing. Ridley (1961) first noted the prevalence of eye-rubbing in keratoconus and found an incidence of 70 per cent (Ridley, 1966). Rarely severe eye-rubbing in keratoconus patients has been attributed to psychotic behaviour (Ridley, 1966), compulsive rubbing (Copeman, 1965), or a sexual deviation in which the patient experiences sexual gratification on rubbing the eyes (ocular masturbation). Ridley (personal communication) has met the latter once, in a celibate priest who achieved orgasm by rubbing the eyes rather than the prohibited genitalia. True compulsion—where the patient repudiates, unsuccessfully, purposeless eye-rubbing—was not encountered in the present series. Copeman (1965) used the term 'compulsion' in a different sense. Likewise, psychotic or sexual behavioural abnormality was not encountered. Investigation of the latter was limited to 20 patients with whom rapport was sufficiently established to allow free discussion of the possibility of ocular masturbation.

Apparently, therefore, patients with keratoconus who progress to contact lens wear are rarely psychotic, compulsive, or sexually deviant. There may be a higher incidence of these in patients who are unable to wear contact lenses. The selection of patients attending a contact lens department probably explains the absence of mesenchymal syndromes associated with keratoconus in our patients and the absence of Leber's tapeto-retinal

degeneration. One-third of the patients with the latter condition, in which eye-rubbing is a common feature, progress to keratoconus (Alström and Olson, 1957). Eye-rubbing is not an overt manifestation of mesenchymal syndromes, although mongols may occasionally be seen to be rubbing their eyes feverishly. It would seem reasonable to suppose that in these conditions the cornea shares in the generalized defect of mesenchyme and stretches as a result of normal intraocular pressures or with normal degrees of eye-rubbing to give keratoconus.

Ridley (1966) suggested that eye-rubbing might be a response to mental stress or emotional tension. These may initiate the habit but we failed to find any persistent psychoneurotic manifestations in our patients from the evidence of the MHQ. The scores of the keratoconus patients were not significantly different from those of the controls. Comparison of the keratoconus patient subgroups for the MHQ scores for anxiety, depression, psychosomatism, obsessionalism, phobia, and hysteria also showed no significant difference. It is noteworthy that the 22 patients in the idiopathic group 4 failed to show any differences in behaviour or psychoneuroticism from those in the other groups when possible dominant aetiological factors could be isolated.

It may be that the idiopathic group 4 in our series belong to group 3 in our proposed classification (see Table). Ridley (1966) found an incidence of 70 per cent of conus posticus in the 30 per cent of keratoconus patients who did not rub their eyes. Such local structural or biochemical anomaly of the cornea may be the dominant aetiological factor in the 'idiopathic' group 4 of the present series and would occupy group 3 of our proposed classification for keratoconus.

The average duration of keratoconus in our patients was 7.1 years. The onset of possible causative eye-rubbing may have been several years before. Persistence of psychoneurosis, if it was an important initiating factor, might be expected if these patients were derived from a background of familial susceptibility to psychoneurosis. However, the incidence of a psychoneurotic history or of a family history of psychoneurosis was similar in the keratoconus patients and the control group. The analogue scale for current life stress was actually lower in the keratoconus group. The present study suggests, therefore, that the current, past, and familial psychoneurotic manifestations of keratoconus patients are within the norm.

At least 50 of our 75 patients had irritable eyes from local or general causes. Probably this irritation acts as a trigger for eye-rubbing in response to the day-to-day stresses of the younger adults of the upper socioeconomic groups. This view is supported by the presentation of a patient subsequent to this

Table *Proposed classification of keratoconus based on dominant aetiological factor*

<i>Class</i>	<i>Aetiology</i>
(1) Eye-rubbing	(a) In atopics or bioallergic groups of vernal catarrh, hay fever, eczema, asthma, blepharitis (b) Leber's tapeto-retinal degeneration (c) Psychogenic-induced eye-rubbing in response to stress or emotional tension (d) Habit, to relieve tiredness, accompanying crying, inducing pleasurable phosphenes (e) Behavioural abnormality in psychotics, ocular masturbation, ? compulsive states
(2) Generalized mesenchymal defects	Fragilitas ossium Mongolism Ehlers-Danlos syndrome Pseudoxanthoma elasticum Marfan's syndrome
(3) Corneal defects	Conus posticus ? Specific corneal mesenchymal defect
(4) Genetic	Could be via atopy, some of the generalized mesenchymal defects, or corneal defects

study who had bilateral acute keratoconus (Fig. 2). He was an asthmatic studying excessively hard for examinations, and his associated nail-biting in response to stress is seen in Fig. 3. He has been seen to rub his eyes for 10-minute periods under the bilateral pads and bandages that have been applied. Such eye-rubbing could well become habitual and eventually unrelated to a stimulus long after the subsidence of psychoneurotic manifestations.

Summary

Keratoconus has a common association with atopic conditions. Most keratoconus patients rub their eyes excessively. Eye-rubbing is considered the dominant aetiological factor in two-thirds of patients with keratoconus who progress to contact lens wear. A classification of keratoconus based on the dominant aetiological factors is proposed. No significant psychoneurotic factor was found in the keratoconus patients compared with patients in the control group.

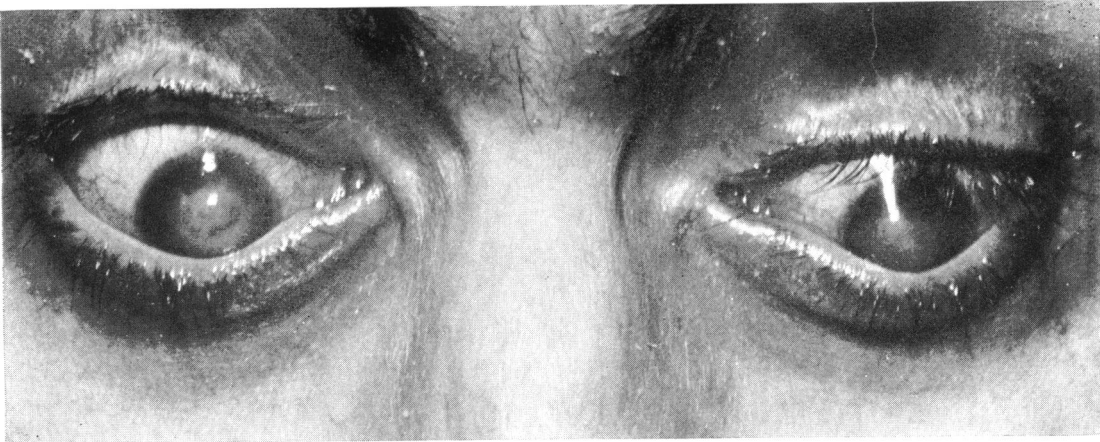


FIG. 2 Patient with bilateral acute keratoconus

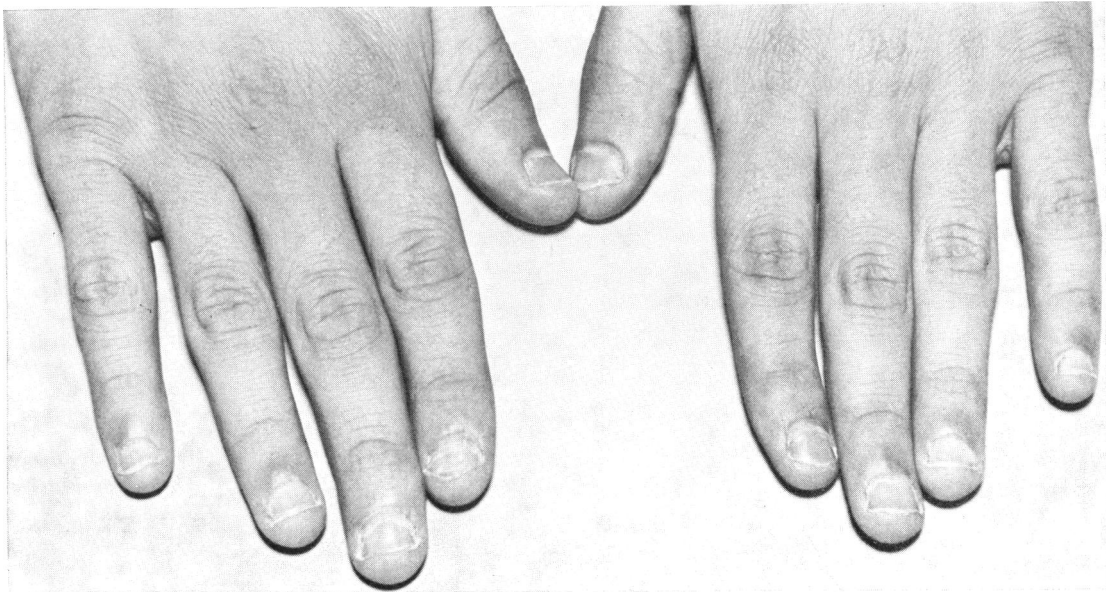


FIG. 3 Same patient as in Fig. 2 showing severe nail-biting

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