

## Pterygium in welders

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**SUMMARY** Pterygium is thought to be hyperaemia of fibrovascular tissue on to the cornea caused by ultraviolet radiation of sunlight. We observed a significantly high incidence of pterygia in welders who were exposed occupationally to excess ultraviolet radiation and found a close relationship between the incidence and the length of employment as a welder ( $r=0.975$ ,  $p<0.05$ ). This study attempts to clarify the causative relationship between ultraviolet radiation and pterygia.

Pterygium is common in southern countries but uncommon in northern countries such as Japan. It was recognised by ancient physicians such as Hippocrates and many explanations have been proposed,<sup>1,2</sup> but the aetiology has not been clarified completely yet. A possible relationship to ultraviolet radiation (UV) of sunlight has been pointed out<sup>3</sup> though not verified, for example, by experiments using animals exposed to UV.

We checked the incidence of pterygia among welders who had been exposed occupationally to excess UV in order to clarify the relationship to UV by epidemiological study.

### Subjects and methods

A total of 191 Japanese male welders with a mean age of 41.9 years (range 17-65) in 3 welding factories in Osaka were studied. The welders in these factories were employed on the welding of bridges and towers. The control group was composed of 214 men with a mean age of 42.3 years (range 19-73) employed in chemical and machinery factories in the same city.

Using a slit lamp we examined the cornea and the conjunctiva in both groups for the existence of pterygia and pingueculae. The welders were asked about the length of their employment as welders, the average working hours of welding a day, welding method, onset time of the pterygium, and the past history of ocular diseases such as foreign bodies of the cornea. Most workers having pterygia did not know exactly when they had started, so we studied the relationship between the incidence of pterygia and the length of employment as at the examination day.

Statistical significance was tested by the  $\chi^2$  test.

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### Results

Pterygia were found in 17 of 191 welders but in only one of 214 control workers ( $p<0.001$ ) (Table 1). Pterygia in welders (Fig. 1) were observed in both eyes in 2 workers and in one eye in 15 workers, and all were at the nasal part of the cornea. Table 2 shows that the incidence of pterygia increased with the employment length of a welder. A closer relationship between the incidence of pterygia and the employment length was observed ( $r=0.975$ ,  $p<0.05$ ) than that between the incidence and the total working history of the welder ( $r=0.880$ ,  $p<0.10$ ). (The history was calculated from the employment length and the average working hours of welding a day.)

Welding methods used in the 3 factories studied were: shielded metal arc welding (SMAW), sub-

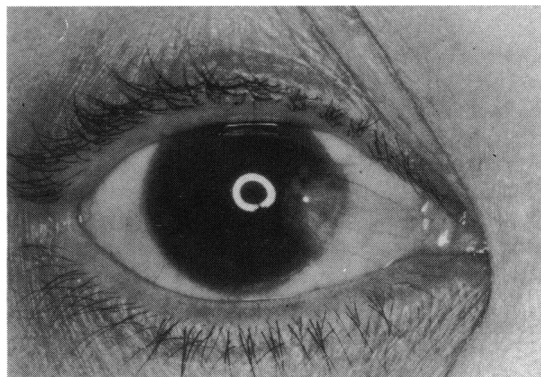


Fig. 1 Pterygium in a welder's right eye. A 39-year-old male engaged in arch welding for 20 years. He complained of having pterygium in his left eye for 10 years and in his right eye for 2 years. The pterygium in his left eye was operated on 6 years ago and reoperated on 2 years ago.

Table 1 Pterygium incidence according to age distribution

Age	No of control workers	Pterygium incidence (%)	No of welders	Pterygium incidence (%)
0-19	1	0 (0.0)	1	0 (0.0)
20-29	22	0 (0.0)	16	0 (0.0)
30-39	49	0 (0.0)	53	5 (9.4)
40-49	100	1 (1.0)	87	8 (9.2)
50-59	40	0 (0.0)	31	4 (12.9)
60+	2	0 (0.0)	3	0 (0.0)
Total	214	1 (0.5)	191	17 (8.9)

Table 2 Pterygium incidence and age distribution of welders and controls

Length of employment as a welder (years)	Age distribution (years) (mean±SD)	Incidence of pterygium (%)
Controls	19-73 (42.3±8.7)	1/214 (0.5)
1-9	17-58 (39.5±11.4)	2/39 (5.1)
10-19	27-59 (40.2±7.1)	8/86 (9.3)
20	36-65 (45.6±6.8)	7/66 (10.6)

merged arc welding (SAW), metal inert gas arc welding (MIG), metal active gas shielded arc welding (MAG), and tungsten-inert-gas arc welding (TIG). The intensity of UV radiation was in the following order: MIG>SMAW>TIG>MAG.<sup>4</sup> SAW hardly generates UV radiation. In these factories MAG, SAW, and SMAW were mostly used, and MIG and TIG were rarely used. The welders did not use the same welding method for long periods and sometimes changed methods frequently. Therefore the effects of differences in methods were not considered. On the other hand more than 99.9% of UV radiation was eliminated by the use of an eye protector for welding, and the transmitted UV radiation through the eye protector could be disregarded. Workers with eye protectors who engaged in welding without taking proper care suffered from electric ophthalmia and workers without eye protectors working around welding points though not welding sometimes suffered from electric ophthalmia.<sup>4</sup> The intensity of UV radiation by welding did not correlate with the exposure dose of UV radiation on the eyes of welders. This study would rather suggest that employment duration as a welder correlated well with exposure dose.

## Discussion

Pterygium is a degeneration of fibrous connective tissue, but the pathogenesis has not been clarified completely yet. Various causes have been considered such as neoplasm,<sup>5</sup> inflammation following corneal ulcer,<sup>6</sup> episcleritis<sup>7</sup> or conjunctivitis,<sup>8</sup> allergy,<sup>9</sup>

hyperplasia by irritation due to dust and dryness,<sup>10</sup> or metabolic disorders.<sup>11</sup> Recently the sunlight theory has attracted attention, and more recently association with the UV radiation in sunlight has been considered as the most significant environmental causative factor. Support for this hypothesis comes from: (1) pterygia are relatively common among fishermen,<sup>12</sup> Eskimos<sup>13</sup> and Canadian Cree Indians;<sup>14</sup> (2) the prevalence of pterygium increases nearer the equator, where sunlight UV intensity is stronger;<sup>3</sup> and (3) an experiment with mice showed that large doses of UV radiation produce epithelial hyperplasia, degeneration of Bowman's membrane, and vascularisation of the corneal stroma.<sup>15</sup> Therefore the UV theory supported by Darrell and Bachrach<sup>3</sup> has been thought to be the most plausible, although no direct experimental evidence of pterygia in animals exposed to UV radiation has yet been reported. This study shows a significant relationship between UV radiation exposure and pterygium incidence in welders who have been exposed occupationally to UV radiation, and this epidemiological study should help to clarify the pathology of pterygia.

The relation between pingueculae and pterygia has been discussed frequently. Fuchs<sup>10</sup> stated that a pinguecula grows into a pterygium by invading the limbus and cornea. Mori<sup>16</sup> reported the histochemically similar composition of pingueculae and pterygia supporting Fuchs's theory.<sup>10</sup> However, Hübner<sup>17</sup> claimed that a pinguecula is not necessary for a pterygium, and Talbot<sup>18</sup> supported him. This study shows that there is no difference in the occurrence of pingueculae between the welders and the controls. Therefore our results seem to support Hübner's theory.<sup>17</sup>

Three welders with pterygia reported that it had appeared after the occurrence of a cornea foreign body, while one welder clearly denied any relationship between his pterygium and the foreign body. Corneal opacity due to cornea foreign body was observed in 47% of the eyes (179/381) of welders upon slit lamp examination. The ratio was very small in the controls among the chemical factory workers but 42/75 (56%) in the eyes of the controls among the machinery factory workers handling grinders. Thus the influence of irritation by a foreign body cannot be ignored and might be compared to a tumour promotor, though not an initiator.

The mechanism by which UV radiation might provoke an abnormal tissue response in the form of a pterygium is not clear. UV radiation has the beneficial effect in man of enabling vitamin D production by the skin. On the other hand the detrimental effects include inhibition of the synthesis of DNA, RNA, and proteins, inhibition of cellular division, and changes in cellular permeability and motility.<sup>19</sup> These

bioactive effects might provoke diseases such as skin carcinoma, xerodermia, cataract, nodular band-shaped keratopathy, and also pterygium.

The significant relationship between UV radiation exposure and pterygium incidence found in this study should contribute to the clarification of pterygium pathology.

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