Melanoma and Trauma
*A CLINICAL STUDY OF ZULU FEET UNDER CONDITIONS OF PERSISTENT AND GROSS TRAUMA

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SUMMARY

Our aim was to determine whether trauma plays any part in the aetiology of malignant melanoma in the deeply pigmented skin of Zulus. One hundred and fifty 'Ricksha boys' of Durban, whose bare feet are habitually exposed to the grossest degree of trauma, were investigated. No evidence of 'traumatic melanoma' was found.


Whether trauma plays any significant part in the aetiology of malignant melanomata has been controversial for many years and is still unsolved. Basset and Camain1 reported 73 cases of malignant melanomata on the feet of West African Negroes, 68 of which were situated on the heels. They concluded that trauma was the only aetiological factor that could explain the appearance of malignant melanomata in people with a primitive way of life and who habitually went barefoot. However, Kopf and Andrade2 stressed that in the American Negro who does not go barefooted, the same predilection for the sole as the site of melanomata exists, and that a similar distribution has not been seen in Caucasians who go barefoot; but Levene3 quoted 42 cases (racial characteristics not recorded), of malignant melanomata of the feet of which 28 were situated on the sole and 14 on the dorsal surfaces. Nearly all those on the sole occurred on the arch region and therefore not on weight-bearing areas. In a large series of pigmented naevi Allyn et al.4 also found a similar distribution away from pressure areas.

In a cancer survey of Natal Schönland and Bradshaw,5 covering the 3 years 1964 - 1966, recorded a total of 1 040 cases of all malignancies in approximately 2 500 000 Bantu. Only 7 (0.67%) consisting of 4 males and 3 females, had melanomata. Unfortunately, the sites of these melanomata were not listed.

In the Department of Dermatology at King Edward VIII Hospital, Durban, pigmented lesions and malignant melanomata on the feet of Zulus are rare. As Basset and Camain6 stated that all their cases had died regardless of therapy, we consulted the records of the City Health authority and found that only 2 cases of death from malignant melanoma of the skin in Bantu had been reported within the municipal boundary of Durban during 1960 - 1970, and as far as could be ascertained, these lesions had not been on the feet.

MATERIAL AND METHODS

A group of Zulu 'Ricksha boys' of Durban, habitually barefooted and subject to the most severe degrees of foot trauma, was examined.

The ricksha was invented in Yokohama in 1869 by a Baptist Minister, the word being an abbreviation of 'Jin-riki-sha' ('Jin' = man, 'riki' = power, and 'sha' = vehicle). This two-wheeled, hooded, man-powered form of transport was introduced to Durban in 1892 and has survived to this day. Rickshas are used for 3 purposes, pleasure riding, for conveyance of freight, and as taxis. The rickshas and their pullers are traditional and colourful (Figs. 1 and 2) but unhappily are a dying race, gradually being ousted by motorized transport. Their numbers have diminished and there are now only a handful more.

Fig. 1. Beachfront ricksha boy for pleasure rides.
than the 150 we were able to examine. The pullers generally commence work at about the age of 19 years and continue in their profession for the remainder of their active lives. The oldest 'Ricksha boy' started work at the age of 10 years, has pulled for 63 years and is still in full-time employment.

They run barefooted, pulling varying weights of passengers, luggage and freight for approximately 8 hours per day on road surfaces composed of gravel or dirt, but mainly tar. The terrain is extremely hilly and our survey was carried out in the metropolitan area of Durban, approximately 541 square miles in area, latitude 30° South, on the coast of the Province of Natal, which has a subtropical climate with hot, wet summers and cool, dry winters.

Observation of the mechanics of ricksha pulling showed that the feet are used for starting from rest, 'cruising', braking and stopping. The main sites and degrees of trauma are detailed in Table I.

To compare the Zulu puller with his Japanese counterpart would have been interesting, but unfortunately there have been no rickshas in Japan for many years, and as far as can be ascertained no research was ever carried out on the pullers' feet.

**TABLE I. MECHANICS OF RICKSHA PULLING**

<table>
<thead>
<tr>
<th></th>
<th>Toes and nails</th>
<th>Soles</th>
<th>Heels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting from rest</td>
<td>+++</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Running 'cruising'</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Uphill</td>
<td>+++</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Downhill</td>
<td>-</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Braking and stopping</td>
<td>-</td>
<td>+</td>
<td>+++</td>
</tr>
</tbody>
</table>

**Grouping**

Group I, consisting of 150 ricksha pullers subject to gross trauma of the feet, was compared with group II, a control group of 150 Bantu in miscellaneous occupations of a non-traumatic nature, who invariably wear ordinary shoes and are subject only to 'normal' trauma. The groups were matched for age (Fig. 3) and their length of employment was noted (Fig. 4). It was decided to examine not only for melanomata and pigmented naevi, but also to survey the feet generally for other dermatoses, infections, abnormalities and nail changes, particular attention being paid to malignant melanomata, pigmented lesions, callosities and hyperkeratosis, nail dystrophies, and tinea pedis.

![Fig. 2. Taxi-boy.](image)

![Fig. 3. Age incidence in groups I and II.](image)

![Fig. 4. Years of employment of ricksha pullers (group I).](image)
RESULTS

The only visible pigmentation changes were those of the normal mottling seen on the feet of Bantu, close examination revealing no cases of pigmented naevi nor of melanomata in either group of subjects, thus confirming our clinical impression that these lesions are rare in the Zulu, whether or not exposed to trauma.

Many of the other findings were anticipated, particularly hyperkeratosis in Group I, the ubiquitous ‘African’ callosities in both groups, and the tinea and bunions in Group II. The miscellaneous conditions (Table II), are of no real relevance, but the most interesting abnormality of statistical significance, and not previously described, is the curious koilonychia seen in 24 of the 150 ricksha pullers, (16%). This phenomenon forms the subject of a separate article.2

### TABLE II. ANALYSIS OF FOOT ABNORMALITIES

<table>
<thead>
<tr>
<th>Condition</th>
<th>Group I (gross trauma)</th>
<th>Group II (minimal trauma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callosities</td>
<td>39</td>
<td>53</td>
</tr>
<tr>
<td>Hyperkeratosis</td>
<td>69</td>
<td>37</td>
</tr>
<tr>
<td>Tinea (clinical diagnosis only)</td>
<td>11</td>
<td>48</td>
</tr>
<tr>
<td>Nail dystrophies</td>
<td>25 (24 koilonychia)</td>
<td>7</td>
</tr>
<tr>
<td>Paronychia</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Plantar warts</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Abscess</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Bunions</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Hammer toes</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Clubbed toes</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Multiple toes</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(6 on each foot)</td>
<td></td>
</tr>
</tbody>
</table>

Statistical Analysis of Foot Abnormalities

Analysis using the chi-square ($X^2$) test was carried out. By convention, differences are considered to be statistically significant and unlikely to have arisen by chance if the probability of their occurrence is less than 0.05 (i.e. 5% or 1 : 20).

The foot abnormalities which show significant differences between the Ricksha boys and the miscellaneous group are detailed in Table III, in each case the probability of the difference occurring by chance being $P < 0.001$.

### TABLE III. STATISTICAL ANALYSIS OF FOOT ABNORMALITIES

<table>
<thead>
<tr>
<th>Condition</th>
<th>$X^2$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinea</td>
<td>28.9</td>
</tr>
<tr>
<td>Hyperkeratosis</td>
<td>14.9</td>
</tr>
<tr>
<td>Nail dystrophies</td>
<td>11.3</td>
</tr>
<tr>
<td>Koilonychia</td>
<td>26.1</td>
</tr>
</tbody>
</table>

Callosities are so common in the Zulu that no conclusions can be drawn from our findings.

We examined the records of King Edward VIII Hospital for 1965 - 1969, the Bantu at risk numbering approximately 250 000. The total number of outpatients seen in the dermatological and surgical departments was 183 640, from which 66 cases of malignant melanomata (0.36%) were recorded. Of these, 38 occurred on the feet (0.21%). A search of the records for the actual sites of these lesions showed that 11 were situated on pressure areas, 14 on non-pressure areas, and in 13 the sites were not stated.

The frequency of malignant melanoma on the feet of our hospital patients in a 5 year survey was 38 in 183 640, a mean of 1 : 4 833. If the mean and the standard deviation are taken to be the same (Poisson distribution), the smallest population in which a negative result would be significant would be about 15 000. Our 150 Bantu seemed to be a very small number until we realized that each one probably covers 100 times the daily distance covered by a normal subject.

DISCUSSION

Statistics for malignant melanomata, even when the diagnosis has been ‘confirmed’ histologically, may be suspect. Truax et al.3 reassessed 308 cases of ‘melanoma’ submitted to the Connecticut Tumor Registry during 1935 - 1957. Of 247 patients who had either survived 5 years and were still living, or had since died without evidence of melanoma, it was considered that 62 (25.1%) had never had melanoma, and had been misdiagnosed epitheliomas, carcinomas, haemangiomas, seborrhoeic keratoses and even warts. It would be naive to suppose that errors of this magnitude occur only in Connecticut.

Another source of confusion that may affect statistics when dealing with Negro races is the normal mottled pigmentation seen on the palms and soles, misdiagnosed as pigmented naevi by the unwary.2

Zulus have a genetic background differing from that of other African races and from the American Negro, and accurate comparisons cannot be made. However, American Negroes cannot be accepted as a genetic group as there is abundant evidence that the admixture of Caucasoid genes is high.9 Biberstein9 makes the point that the American Negro does not possess the relative ‘immunity’ ascribed to the African Negro, and a similar difference may exist between other racial groups. However, Hewer10 suggested that trauma of the bare foot by thorn-pricks and sharp stones might account for the predilection of the sole of the foot for melanoma in Sudanese Negroes and related the differences in incidence in American and African Negroes to the wearing of shoes in the former group. Shapiro et al.11 stated that the incidence of malignant melanoma in Africans and Caucasians is very similar, while Davies11 concluded that urbanization and shoe wearing among South African Bantu in Johannesburg had not decreased the incidence of these malignancies.
Ekblad considered that there was neither statistical nor histological proof that naevi exposed to chronic irritation or trauma became malignant more readily than others, and Belisario stated that the constant trauma of walking may not by itself be a prime factor of importance in carcinogenesis. Pack and Davis concluded that the histological character of a mole was of infinitely greater importance in determining possible conversion to a malignant tumour than an accident or injury. Rook states that in the dark-skinned races of Africa and India recurrent trauma may be the reason for the high proportion of tumours on the foot and lower leg, but that it is difficult to assess the importance of an episode of trauma in producing a tumour or initiating malignant change in a melanocytic naevus. Lewis and co-workers in their comprehensive survey of Ugandan Africans note that malignant melanoma is closely related to the particularly high incidence of pigmented areas on the sole, and that it is likely that most melanomas arise in such areas. They attribute this to collections of potentially unstable melanocytes, determined genetically, and conclude that physical and chemical trauma in the shape of contact with hot nails and charcoal fumes may have an effect on unstable pigmented areas, particularly if early junctional activity is present. However, Scoville et al. draw attention to the enormously protective thickness of the sole of the Negro foot and its remarkable resistance to trauma.

The controversy continues, but it will undoubtedly transpire that trauma as a major aetiological factor in the production of malignant melanoma is an oversimplification. The work of Lewis demonstrating tumour-specific antibodies in human malignant melanoma, and the investigations by Ikonopisov et al. on auto-immunization with irradiated tumour cells are pointers to the real complexity of the problem.

CONCLUSIONS

In our study of the feet of South African Zulus we found no evidence to suggest that long and repeated trauma of the grossest nature had played any part in the production of malignant melanomata. Our entirely negative results lend support to other authors who were not impressed with the rôle of this factor. Although we were able to examine almost all the Durban ricksha pullers, our total of 150 is admittedly small. However, it was felt that the study would be worth while, particularly as contact with potentially carcinogenic tarred roads added yet another hazard.

We wish to thank Dr H. Wannenburg, Senior Medical Superintendent of King Edward VIII Hospital, Durban, for allowing us to examine hospital case notes and for permission to publish; Dr C. R. MacKenzie, MOH, Durban, for details from his records; Professor H. Linhart for the statistical analysis; and Mr V. Hickman, the proprietor of the Natal Ricksha Company, who granted us full facilities for examining his employees.

REFERENCES