

AN EPIDEMIOLOGICAL APPRAISAL OF FRACTURES OF THE LEG BONES IN THE MAJOR RACES OF SINGAPORE

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INTRODUCTION

The age and sex distribution of tibial fibular fractures in a confined community was first determined by Buhr and Cooke, 1959. Their study was on the Oxford Community in England.

In a more recent survey by the Medical Research Council of England (data unpublished) the age specific rates of tibial shaft, proximal tibial and fibular and malleolar fractures per 10,000 of both sexes of Dundee and Oxford communities have been made available (See Table V).

In the current analysis, similar determinations have been made on the major racial groups of Singapore. This has been possible for the first time. The investigation is of a preliminary nature and it will be extended when further data become available.

MATERIAL AND METHODS

The Population at Risk

Singapore is the largest city in Malaysia. Its population is predominantly Asian, and totals 1.8 million people, of which 75% are Chinese, 14% Malays, 9% Indians and Ceylonese, and 2% Eurasians and Europeans. The population by race, sex and age is shown in Table I.

Since the General Hospital treats all fractures, and the age and sex distribution of all the Races in the Singapore Community is accurately known, ideal conditions are present not only for epidemiologic studies of leg fractures but also for all fractures.

Fracture Material

This consisted of all patients of the three Races among whom fractures of the leg were diagnosed in the whole of the State of Singapore during the two years 1962-1963. Only fresh fractures were considered and they total 846 for the period under study.

Classification of Fracture Types

I. Shaft Fractures: (591 cases)

They include

- (i) isolated fractures of shafts of either tibia or fibula
- (ii) fractures involving the shafts of tibia and fibula simultaneously.

II. Proximal Fractures: (76 cases)

These include

- (i) fractures of the medial or the lateral condyle (or both) of the tibia

TABLE I

PROJECTED POPULATION OF SINGAPORE 1962

Age groups in thousands		0-19	20-39	40-59	60 and above
CHINESE	Males	366.5	163.8	100.6	25.9
	Females	341.4	162.5	97.1	33.1
INDIANS	Males	33.0	32.5	26.6	3.3
	Females	31.3	12.8	4.3	0.7
MALAYS	Males	67.7	36.6	16.6	3.1
	Females	66.7	32.7	12.0	2.7

- (ii) fractures of the head and neck of the fibula.

III. Distal Fractures: (179 cases)

They include

- (i) fractures of the medial malleolus
- (ii) fractures of the lateral malleolus
- (iii) fractures of both malleoli.

Degree of Trauma

Two degrees were recognized, a direct high energy trauma and an indirect low energy trauma. (Bauer, Edwards and Widmark, 1962).

Trauma which resulted from motor vehicle and motor cycle accidents, falls from heights more than 3 metres, and blows from heavy objects were considered to be of the direct high energy category. Indirect low energy trauma were those arising from falls either at ground level or from low heights *i.e.* less than 3 metres. *E.g.* off a chair, table or out of bed; football; and accidents in which a bicycle was involved.

Hospital records permitted the evaluation of the degree of trauma in 92% of the female and 83% of all the male shaft fractures.

Incidence of Displacement

Shaft fractures were classed as being displaced and undisplaced or minimally so. A fracture is considered displaced if there is one third of a diameter or greater shift of one fragment in relation to the other, or if there is angulation or shortening.

In the present analysis, displacement could be accurately determined in 70% of all the male shaft fractures and in 92% of all the female ones.

Definition and Statistics

1. Age Specific rates. These were calculated from the population figures as the annual incidence of fractures per 100,000 males or females in each age group.
2. Age Specific sex ratio. It is the ratio of age and sex incidences (Alfram, 1964). Because there are more males than females in each of the three races this has been considered a more valid measure of the sex distribution of these fractures than the ordinary sex ratio.
3. Patients less than 20 years were called boys or girls, those from 20 through 39 years were referred to as young adults; middle age were those from 40 through 59 years, and aged were those from 60 years onwards.

RESULTS and INFERENCES

Fractures of the Shafts of the Tibia and Fibula (Table II)

There are 591 shaft fractures, 411 are in Chinese of which 70 are females, and of the 101 fractures in Indians 17 occur in females, and in the Malays 66 are males and only 13 are females.

These are by far the commonest of the leg bone fractures, and they make up approximately 70% of the series.

Sex Ratios

The male to female ratios are; Chinese 4.1:1, Indians 5:1 and Malays 5:1. The corresponding age specific sex ratios are 3.9:1, 1.4:1, 5.3:1.

Age Specific Incidences

MALES (Fig. 1): In Chinese it rises from boys (minimal) through young adults, declines a little in middle age to attain its maximum in the aged. In Indians and Malays they are lowest in young adults whence they rise through middle age and are again highest in the elderly. Incidences are highest in Indians at all age levels except in the very old in which group the highest incidence is in the elderly Chinese. In Malay boys and those of middle age they are greater than those of the Chinese at the same age levels, this is reversed in young adults and the elderly.

FEMALES (Fig. 1): Incidences in all the females rise from young adults (minimal) through middle age to their maximal in old age. They were highest in the Indians in all the 20 year age groups.

Excluding the elderly Indian females, incidences in all the males exceed those of their females in all the corresponding ages.

Relationship to Trauma (Table II)

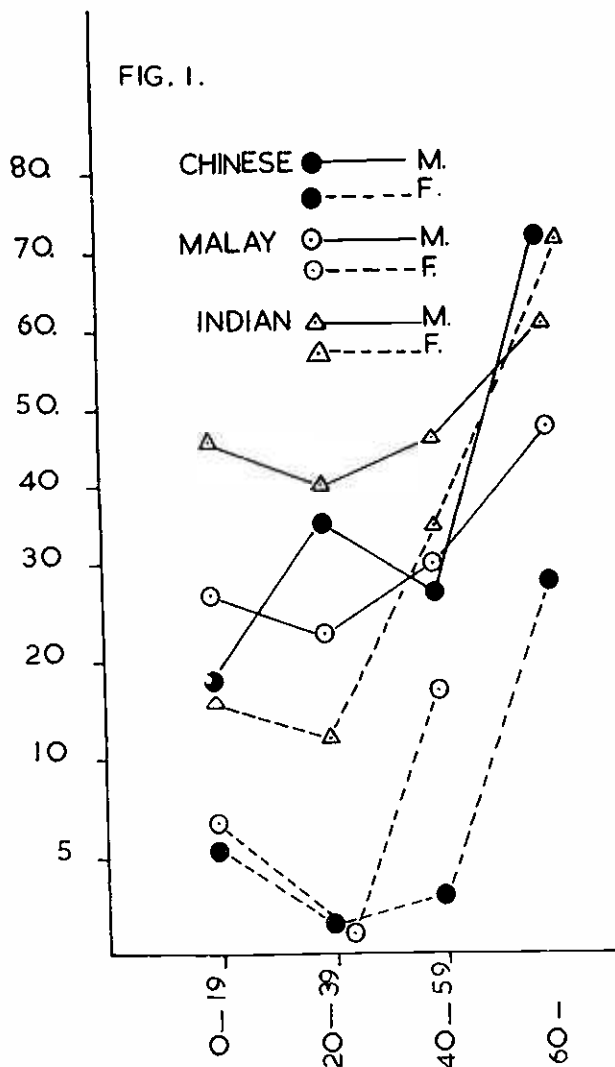
The overall percentages of fractures arising from severe trauma in the Males are: Chinese 84%, Malays 70% and Indians 62%. The corresponding percentages in the females are 67%, 60% and 53%.

These percentages can be interpreted to mean that in all the males and the Chinese females, severe trauma fractures contribute principally to the incidences of tibial fibular shaft fractures among them. The exceptions are in Indian children, young adult females and old men among whom incidences are determined mainly by fractures of the low energy category.

TABLE II
SHAFT FRACTURES

AGE GROUPS IN YEARS		0-19	20-39	40-59	60 and above	
NO. of CASES	CHINESE	MALES	133	115	56	37
		FEMALES	40	5	6	19
	INDIANS	MALES	30	26	24	4
		FEMALES	10	3	3	1
AGE SPECIFIC	MALAYS	MALES	36	17	10	3
		FEMALES	8	1	4	0
RATES of FRACTURES	CHINESE	MALES	5.5	1.2	2.5	7.7
		FEMALES	3.8	0.9	2.0	21.1
due to MODERATE	INDIANS	MALES	30.3	6.0	9.4	46.5
		FEMALES	6.4	4.0	37.5	71.4
TRAUMA PER 100,000	MALAYS	MALES	9.6	4.1	9.0	16.1
		FEMALES	4.4	0.0	12.3	0.0
RATIO of SEVERE to MODERATE	CHINESE	MALES	2.3	30.0	8.4	7.7
		FEMALES	2.0	1.5	2.0	2.8
TRAUMA	INDIANS	MALES	0.5	6.3	3.8	0.3
		FEMALES	0.7	0.5	3/0	1/0
	MALAYS	MALES	1.7	4.7	2.3	2.0
		FEMALES	3.0	0/1	3.0	0
RATIO of DISPLACED to NON- DISPLACED FRACTURES	CHINESE	MALES	0.3	1.2	1.9	2.1
		FEMALES	0.3	1.5	2.0	2.8
	INDIANS	MALES	0.2	0.6	1.9	3.0
		FEMALES	0.1	2.0	2.0	1/0
	MALAYS	MALES	0.5	1.1	1.8	2.0
		FEMALES	0.6	0.0	3.0	0

In the males severe trauma fractures decline from young adults, very steeply in the Chinese, through middle age to their lowest in the elderly. Quite unexpectedly, in Chinese women severe trauma fractures are observed to rise with increasing age. The same trend may be followed by the Indian and Malay females, but because so few fractures have been diagnosed among them, this cannot be stated with any degree of certainty.



Displacement (Table II)

In all the males of the three races the proportion of displaced fractures rises with age. This also occurs in Chinese women and possibly in Indian and Malay women as well, and for reasons already stated, this again, may be questionable.

Correlation Between Shaft Fragility and Fractures Due to Low Energy Trauma

In all the adult males the incidences of fractures due to moderate trauma rise with age

and are highest in the Indians at all the adult age levels (Table II). They are followed by the Chinese then the Malays. The inference, therefore, is that fragility of the shafts of the tibia and fibula increases with age in the males of the three races and that the order of fragility among them is Indian, Malay and Chinese.

The rising incidence of low energy trauma fractures with age in the Chinese and Indian females, and perhaps in Malay females, also establishes beyond doubt an increasingly weak tibial fibular shaft among them.

Malleolar Fractures (Table III)

There are 179 malleolar fractures, 88 are diagnosed in Chinese males and 31 in Chinese females. In the Indian population 39 such fractures are diagnosed of which 35 are in the males and only 4 in the females; 18 of the fractures occur in Malay males and 3 in the females.

No fractures are recorded in Malay or Indian girls or elderly male Malays.

The male to female ratios in Chinese, Indians and Malays are respectively 2.8:1, 9:1 and 6:1. The age specific sex ratios in Chinese and Malays are 1.8:1 and 1.3:1 both in favour of the males but in the Indians it is 1.1:1 slightly favouring the females.

In all the females and Indian males incidences increase with age. In Chinese males maximal incidences are in young adults and middle age, some decline occurs at old age. Maximal incidence in Malay males is in young adults, in middle age it decreases a little.

Highest incidences in females are in the Indians (Indian girls excluded). In males highest incidences are also observed in the Indians.

Similarity of incidences occur in boys and those of middle age in the Chinese and Malays.

Incidences in men exceed those of the women in young adults and middle age, but incidences in the elderly women of all three races exceed those of their males.

Proximal Fractures (Table IV)

These are the least common of all the leg bone fractures. Both males and females total only 76 or 9% of the tibial fibular fractures. The very few fractures which are recorded in Malay and Indian females are not analyzed.

No fractures are diagnosed in Malay and Indian boys. Incidences in the males tend to rise

TABLE III
MALLEOLAR FRACTURES

AGE GROUPS IN YEARS			0-19	20-39	40-59	60 and above
NUMBER	CHINESE	MALES	16	41	26	5
		FEMALES	4	8	10	9
of	INDIANS	MALES	7	13	13	2
		FEMALES	0	2	1	1
CASES	MALAYS	MALES	3	11	4	0
		FEMALES	0	1	1	1
AGE	CHINESE	MALES	2.2	12.5	13.0	9.8
		FEMALES	0.6	2.6	5.1	1 3.5
SPECIFIC	INDIANS	MALES	10.6	20.0	24.4	30.3
		FEMALES	0.0	7.8	11.6	71.4
RATES PER	MALAYS	MALES	2.2	15.0	12.0	0.0
		FEMALES	0.0	1.5	4.2	18.5
100,000						

with age. Excluding boys, highest incidences are observed in Indians at all other age levels.

In Chinese females there is also a tendency for incidences to increase with age but they are below those of the males wherever comparison can be made.

SUMMARY AND CONCLUSION

An epidemiological survey of 846 tibial fibular fractures, diagnosed in the two year period 1962-63 in a mixed Asian Community of 1.8 million persons, consisting predominantly of Chinese with smaller proportions of Indians and Malays, was made.

The Principal Findings are

1. The commonest fractures are shaft fractures, 69.8%, next are malleolar fractures 21.2%, and the least common are proximal fractures only 9%.
2. Tibial Fibular Shaft Fractures.
 - a) Excluding the elderly Chinese males in both sexes in all three races, incidences

are highest in all the other 20 year age groups in the Indian population.

- b) Excluding elderly Indian females, male incidences exceed those of the females at all ages.
- c) In both sexes in all three races, there is progressive weakening of the tibial fibular shafts with aging. In males the process is most marked in the Indians, followed by the Malays then the Chinese. The order is probably the same in the females.

3. Malleolar Fractures

- a) In the females of all the three races and also Indian Males, incidences increase with aging.
- b) Where comparisons can be made, highest incidences occur in the Indian population.
- c) Incidences in the males of all three races exceed those of their females in all age groups except in the elderly.

TABLE IV
PROXIMAL FRACTURES

AGE GROUPS IN YEARS			0-19	20-39	40-59	60 and above
NUMBER of CASES AGE SPECIFIC RATES PER 100,000	CHINESE	MALES	5	17	13	4
		FEMALES	0	2	3	2
	INDIANS	MALES	0	5	12	3
		FEMALES	4	0	0	0
	MALAYS	MALES	0	2	1	1
		FEMALES	1	0	1	0
	CHINESE	MALES	0.7	5.4	6.5	7.7
		FEMALES	0.0	0.6	1.5	3.0
	INDIANS	MALES	0.0	7.5	22.5	45.5
		FEMALES	NOT DETERMINED			
	MALAYS	MALES	0.0	2.8	3.0	16.1
		FEMALES	NOT DETERMINED			

TABLE V
OXFORD AND DUNDEE
AGE SPECIFIC RATES PER 10,000

AGE GROUPS IN YEARS		35-54	55-74	75+
TIBIAL SHAFTS	MALES	1	2	3
	FEMALES	1	3	3
PROXIMAL TIBIA and FIBULA	MALES	1	2	0
	FEMALES	1	3	0
TIBIAL MALLEOLUS	MALES	3	1	3
	FEMALES	4	5	3
FIBULAR MALLEOLUS	MALES	6	7	6
	FEMALES	6	11	10

4. *Proximal Fractures*

- a) In the males of all the races, and Chinese females incidences increase with age.
- b) Excluding boys, highest incidences occur in the Indian males.
- c) Incidences in Chinese males exceed those of their females.

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