

An analysis of fractures of the facial skeleton in three populations in the Johannesburg urban area

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SUMMARY

Facial bone fractures account for a sizeable proportion of the cases treated by maxillo-facial and oral surgery units in South Africa. In this study, clinical records of all facial bone fractures among black, coloured, Asian, and white patients treated in the Department of Maxillo-Facial and Oral Surgery in the Johannesburg group of teaching hospitals over a six-month period, were recorded and analysed. The results showed that the mean age of black patients sustaining facial trauma was higher than that of the other two groups studied, and in all groups, males were more commonly the victims of violence that resulted in facial bone fractures than females. In all categories of facial fractures, intentional violence was the commonest aetiological factor, except in middle third facial fractures in the white group which were generally the result of motor accidents. In all groups, the mandible was the facial bone most commonly fractured, while fractures of the middle third of the facial skeleton, and combined fractures of the mandible and middle third were less common.

OPSOMMING

Frakture van die bene van die gesig is verantwoordelik vir 'n noemenswaardige proporsie van alle gevalle wat by kaak-, gesigs- en mondchirurgiese eenhede in Suid-Afrika behandel word. Vir die doeleindes van hierdie ondersoek is die kliniese verslae van alle pasiënte, insluitende persone wat behoort tot Swart-, Kleurling, Asiër- en Wit bevolkingsgroepe wat oor 'n tydperk van ses maande by 'n groep Johannesburgse Opleidingshospitale vir frakture van die gesigsbene behandel is, ontleed. Die resultate toon dat die gemiddelde ouderdom van Swart pasiënte met gesigsbeserings hoër was as in die ander groepe. Verder, in alle groepe, was manlike persone meer dikwels die slagoffers van geweld wat tot frakture van die gesigsbene aanleiding gegee het. Aanranding was in alle gevalle die mees algemene oorsaak van frakture behalwe in die geval van middelderde-gesigsfrakture in Wit pasiënte waarin motorongelukke die vernaamste faktor was. In alle groepe was mandibulêre frakture die algemeenste, gevolg deur middelderde-gesigsfrakture en laastens 'n kombinasie van beide.

INTRODUCTION

As a result of the prominent and exposed position occupied by the head, and because of its vulnerability in the eyes of assailants, the facial skeleton is commonly the target of both intentional and unintentional violence.

The earliest evidence of facial fractures receiving the attention of man was documented in the Egyptian papyrus discovered by Edwin Smith, dating from about 1600 BC (Rowe and Killey 1968). The author, apparently an Egyptian military surgeon, described the clinical features and principles of treatment for facial-bone fractures, many of which are adhered to today.

There is no universal agreement on classification of fractures of the facial bones. Several classifications of fractures of the facial bones have been suggested (Le Fort 1901, Rowe and Killey 1968, Killey 1971). For maxillary fractures the most widely accepted classification is that of Le Fort (1901) who described three common levels of fractures of the midface following experi-

mental trauma to cadavers (Fig 1). In the mandible fractures are most commonly classified according to their anatomical position (Fig 2). These types of maxillo-facial injuries are increasing and are common in both peace and war. The incidence of facial fractures overseas is well documented (Krömer 1954, Schuchardt *et al* 1960, Rowe and Killey 1968, Killey 1971, Afzelius and Rosen 1980), but information regarding the situation in South Africa is less detailed (Snijman, 1963; Rosenberg and Smith, 1976; Muller and Schoeman, 1977; Duvenhage, 1979).

In an analysis of 1 699 patients with facial skeleton fractures treated at the University of Pretoria (Snijman 1963), it was shown that 83 per cent occurred in the black population group compared with only 17 per cent in whites. The frequency of site of fracture in descending order was fractures of mandible, followed by isolated zygomatic complex fractures, midfacial fractures of the Le Fort type and finally combined mid-third and mandibular fractures.

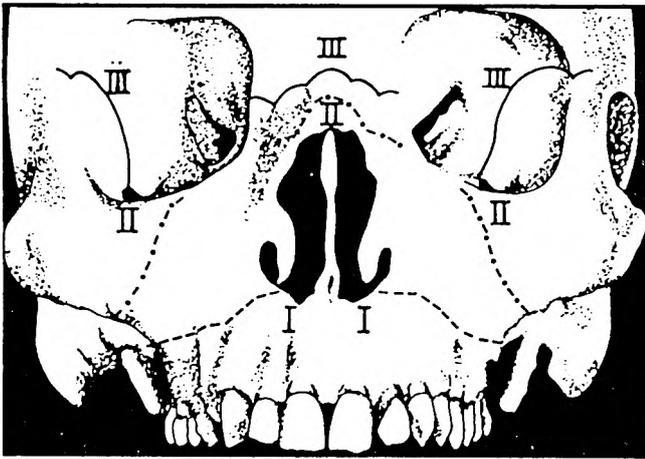


Figure 1: Classification of fractures of the middle third of the facial skeleton.

- I = Le Fort I type fracture
- II = Le Fort II type fracture
- III = Le Fort III type fracture

In the mandible the body was affected more in blacks, and the condylar neck more in whites. A comparison of the aetiology of the fractures between the two ethnic groups showed that intentional violence accounted for 82 per cent of fractures in blacks and 43 per cent in whites. Motor vehicle accidents accounted for 34 per cent in whites and 11 per cent in blacks while injuries related to sports and gunshot wounds comprised 8 per cent of instances in the white group only; in children and elderly patients the majority of injuries were the result of falls. In both population groups most cases were in the third decade.

In a series of 1 233 patients from the Pretoria area, with fractures of the zygomatico-maxillary complex, including middle third Le Fort fractures, it was shown that the prevalence of middle third fractures was higher in whites than in blacks (Muller and Schoeman, 1977). Motor vehicle accidents were the commonest cause in whites, while intentional violence was commonest in blacks.

In another study carried out at the University of Pretoria by Duvenhage (1979), in which the incidence of facial fractures over a 6-yr period in black and white populations was compared, it was found that the annual incidence was similar over the 6-yr period with the majority of cases (86 per cent) occurring in the black group. It was further shown that intentional violence was the cause of the injuries in 85 per cent of the blacks and 38 per cent of whites, while motor vehicle accidents accounted for 11 per cent and 35 per cent of injuries, respectively. None of these investigations have dealt with populations living on the Witwatersrand. The objectives of the present study therefore, were to perform a retrospective survey of all fractures of the facial skeleton in the black, coloured, Asian and white population groups, treated in the Division of Maxillo-Facial and Oral Surgery, Johannesburg group of teaching hospitals over a 6-month period, and to compare and contrast age, sex, ethnic group, aetiology and nature of injuries in the groups.

MATERIALS AND METHODS

The case records of the Johannesburg group of teaching hospitals were examined for the period 1 July to 31

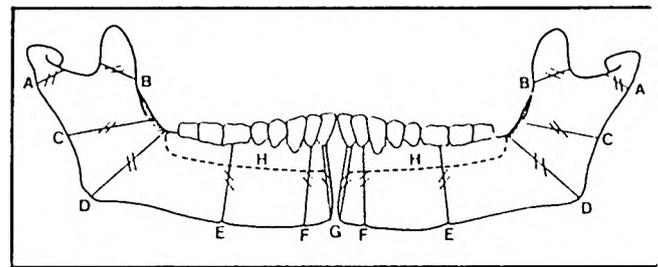


Figure 2: Classification of fractures of the mandible.

- A = Condylar
- B = Coronoid
- C = Ramus
- D = Angle
- E = Body
- F = Parasymphysis
- G = Symphyseal
- H = Dentoalveolar

December, 1979, a period which includes both winter and summer. The hospitals served an approximate population of 4 151 600 and had 5 490 beds available for all forms of medical treatment. The records of 389 cases of facial fracture were found, subdivided by ethnic group as follows black 287 (74 per cent), coloured and Asian 42 (11 per cent) and white 60 (15 per cent). Information obtained from the records was transferred to punch cards and analysed on an IBM 370/158 computer using the Statistical Package for the Social Sciences (Nie et al 1975).

RESULTS

General

The youngest patient was a coloured child of 5, and the oldest a black male aged 72. Mean ages in years (and standard deviations) were: blacks 32 (± 11), coloured and Asian 30 (± 10) and white 27 (± 10). In all three ethnic groups the peak prevalence of fractures was in the third and fourth decades.

In all groups, the majority of cases occurred in males (81-87 per cent). Fractures in females were most common in the coloured and Asian group (19 per cent) followed in descending order by the white group (15 per cent). Regarding seasonal prevalence, in all groups facial fractures were most common in October.

The frequency distribution of fractures by associated injuries and ethnic groups is shown in Table 1. In the black group 26 per cent of patients had other injuries associated with the facial bone fracture, compared with only 5 per cent in the coloured and Asian group and 14 per cent of the white cases. Cranial injuries (18 per cent)

Table 1: Frequency distribution of fractures by associated injuries and ethnic group

| Region | Black | | Coloured and Asian | | White | |
|---------------------|-------|----|--------------------|---|-------|----|
| | n | % | n | % | n | % |
| Cranial | 52 | 18 | — | — | 4 | 7 |
| Ophthalmic | 11 | 4 | — | — | — | — |
| Limbs | 6 | 2 | 2 | 5 | 4 | 7 |
| Thoracic/ Abdominal | 6 | 2 | — | — | — | — |
| Total | 75 | 26 | 2 | 5 | 8 | 14 |

were the commonest associated injury in black patients, while fractures of fore and hind limbs and head injuries were equally prevalent in the white group (7 per cent). Limb fractures were the only recorded associated injury in the coloured and Asian group (5 per cent).

In the three groups, the mandible was the most common site of fracture in the majority of cases, accounting for 75 per cent of black fractures, 88 per cent of coloured and Asian cases and 80 per cent of fractures in the White group (Table II). Middle third fractures were next in frequency in the black and the coloured and Asian groups, followed by combined fractures of the mandible and middle third of the facial skeleton. In the white group, combined fractures were marginally less common than those of the middle third alone. Fractures of the upper third of the facial skeleton (the supraorbital ridge) occurred only in the black and white groups.

Table II: Frequency distribution of facial fractures by region of fracture and ethnic group

| Nature | Black | | Coloured and Asian | | White | |
|------------|-------|-----|--------------------|-----|-------|-----|
| | n | % | n | % | n | % |
| Middle 1/3 | 46 | 16 | 5 | 10 | 7 | 12 |
| Mandible | 215 | 75 | 36 | 88 | 48 | 80 |
| Upper 1/3 | 3 | 1 | — | — | 1 | 2 |
| Combined | 23 | 8 | 1 | 2 | 4 | 6 |
| Total | 287 | 100 | 42 | 100 | 60 | 100 |

Middle third fractures (Le Fort type fractures)

The aetiology of middle third facial fractures was different for each population group (Table III). In both the black and the coloured and Asian groups, assaults accounted for the majority of cases (85 per cent and 66 per cent) with motor vehicle accidents (MVA) and other causes being less frequent. In the white group, however, motor accidents accounted for the majority of cases (46

Table III: Frequency distribution of middle third fractures by aetiology and ethnic group

| Aetiology | Black | | Coloured and Asian | | White | |
|-----------------------------------|-------|----|--------------------|----|-------|----|
| | n | % | n | % | n | % |
| M.V.A. | | | | | | |
| Vehicle Occupant | 1 | 2 | — | — | 2 | 15 |
| Pedestrian | 4 | 7 | 1 | 17 | — | — |
| Motorcyclist | — | — | — | — | 4 | 31 |
| Total M.V.A. | 5 | 9 | 1 | 17 | 6 | 46 |
| Assault | | | | | | |
| Punched | 6 | 11 | 2 | 33 | — | — |
| Kicked | 5 | 9 | — | — | — | — |
| Stick/iron bar | 16 | 29 | 2 | 33 | 1 | 8 |
| Unknown instrument | 20 | 36 | — | — | 2 | 23 |
| Total assault | 47 | 85 | 4 | 66 | 3 | 31 |
| Sport | | | | | | |
| Other causes and unrecorded cases | 3 | 6 | 1 | 17 | 2 | 23 |
| Total cases where data available | 55 | | 6 | | 11 | |

per cent) with 31 per cent arising from assaults. No injuries sustained during sporting activities were noted in the three groups.

An analysis of the motor vehicle accident victims reveals that motor cyclists sustained mid-facial fractures most commonly, accounting for 31 per cent of all cases, all of which occurred in the white group. Seventeen per cent of cases occurred as a result of pedestrians being struck by motor vehicles, in the coloured and Asian population. Injuries to vehicle occupants accounted for the lowest number of motor vehicle accident cases treated, 15 per cent of which were in the white group.

The majority of cases resulting from assault occurred as a result of being struck by a stick or an iron bar, and these cases occurred largely in the coloured and Asian (33 per cent) and the black (29 per cent) groups. Assault with an unknown instrument was the next most common. Fractures from a punch accounted for 33 per cent of coloured and Asian cases and 11 per cent of black patients. Fractures resulting from falls and those occurring in cases where the aetiology was not noted, accounted for the remainder of the cases.

The distribution of middle third fractures by site and ethnic group is recorded in Table IV. Fractures involving the zygomatico-maxillary complex accounted for the majority of cases treated in all three population groups. In the black group 43 per cent of middle third fracture cases presented with zygomatico-maxillary fractures, while 28 per cent were Le Fort type. Sixteen per cent were isolated fractures of the orbital floor, and dentoalveolar fractures accounted for the remaining 13 per cent.

Table IV: Frequency distribution of middle third fractures by site and ethnic group

| Site | Black | | Coloured and Asian | | White | |
|------------------------------|-------|-----|--------------------|-----|-------|-----|
| | n | % | n | % | n | % |
| Dentoalveolar | 9 | 13 | — | — | — | 8 |
| Le Fort I (unilateral) | 5 | 8 | — | — | — | — |
| Le Fort I (bilateral) | 5 | 7 | — | — | — | — |
| Le Fort II (bilateral) | 4 | 6 | — | — | 3 | 25 |
| Le Fort III | 2 | 3 | — | — | — | — |
| Le Fort I with Le Fort II | 3 | 4 | — | — | 2 | 17 |
| Zygomatico Maxillary Complex | 30 | 43 | 5 | 80 | 5 | 50 |
| Orbital Floor | 11 | 16 | 1 | 20 | — | — |
| Total | 69 | 100 | 6 | 100 | 11 | 100 |

All cases in the coloured and Asian group occurred in the lateral region of the middle third of the face, 80 per cent involving the zygomatico-maxillary complex. Fractures of the orbital floor comprised the remaining 20 per cent of cases. In the White group, half of the fractures occurred in the zygomatico-maxillary region, while 42 per cent of cases sustained Le Fort type fractures. Dentoalveolar fractures accounted for the remaining 8 per cent.

Mandibular fractures

In all ethnic groups in the study, intentional assault was the most common aetiology (Table V). Assaults accounted for a greater per centage of cases in the black and the coloured and Asian groups (88 per cent and 86 per cent, respectively) than in the white population group (51 per cent). In the coloured and Asian and the white group, motor vehicle accidents were the second most common aetiology, followed by falls and other causes and by sporting injuries. In the black groups, fractures resulting from falls and other causes were slightly more common than those resulting from motor vehicle accidents, but accounted for few of the cases.

In the coloured and Asian and the white groups, vehicle occupants sustained the majority of fractures in motor vehicle accidents, while pedestrian accidents produced most black cases in this group.

Table V: Frequency distribution of mandibular fractures by aetiology and ethnic group

| Aetiology | Black | | Coloured and Asian | | White | |
|---------------------------------------------------|------------|-----------|--------------------|-----------|-----------|-----------|
| | n | % | n | % | n | % |
| Motor vehicle accidents | | | | | | |
| Vehicle | | | | | | |
| Occupant | 4 | 2 | 2 | 7 | 6 | 12 |
| Pedestrian | 8 | 4 | — | — | 1 | 2 |
| Motorcyclist | — | — | — | — | 4 | 8 |
| Total M.V.A. | 12 | 6 | 2 | 7 | 11 | 22 |
| Assault | | | | | | |
| Punched | 21 | 10 | 5 | 19 | 6 | 12 |
| Kicked | 16 | 8 | 2 | 8 | 2 | 4 |
| Stick/iron bar | 47 | 22 | 3 | 11 | 2 | 4 |
| Unknown instrument | 100 | 48 | 11 | 48 | 15 | 31 |
| Total assault | 184 | 88 | 23 | 86 | 25 | 51 |
| Sport and Falls and other causes | | | | | | |
| | 14 | 6 | 2 | 7 | 13 | 27 |
| Total number of cases where data available | 210 | | 27 | | 49 | |

In all groups, intentional assault with an unknown or unrecorded instrument was the most common assault resulting in mandibular fractures. This was followed in prevalence in the coloured and Asian and the white groups by the victim being punched with a fist, and in the black group by assault with a stick or an iron bar.

All the coloured and Asian sports injuries, and 4 per cent of the white sports injuries were sustained while playing football, and 2 per cent of these white cases received the injury during rugby football games. Fractures resulting from falls and other causes were more common in the white group than in the other two groups.

When the frequency and distribution of all mandibular fractures were studied according to anatomical site and ethnic group it was found that of the 214 black patients for which this information was available, there were 307 mandibular fracture sites. Thirty-nine fracture sites were found in 28 coloured and Asian cases, and 76

fracture sites were noted in 50 white cases (Table VI). In the black group, fractures of the body region were most common, followed by fractures of the angle, the symphyseal region and the condyle. Dentoalveolar and ramus fractures were rare. In both the Coloured and Asian and the White groups, angle fractures accounted for the majority of fractures and were slightly more common than body fractures. The condyle region was the third most frequent site in the white group, while symphyseal fractures occupied this position in the coloured and Asian groups. No coronoid fractures occurred in the three groups.

Table VI: Frequency distribution of all mandibular fractures by anatomical site and ethnic group

| Site | Black | | Coloured and Asian | | White | |
|------------------------------------------------|------------|----|--------------------|----|-----------|----|
| | n | % | n | % | n | % |
| Dentoalveolar | 3 | 1 | — | — | 3 | 14 |
| Symphyseal | 55 | 18 | 6 | 15 | 9 | 12 |
| Body | 120 | 39 | 14 | 36 | 21 | 28 |
| Angle | 86 | 28 | 15 | 38 | 24 | 30 |
| Ramus | 9 | 3 | 1 | 3 | — | — |
| Condyle | 34 | 11 | 3 | 8 | 20 | 26 |
| Coronoid | — | — | — | — | — | — |
| Number of patients where data available | 214 | | 28 | | 49 | |
| Total number of fractures | 307 | | 39 | | 76 | |

Unilateral fractures were clearly more common than bilateral fractures in both the black and the coloured and Asian groups, while they occurred almost equally in the white group. In the three groups, unilateral fractures involving the left side of the mandible were more common than those involving the right side, and this difference was greater in the black group (13 per cent), less in the coloured and Asian group (7 per cent) and the difference was least in the white population group (2 per cent).

Fractures of the body and the angle of the mandible were the most common single fractures in the three groups. In the black and the coloured and Asian groups single body fractures were more common than angle fractures while this ratio was reversed in the white group. Fractures of the symphyseal region, the ascending ramus, the condyle and the dentoalveolus, accounted for the remainder of the single fractures. No fractures of the coronoid process were recorded. In both the black and the coloured and Asian group, fracture of the body of the mandible associated with an angle fracture was the most common double fracture combination, while simultaneous fracture of the body and the condyle accounted for the majority of fractures in the white group. The classical triple fracture, the so-called "guardsman fracture" involving a fracture of the symphyseal region, together with a bilateral condylar fracture occurred most commonly in the white group. Fracture combinations of the symphyseal and angle, and the symphyseal and condyle were common to the three groups.

An examination of the double and multiple fractures, reveals that in the white group, the condyle region was

involved in 30 per cent of these fracture combinations, while accounting for only 10 per cent in the coloured and Asian group, and 12 per cent in the black group.

An analysis of the total number of single and double or multiple fractures, reveals that in the coloured and Asian group, single fractures (55 per cent) were more common than double or multiple fractures, while in the white group, double or multiple fractures accounted for the majority of cases (52 per cent). This ratio was equal for the black group.

DISCUSSION

The peak prevalence of fractures occurring predominantly in the third and fourth decades is similar to both overseas and local studies (Schuchardt *et al*, 1969; Snijman, 1965; Rowe and Killey, 1968). A rapid increase in the number of cases in the second and third decades (Snijman, 1963), was also found in the present study. The fact that in all groups males were most commonly the victims of assaults and motor vehicles accidents, resulting in fractures, also correlates well with results of European studies (Donaldson, 1961; Rowe and Killey, 1968; Lundin *et al*, 1973).

Although no gross trend towards an increase of fractures was noted over the summer months, which does not support a clinical impression harboured by many clinicians, during October, the spring season, the three ethnic groups all recorded their peak fracture prevalence. In a Swedish study (Lindström, 1960), the peak prevalence occurred in July, a summer month in Europe. No other similar comparison has been published.

In the black group, cranial injuries accounted for the majority of those cases with associated general injuries, possibly because of the severity of the trauma to the head resulting in the facial bone fracture. This may occur in severe assaults and severe motor accidents. Overseas studies report a lower incidence of cranial injuries as ranging from 3 to 6 per cent (Rowe and Killey, 1968; Nakamura and Gross, 1973). Facial assaults in the black group are often more severe than in the other groups. This is a clinically based opinion shared by some surgeons and casualty officers.

As in all statistical studies reviewed, the mandible is the site of fracture most often diagnosed. This is the result of both its prominence and its selection as a target of intentional violence.

The ratio of the fracture regions in the present study closely parallels those reported in the oral surgery literature (Schuchardt *et al*, 1960; Rowe and Killey, 1968). The high ratio of traffic accidents to intentional violence as a cause of mid-third fractures in this study is similar to that of studies carried out in the United Kingdom (Rowe and Killey, 1968, Morgan *et al*, 1972).

The major portion of mid-third fractures of traffic accident origin in the black and the coloured and Asian groups arise from pedestrians, injuries, whilst white motor-cyclists are prominent in the statistics. This is consistent with the large number of black pedestrians seen on our streets today, and in the case of the whites, the ever-increasing number of motor-cyclists.

The zygomatico-maxillary complex was the most common site of middle third fractures, and this is constant for the three population groups studied. This compares with overseas studies where up to 85 per cent of middle third fractures involved the zygomatic complex (Donaldson, 1961; Rowe and Killey, 1968; Gwyn *et al* 1971). A similar ratio was found in a previous South African study (Muller and Schoeman 1977).

In the Johannesburg region, however, and probably South Africa as a whole, physical violence with intentional assault accounted for the majority of mandibular fractures in all groups. Similar conclusions were reached by other authors (Snijman, 1963; Rosenberg and Smith, 1976). The significantly higher number of condyle fractures in the white group is also reflected as stated previously (Snijman 1963).

These findings are in sharp contrast to the British and European studies, where traffic accidents accounted for most cases of mandibular fractures (Donaldson, 1961; Rowe and Killey, 1968; Afzelius and Rosen 1980). As with middle third facial fractures it can be postulated that the reason for the preponderance of unilateral left-sided fractures of the mandible appears to be that many patients treated were the victims of assault by right-handed assailants.

The double and multiple fracture pattern that occurred in the Black and the Coloured and Asian groups, was similar to that of the previous South African studies (Snijman, 1963; Rosenberg and Smith, 1976).

In the present study in the white group, the results closely resemble the British analysis (Rowe and Killey, 1968), with a fracture of the body or molar region associated with a fracture of the condyle being most common. This phenomenon may be related to the racial difference in neck condyle anatomy (Snijman, 1963).

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