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Prospective audit of mandibular fractures at the Charlotte Maxeke Johannesburg Academic Hospital

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Summary

Objective. This study was a prospective cross-sectional clinical audit of patients with mandibular fractures at the Charlotte Maxeke Johannesburg Academic Hospital.

Methods. Between 1 March and 31 August 2004, patients with mandibular fractures seen by one clinician had their details recorded.

Results. The female:male ratio of the study sample of 133 patients was 1:6. Seventy-seven per cent were aged 20 - 39 years. Most fractures (86%) were the result of interpersonal violence, and 65% were alcohol-associated. Open reduction (75%) was the most common treatment.

Conclusion. This study had the highest interpersonal violence and open reduction rates of all the studies reviewed.

The history of maxillofacial and oral injuries, including mandibular fractures, from 1650 BC to the present, is the topic of two publications.[1,2] To summarise: the Greek 'Father of Medicine' Hippocrates was the first to describe fracture treatment – he recommended bandages and single jaw fixation. Celsus, a Roman (30 BC - 50 AD), was one of the earliest physicians to recognise the importance of establishing the occlusion in the treatment of fractures. His principle of fracture immobilisation was the forerunner of intermaxillary fixation (IMF), a system still in use. In 1275, Salicetti of Salerno continued Celsus' IMF principle, combining this with wiring together of teeth adjacent to a fracture (the tension band principle). From the late 18th century, the development and use of extra-oral splints was in favour, combined with closed reduction of fractures. Once anaesthesia was introduced in the mid-19th century, open reduction and immobilisation of fractures improved treatment and was further refined from the 1960s to today.

Whatever mandibular fracture management may be used, clinicians and service planners need to understand work loads. For this, a clinical audit[3] is a useful method. The current study was a prospective clinical audit of mandibular fractures in the Division of Maxillofacial and Oral Surgery at Charlotte Maxeke Johannesburg Academic Hospital from 1 March to 31 August 2004, to determine presentation patterns for service planning and comparison with other audits in South Africa and elsewhere.

Methods

Before beginning the audit, ethics clearance was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (clearance M040324). Because the study was prospective, informed consent was obtained from each patient for their inclusion in the study.

The study sample was 133 patients with mandibular fractures attending the outpatient clinic of the Division of Maxillofacial and Oral Surgery. All were seen by the principal investigator (JD) to standardise diagnosis and data recording. The sample comprised 70% of the 190 patients with such fractures seen in the division over the period of data collection (1 March - 31 August 2004). The remaining patients were seen by other clinicians when the principal investigator, a trainee specialist at the time, was not available owing to duties elsewhere.

Each patient was assessed clinically and with radiographs: orthopantomographs and posterior-anterior views for all patients plus reverse Towne's view when a suspected condylar fracture could not be seen on the other 2 views.

Data recorded were:

- personal demographics, dates of injury, consultation, hospital admission and discharge
- mechanism of injury – high- or low-velocity blunt trauma, high- or low-velocity penetrating trauma
- alcohol use

- loss of consciousness
- airway status
- Glasgow Coma Scale
- associated injuries
- details of the fractures and their treatment.

Data analysis was by SAS for Windows (version 9.02, SAS Institute Inc., Cary NC, USA) and Instat[3] (Graphpad Software Inc, San Diego CA, USA).

An extensive online literature search was done for previously published audits in South Africa and elsewhere. These audits had to deal with all facial fractures or with mandibular fractures; articles were limited to specific fracture sites – the mandibular condyle was not included. Inclusion of papers published on non-South African samples were concentrated on audits in Africa, with inclusion of some representative studies from elsewhere.

Results

The age and gender distributions are listed in Table I. The female/male ratio was 1:6; >75% of the study sample were in the 20 - 39-year age range.

Table II shows the prevalences of general features of the patents and their injuries. The racial distribution is a typical profile of patients attending the state-funded hospital. Notable features are that unemployed people were the most common group, interpersonal violence was the most common cause, alcohol played a role in about two-thirds of all instances and, while 39% of patients lost consciousness during the causative event, only 2 showed a slight reduction in Glasgow Coma Scale on examination. The airway was seldom compromised.

Regarding the prevalences of fracture characteristics (Table III), single and multiple fractures occurred almost

TABLE I. FREQUENCY DISTRIBUTION OF PATIENTS BY AGE IN DECADES AND GENDER

	Female		Male		Total	
Age	*N*	%	*N*	%	*N*	%
10 - 19	**2**	**11**	**4**	**3**	**6**	**5**
20 - 29	**9**	**50**	**42**	**36**	**51**	**38**
30 - 39	**4**	**22**	**48**	**42**	**52**	**39**
40 - 49	**3**	**17**	**18**	**16**	**21**	**16**
50 - 59	**0**	**0**	**3**	**3**	**3**	**2**
Total	**18**	**100**	**115**	**100**	**133**	**100**

TABLE II. PREVALENCE OF GENERAL FEATURES OF PATIENTS AND INJURIES (*N*=133)

Race	**Black 100 (75%), white 21 (16%), coloured 10 (8%), Indian 2 (1%)**
Employment	**Professional 1 (<1%), private sector 38 (29%), public sector 4 (3%), labourer 24 (26%), student 10 (7%), unemployed 46 (35%)**
Cause of injury	**Accidental 18 (14%), interpersonal violence 115 (86%)**
Alcohol-associated	**Yes 86 (65%)**
Loss of consciousness	**Yes 52 (39%)**
Associated injury	**Yes 40 (30%)**
Impact site	**Left 59 (45%), midline 28 (21%), right 46 (34%)**
Glasgow Coma Scale	**15 131 (99%), 14 1 (<1%), 13 1 (<1%)**
Airway	**Patent 129 (97%), compromised 4 (3%)**

TABLE III. PREVALENCE OF FRACTURE CHARACTERISTICS (*N*=133)

Fractures per mandible	**Single 64 (48%), multiple 69 (52%)**
Fracture sites	**Total 203; angle 79 (39%), parasymphyseal 39 (19%), body 36 (18%), condyle 33 (17%), symphysis 11 (5%), dento-alveolar 5 (3%), ramus 0, coronoid 0**
Type of fracture	**Closed 32 (24%), open 101 (76%)**
Tooth in fracture line	**Yes 102 (77%)**
Displaced	**Yes 98 (74%)**
Nerve damage	**Yes 77 (58%)**
Treatment	**Open reduction 99 (74%), closed reduction 27 (20%), none 7 (5%)**

TABLE IV. COMPARISON OF SOUTH AFRICAN MANDIBULAR FRACTURE STUDIES

Study	Academic hospital	Facial fracture studied	Study period	Age range	Age with highest prevalence	Number of patients, % mandibular fractures	F:M ratio	Cause of injury (%)		
								IPV	Accidents	Other
Snijman[4]	**Pretoria**	**All**	**-**	**0 - 60**	**21 - 30**	**1 699, 76**	**-**	**75**	**21**	**4**
Smith[5]	**Johannesburg**	**All**	**1971 - 1973**	**0 - 70+**	**20 - 29**	**1 703, 80**	**1:6**		**-**	
Melmed & Koonin[6]	**Cape Town**	**Mandible**	**1968 - 1973**	**0 - 60+**	**20 - 29**	**909, 100**	**1:4**		**-**	
Rosenberg & Smith[7]	**Johannesburg**	**Mandible**	**-**	**10 - 59**	**20 - 39**	**162, 100**	**1:9**		**-**	
Duvenage[8]	**Pretoria**	**All**	**1971 - 1976**	**mean 30**	**-**	**5 074, 83**	**1:3**	**61**	**28**	**11**
Beaumont *et al.*[9]	**Johannesburg**	**All**	**1979**	**5 - 72**	**20 - 29**	**389, 81**	**1:6**	**75**	**25**	**-**
Bamjee *et al.*[10]	**Johannesburg**	**All**	**1989 - 1992**	**0 - 18**	**13 - 18**	**326, 69**	**1:2**	**48**	**51**	**-**
Roode *et al.*[11]	**Pretoria**	**Mandible**	**1999 - 2003**	**21 - 30**	**21 - 30**	**501, 100**	**1:5**	**73**	**23**	**9**
Current study	**Johannesburg**	**Mandible**	**6 months 2004**	**16 - 59**	**20 - 39**	**133, 100**	**1:6**	**86**	**14**	**-**

IPV = interpersonal violence.

TABLE V. COMPARISON OF NON-SOUTH AFRICAN STUDIES

Study	Study area	Facial fracture studied	Study period	Age range	Age with highest prevalence	Number of patients, % mandibular fractures	F:M ratio	Cause of injury		
								IPV	Accidents	Other
Olson *et al.*[12]	**Iowa, USA**	**Mandible**	**1972 -1978**	**2 - 83**	**20 - 29**	**580, 100**	**1:4**	**34**	**59**	**7**
Busuito *et al.*[13]	**Detroit, USA**	**Mandible**	**1980 - 1984**	**Mean 33**	**-**	**307, 100**	**1:4**	**75**	**23**	**2**
Haug *et al.*[14]	**Cleveland, USA**	**All**	**1984 - 1988**	**0 - 70**	**26 - 30**	**402, 76**	**1:3**	**54**	**41**	**1**
Adi *et al.*[15]	**Dundee, UK**	**Mandible**	**1977 - 1985**	**7 - 87**	**20 - 29**	**692, 100**	**1:3**	**54**	**40**	**6**
Mwaniki & Guthua[16]	**Nairobi, Kenya**	**Mandible**	**1984 - 1986**	**0 - 62**	**20 - 40**	**355, 100**	**1:8**	**75**	**22**	**3**
Dimitroulis & Eyre[17]	**London, UK**	**All**	**1983 - 1989**	**7 - 92**	**21 - 30**	**439, 50**	**1:3**	**56**	**41**	**3**
Ugboko *et al.*[18]	**Ile-Ife, Nigeria**	**All**	**1982 - 1995**	**0 - 70**	**21 - 30**	**442, 64**	**1:4**	**11**	**88**	**1**
Oji[19]	**Enugu, Nigeria**	**All**	**1985 - 1995**	**1 - 61+**	**21 - 30**	**900, 73**	**1:3**	**8**	**91**	**1**
Sojat *et al.*[20]	**Toronto, Canada**	**Mandible**	**1995 - 2000**	**14 - 90**	**21 - 30**	**246, 100**	**1:5**	**53**	**47**	
Ferreira *et al.*[21]	**Porto, Portugal**	**All**	**1993 - 2002**	**0 - 18**	**16 - 18**	**912, 49**	**1:3**	**5**	**86**	**9**
Sakr[22]	**Alexandria, Egypt**	**Mandible**	**1991 - 2000**	**0 - 60+**	**11 - 30**	**509, 100**	**1:4**	**16**	**76**	**8**
Subhashraj *et al.*[23]	**Chennai, India**	**All**	**1999 - 2005**	**0 - 61+**	**21 - 30**	**1688, 30**	**1:4**	**3**	**97**	
Adeyemo *et al.*[24]	**Lagos, Nigeria**	**Mandible**	**1998 - 2007**	**6 - 60**	**21 - 30**	**314, 100**	**1:4**	**25**	**73**	**2**

IPV = interpersonal violence.

TABLE VI. COMPARISON OF MANDIBULAR FRACTURE SITES AND TYPE OF TREATMENT IN SOUTH AFRICAN STUDIES (%)

Study	Condyle	Coronoid	Angle	Ramus	Body	Parasymphysis	Symphysis	Dento-alveolar	Treatment		
									Closed	Open	None
Snijman[4]	9	0	14	2	56	8	11	-	86	14	0
Melmed & Koonin[6]	17	2	31	3	40	-	7	-	84	10	6
Beaumont *et al.*[9]	14	0	30	2	36	-	17	2	-	-	-
Bamjee *et al.*[10]	14	1	33	4	65	22	7	1	-	-	-
Roode *et al.*[11]	15	1	12	5	41	19	5	3	-	-	-
Current study	17	1	39	0	18	19	5	3	20	75	7

- = no information available.

TABLE VII. COMPARISON OF MANDIBULAR FRACTURE SITES AND TYPE OF TREATMENT IN NON-SOUTH AFRICAN STUDIES (%)

Study	Condyle	Coronoid	Angle	Ramus	Body	Parasymphysis	Symphysis	Dento-alveolar	Treatment		
									Closed	Open	None
Olson *et al.*[12]	29	1	25	2	16	22 (both)		3	59	38	3
Busuito *et al.*[13]	18	2	22	6	30	16	5	4	31	42	27
Haug *et al.*[14]	21	0.2	27	2	30	20 (both)		-	-	-	-
Adi *et al.*[15]	26	2	20	4	26	19 (both)		4	66	11	23
Dimitroulis & Eyre[17]	-	-	-	-	-	-		-	80	20	0
Ugboko *et al.*[18]	12	0.2	9	5	25	17	11	16	91	5	4
Oji[19]	26	0.2	17	2	36	15 (both)		2	-	-	-
Sojat *et al.*[20]	-	-	-	-	-	-		-	46	52	2
Ferreira *et al.*[21]	35	0.5	18	8	35	15	9	-	65	20	15
Sakr[22]	19	1	22	1	19	21	8	5	48	40	12
Subhashraj *et al.*[23]	19	4	12	5	19	31	11	11	19	80	1
Adeyemo *et al.*[24]	11	0.2	25	1	11	21	8	4	83	13	4

both = parasymphysis and symphysis combined in study results.

equally. The most common fracture site was the mandibular angle; 75% were open fractures with a tooth in the line of fracture. Both fracture displacement and nerve damage were common. Three-quarters of the patients were treated with open reduction.

Discussion

Main findings and comparison with other South African studies

In common with earlier prevalence studies on adults in South Africa[4-9,11] (Table IV) from 1968 to 2003, males predominated, with the highest prevalence among 20 - 39-year-olds. In studies where causes of injury were listed, interpersonal violence was about 3 times more frequent than accidents of any other type. The interpersonal violence prevalence in the current audit is higher than in any other South African reports. When mandibular fractures in individuals aged ≤18 years were considered, the female/male ratio was much lower at 1:2, with accidents and interpersonal violence occurring almost equally.[10]

The study shows a clear swing to open reduction and immobilisation of mandibular fractures in the Division of Maxillofacial and Oral Surgery. The reasons are a combination of more resources for the procedure and perceived late presentation of patients for treatment, which often necessitates surgical re-fracture.

Comparison with studies outside South Africa

Table V lists results from 13 studies: 5 from Africa,[16,18,19,23,24] 3 from Europe,[15,17,21] 1 from India,[23] and 4 from North America.[2-14,20] The female/male ratios were mostly 1:3 or 1:4, rising in one instance (Kenya) to 1:8. In 8 studies, the highest prevalence was between 20 and 30. Accidents were the most common in 7 of the studies, and interpersonal violence in 6.

When compared with the current study, it is clear that interpersonal violence is a less common cause of mandibular fractures than in the current study – only in Detroit, USA[13] and Nairobi, Kenya[16] does this cause approach the rate in the current report. Similarly, only in Chennai, India 23 is the rate of open reduction high: 80% compared with 75% in the present study.

Regarding the site of fracture, the mandibular angle is more common in South African reports than elsewhere (Tables VI a and VII).

Limitations of the study

Regular clinical audits of rates of patient presentation and management help to plan service delivery. It is unfortunate that the heavy service load on staff – notably trainee specialists – limits the frequency of such audits and delays the presentation of results.

Conclusion

The current study has shown a high rate of interpersonal violence as a cause of mandibular fractures in patients served by the Division of Maxillofacial and Oral Surgery. The high rate of open reduction of fractures has cost implications. To understand the perceived late presentation of fractures that necessitates the open reductions, a study of time to presentation for diagnosis, time to treatment and length of hospital stay is in progress in the Division.

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