

# The relationship between the mechanism of injury and mandibular fractures

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## ABSTRACT

### Introduction

This prospective study describes the mechanism of injury, patient demographics and clinical presentation of 100 consecutive patients encountered in the patient population served by the Department of Maxillofacial and Oral Surgery at the Sefako Makgatho Health Sciences University.

### Objectives

To determine the demographics, presentation and mechanism of injury of patients presenting with mandibular fractures in the patient population served by Sefako Makgatho Health Sciences University.

### Results

Seventy percent of mandibular fractures were secondary to assault. Although this was high in comparison to other studies, it was similar to studies performed in London and other regions of South Africa. Mandibular fractures resulting from MVA (motor vehicle accidents), falls and sports were found to be less than the norm.

### Conclusion and recommendations

The high percentage of mandibular fractures due to assault concurs with similar studies previously conducted in South Africa. With some variables similar to international trends, while others are not; certain salient results highlight the need for interventional campaigns.

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4. **Muniera Ibrahim:** data analysis, researching relevant related articles - 10%
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### Keywords

Mandible, fracture, trauma, maxillofacial, injury, jaw.

## INTRODUCTION

The oldest known literature describing mandibular fractures dates back to the 17<sup>th</sup> century BC; with the original manuscript believed to have been written during the pyramid age, approximately 3000 BC.<sup>1</sup> This Ancient Egyptian text proposes no treatment for mandibular fractures. Much knowledge and treatment methods were gained during the years of world wars.<sup>2</sup> (Hippocrates) said: *War is the only proper school for a surgeon*. Continued social violence and urban warfare have provided both the need and platform for continued research in the field. The basic principles of traumatology rest on a biologic and anatomic foundation, as was seen by similar fracture patterns by (René Le Fort) in 1901.<sup>3</sup>

## DISCUSSION

With an exception of comminuted condylar head injuries, most (>75%) of mandibular fractures occur along areas of primary tensile strain.<sup>4</sup> Biomechanical analysis has shown a greater tendency of higher fractures, along the condylar head and neck, when the mouth was open at the time of injury; whereas a greater tendency of fractures inferior to the condylar head was noted in injuries sustained with the mouth in a closed position.<sup>5,6</sup> The presence of mandibular third molars increases the risk of mandibular angle fractures.<sup>7</sup>

Forces are conducted along buttresses and fractures occur at weak spots. The lowest force required to cause a mandibular fracture is 193kg, which may fracture a single condyle. 243-250kg is needed for bilateral condylar fractures and 386-420kg is required for a symphysis fracture.

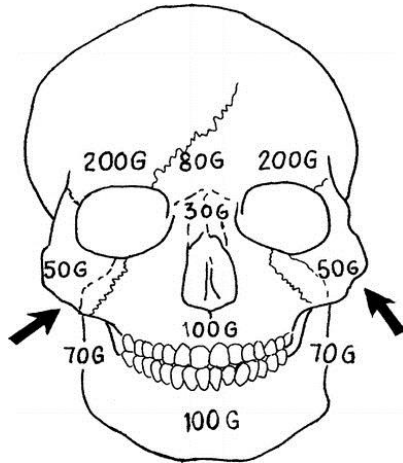


Figure 1. Resistance of force by facial skeleton.<sup>9</sup>

Maxillofacial trauma has been shown to have a wide range of effects, even affecting body posture, which subsequently improves following definitive treatment.<sup>9</sup> Television is widely accessible and is implicated in violent behavioural modification.<sup>10</sup> Alcohol consumption is rampant in South Africa and is associated with violence, traffic accidents, crime, considerable morbidity and mortality; with control measures largely being absent.<sup>11</sup>

Studies conducted in Johannesburg demonstrated that 65%<sup>12</sup> and 53.8%<sup>13</sup> of patients with mandibular fractures had a history of alcohol consumption at the time of injury. Table 1 compares the causes of mandibular fractures of studies from multiple geographic locations, while Table 2 compares the areas of the mandible fractured in these studies.

**METHOD**

The study sample included the first 100 consecutive, consenting patients who presented with mandibular fractures; thus being a random patient sample. Patient history, demographics and clinical presentation were recorded. Exclusion criteria included non-consent and inadequate history.

**RESULTS**

Patients were mainly of the third to fourth decade (71%). A male to female ratio of 4.9:1 and an unemployment rate of 65% were noted. The mechanism of injury is summarised in Figure 2. The fracture details and force vectors are summarised in Figure 3, Figure 4 and Table 3.

With 67% of patients injured between 19:00 and 06:00, an active night life appears to contribute to incidence of mandibular fractures. Although 65% of the study population reported unemployment, 76% were alcohol consumers and 55% inebriated at the time of injury; indicating a potential for unproductive efforts resulting in injurious results.

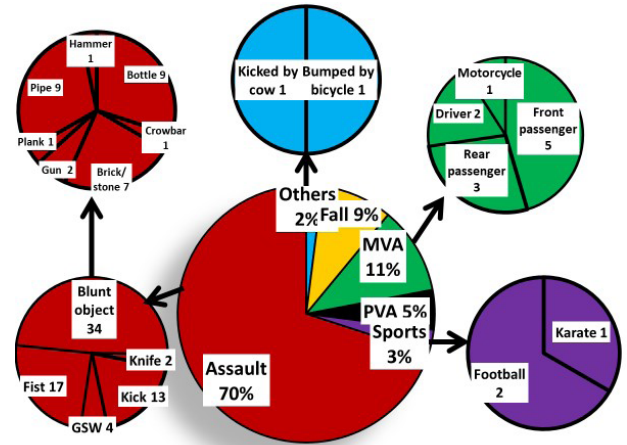


Figure 2. Mechanism of injury.

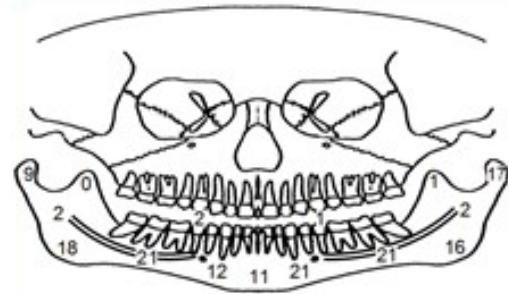


Figure 3. Area of mandible fracture.

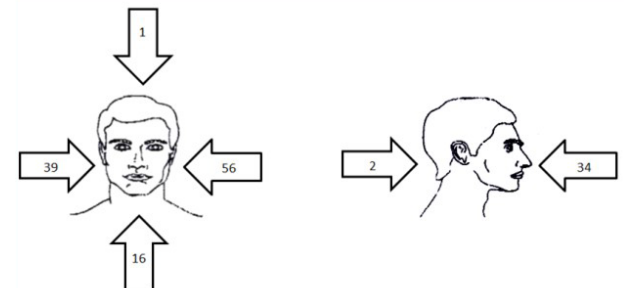


Figure 4. Direction of force sustained.

The percentage (70%) of mandibular fractures sustained secondary to assault was found to be high in comparison to other studies. A higher percentage of assault-related mandibular fractures were noted in London,<sup>19</sup> Pretoria<sup>25</sup> and Ga-Rankuwa<sup>23</sup> (same patient base as current study, but facial fractures studied).

Mandibular fractures resulting from MVA, falls and sports were found to be less than the national and international norm according to studies referenced.

A higher percentage of mandibular corpus and parasymphyseal fractures were found in relation to studies referenced; while a relatively lower percentage of dento-alveolar fractures were noted, possibly related to a referral bias.

With 58% of fractures occurring on the left and 88% of the population being right handed,<sup>26</sup> the effect of assault

**Table 1.** Comparative cause of fracture.

| Model                                    | % Assault | % MVA | % Sport | % Work | % Fall | % Other | Total | Facial/<br>Mandibular | Male/<br>Female |
|--|-----------|-------|---------|--------|--------|---------|-------|-----------------------|-----------------|
| <b>International</b>                     |           |       |         |        |        |         |       |                       |                 |
| Australia <sup>14</sup>                  | 29.9      | 28    | 15.4    | 0      | 21.3   | 5.4     | 100   | facial                | 4:1             |
| Austria <sup>15</sup>                    | 12.3      | 11.7  | 31.3    | 5.3    | 39.4   |         | 100   | facial                | 2.1:1           |
| Bahrain <sup>16</sup>                    | 3.1       | 44.6  | 12.3    | 0      | 40     | 0       | 100   | md                    | 6:1             |
| Brazil <sup>17</sup>                     | 30.2      | 43.9  | 2.4     | 0      | 19     | 4.5     | 100   | md                    | 5.5:1           |
| China <sup>18</sup>                      | 10.1      | 43.6  | 0       | 4.5    | 40     | 1.8     | 100   | md                    | 2.8:1           |
| England <sup>19</sup>                    | 72        | 4     | 5       | 0      | 18     | 1       | 100   | md                    | 6.7:1           |
| Pan-Europe <sup>20</sup>                 | 39        | 11    | 11      | 3      | 31     | 5       | 100   | facial                | 3.6:1           |
| <b>Africa</b>                            |           |       |         |        |        |         |       |                       |                 |
| Benin <sup>21</sup>                      | 13.2      | 79.9  | 4.6     | 0.6    | 1.7    | 0       | 100   | md                    | 4.4:1           |
| Nigeria <sup>22</sup>                    | 24.5      | 67.5  | 1.3     | 2.6    | 3.5    | 0.6     | 100   | md                    | 4.3:1           |
| Ga-Rankuwa, South Africa <sup>23</sup>   | 80.6      | 15    | 0       | 0      | 4.4    | 0       | 100   | facial                | 6.6:1           |
| Johannesburg, South Africa <sup>24</sup> | 54.3      | 26.6  | 0       | 0      | 5.3    | 13.8    | 100   | facial                | 4.9:1           |
| Pretoria, South Africa <sup>25</sup>     | 72.5      | 14.2  | 1.6     | 0      | 8.8    | 2.9     | 100   | md                    | 5:1             |

**Table 2.** Areas of mandible fractured.

| %  | Condyle | Coronoid | Ramus | Angle | Corpus | Para symph | Symphysis | Dento-alveolar |
|--|---------|----------|-------|-------|--------|------------|-----------|----------------|
| <b>International</b>                     |         |          |       |       |        |            |           |                |
| Australia <sup>14</sup>                  | 7.3     | 0        | 16.1  | 25.1  | 30     | 21.5       |           | 0              |
| Austria <sup>15</sup>                    | 2.1     | 0        | 8.3   | 10.4  |        | 1.3        |           | 2.2            |
| Bahrain <sup>16</sup>                    | 24.6    | 0        | 0.6   | 39.1  | 20.6   | 15.1       |           | 0              |
| Brazil <sup>17</sup>                     | 30      | 1.3      | 2.3   | 15.3  | 24.3   | 16.4       | 8.5       | 0              |
| China <sup>18</sup>                      | 36.2    | 0.5      | 2     | 13.3  | 20.7   | 23.9       |           | 3.4            |
| England <sup>19</sup>                    | 27      | <1       | 3     | 30    | 9      | 27         | 4         | 0              |
| Pan-Europe <sup>20</sup>                 | 34      | 2        | 3     | 19    | 22     | 17         |           | 3              |
| <b>Africa</b>                            |         |          |       |       |        |            |           |                |
| Benin <sup>21</sup>                      | 9.8     | 0        | 8.6   | 12.3  | 47.1   | 15.6       | 6.6       | 0              |
| Nigeria <sup>22</sup>                    | 10.8    | 0.2      | 1.3   | 24.6  | 29.6   | 21.4       | 7.8       | 4.3            |
| Ga-Rankuwa, South Africa <sup>23</sup>   | 8.5     | 0.8      | 3     | 35.6  | 18.1   | 21.4       | 12.5      | 0              |
| Johannesburg, South Africa <sup>24</sup> | 16.8    | 0        | 0     | 38.9  | 17.7   | 19.2       | 5.4       | 2              |
| Pretoria, South Africa <sup>25</sup>     | 14.6    | 0.5      | 4.9   | 12.3  | 41.1   | 18.5       | 4.6       | 3.5            |

by the dominant hand of an assailant appears to have an effect on the mandibular fracture configuration of the study group.

A slightly increased incidence of fracture favourability and markedly decreased incidence of fracture comminution is in accord with the expected lower force encountered in the assaults as opposed to a higher velocity injury (Table 3).

To conclude the discussion on an optimistic note, the trend of cause of injury appears to have changed from a previous report.<sup>23</sup> Just as the most common cause of mandibular fractures in Baghdad changed over a period of 10 years from assault by fist to shell and bullet injury,<sup>27</sup> changes in patterns of injury are not uncommon in the same institution at different times. Although (Singh) considered the cause of facial fractures in general,<sup>23</sup> the current study using the same patient base reveals that assault is no longer as common an injurious cause as in 2009 (a decrease from 80.6% to 70%).

## CONCLUSION AND RECOMMENDATIONS

The correlation between high risk behaviour and social challenges, such as unemployment, violence, excessive alcohol consumption and disregarding the use of seat belts should be considered on an interventional basis.

**Table 3.** Fracture details.

|                        | Favourable | Unfavourable |
|------------------------|------------|--------------|
| Horizontal             | 54         | 46           |
| Vertical               | 56         | 44           |
| Teeth in fracture line | Yes        | No           |
|                        | 88         | 12           |
| Multi-rooted           | Yes        | No           |
|                        | 54         | 34           |
| Fracture comminution   | Yes        | No           |
|                        | 26         | 74           |

The percentage (70%) of patients with mandibular fractures due to assault is indeed a point of concern, which interventional campaigns may target.

Motor vehicle usage patterns, safety features, road conditions and traffic legislature affect the injury patterns associated with MVA. The role of violent sport, occupational risks and other high risk behaviours are other factors that need to be considered when treating the traumatised patient and implementing preventative measures.

A renewed call is made to invest in campaigns reducing these contributing factors to high risk behaviour in light of the effect displayed on the health of the patient population studied.

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### Ethics

SMUREC ethics reference number: SMUREC/D/8240 05: PG.

### Conflicts of interest

The authors declare no conflict of interest.

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