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Facial fractures in a level I trauma centre: the importance of protective devices and alcohol abuse

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Abstract

Urban trauma centres have recently noted a shift in the causative mechanism of facial fractures away from motor vehicle crashes (MVC) to blunt assaults (BA). This study was conducted to examine the incidence and aetiology of facial fractures at our institution as well as the relationship with alcohol and protective device use. Trauma registry records of all patients admitted to a level I trauma centre from 1 January 1988 to 1 January 1999 were reviewed. There were 13594 trauma admissions during the 11-year period. Facial fractures were sustained by 1429 patients (10.5%) and this group forms the subject of this study. MVC was the predominant aetiology (59.9%) followed by BA (18.8%). Facial fractures were found in 9.5% of restrained MVC patients compared to 15.4% of unrestrained patients ($P < 0.00l$). Non-helmeted motorcyclists were four times more likely to sustain facial fractures (4.3% vs. 18.4%) than helmeted patients ($P < 0.00l$). 39.6% of patients in the MVC group were legally intoxicated compared to 73.5% in the BA group ($P < 0.00l$). 45.4% of unrestrained patients with facial fractures were intoxicated compared to 11.8% of restrained MVC patients with facial fractures ($P < 0.001$). MVC continue to be the primary aetiology of facial fractures in our trauma population. Protective devices decrease the incidence of facial fractures. Lack of protective device use and the consumption of alcohol correlate with sustaining facial fractures. Published by Elsevier Science Ltd.

1. Introduction

Facial fractures account for half of all facial injuries [1]. Many urban trauma centres have reported a shift in the most common mechanism of facial injury from motor vehicle crashes (MVC) to blunt assaults (BA) [2–5]. The reason for this change is unclear but it is generally attributed to increased safety belt usage, airbags, and greater enforcement of drunk driving laws. The development of regional trauma centres with air ambulance services may also be responsible for altering the type of injuries seen in some urban trauma centres. The purpose of this study was to examine facial fracture aetiologies, particularly MVC and BA, and their associations with the use of protective devices and alcohol abuse.

2. Methods

A retrospective review of 13594 patients admitted to a regional level I trauma centre revealed 1429 patients sustained at least one facial fracture over an 11-year period. The trauma registry was utilised to obtain data pertaining to the age, gender, mechanism of injury, injury severity score (ISS), revised trauma score (RTS), Glasgow coma score (GCS), outcome, blood alcohol level (BAL) and use of protective devices. Statistical analysis using the χ^2 method, ANOVA or t-tests was used as appropriate. A $P < 0.05$ was accepted as being statistically significant.

3. Results

During the 11-year period reviewed, 13594 patients with injuries were admitted to the Miami Valley Hospital Trauma Center. Of these, 1429 patients (10.5%) sustained at least one facial fracture. This group con-

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Table 1
Aetiology of facial fractures

Aetiology	Number of fractures	Total (%)
MVC	856	59.9
BA	269	18.8
Fall	122	8.5
Gunshot wound	47	3.3
Pedestrian accident	46	3.2
Other	31	2.2
Sporting injury	21	1.2
Bicycle accident	17	1.2
Industrial accident	12	0.8
Explosion	4	0.3
Stabbing	4	0.3

tains 1059 (74%) males and 370 (26%) females. The mean age is 34.1 ± 16.3 yr with a range from 3 to 97 years. The leading causes of facial fractures were MVC, involving cars, trucks and motorcycles, followed by BA and falls (Table 1). Facial fracture frequency, gender and age differences for the patients in the MVC and BA groups are presented in Table 2. Comparison of the trauma scores and mortality shows that victims of MVC sustained more severe injuries compared to those involved in a BA (Table 3). The annual incidence of facial fractures was noted to increase over the course of the study period (Fig. 1). Overall mortality for patients with facial fractures was 8.7%.

Patients who were restrained with safety belts sustained facial fractures less often during MVC than did those patients who were unrestrained. Of the patients restrained during a crash only 9.5% suffered facial fractures compared to 15.4% of non-restrained patients ($P < 0.001$). The protective effect of motorcycle helmet use was also demonstrated, only 4.3% of helmeted motorcyclists suffered facial fractures compared to 18.4% of non-helmeted motorcyclists ($P < 0.00$l).

Data on alcohol use is often extremely difficult to obtain as the patient is not necessarily the intoxicated party. Despite this, BAL were documented in 738 patients (51%). Forty-five percent were found to be legally intoxicated with a BAL > 99 mg/dl. One hundred and ninety-seven (39.6%) patients in the MVC group were legally intoxicated compared to 78 patients (73.5%) in the BA group ($P < 0.001$). Only 11.8% of restrained motor vehicle crash patients with facial fractures were

Table 2
MVC and BA demographics

	MVC	BA
Total patients	856 (59.9%)	269 (18.8%)
Men	580	232
Women	276	37
Mean age	32.1	32.8

Table 3
Trauma scores and mortality of MVC and BA groups ($P < 0.00$l)

	MVC	BA
Injury severity score	22.9 ± 16.3	7.9 ± 7.6
Glasgow coma score	11.7 ± 4.5	14.4 ± 1.9
Revised trauma score	6.71 ± 1.8	7.68 ± 0.7
Mortality	11.33%	0.74%

legally intoxicated compared to 45.4% of unrestrained patients with facial fractures ($P < 0.001$). None of the helmeted motorcyclists sustaining facial fractures were found to be legally intoxicated compared to 39.3% of non-helmeted motorcyclists suffering facial fractures ($P > 0.2$). Only 5.8% of legally intoxicated patients in the MVC group were using protective devices (safety belts or helmets).

4. Discussion

The two most common mechanisms of injury in craniofacial trauma are MVC and BA. Two decades ago, Luce et al. [6] reported motor vehicle accidents to be the primary cause, accounting for 65% of facial fractures. Subsequent studies have supported that finding [7,8], however recent trends have shown an increase in the incidence of BA and suggest it is now the principal mechanism of facial fractures [9,10]. Strictly enforced speed limits, drunken driving laws, air bag use and mandatory seatbelt laws are credited with decreasing the number of facial fractures due to MVC [3,10].

Our study found MVC to be the predominant aetiology, accounting for 59.9% of facial fractures, with BA being responsible for only 18.8%. We also note an increase in facial fractures during the study period due to MVC at our institution, a regional, level I trauma centre with a large percentage of air ambulance refer-

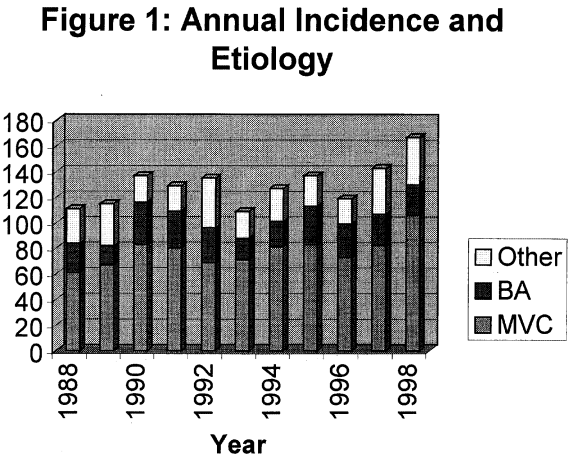

Fig. 1. Annual incidence and etiology.

rals. We believe motor vehicle accidents are the predominant aetiology of facial fractures in our study due to the regionalisation of trauma care, which may affect the types of injuries an institution treats. The employment of air ambulance transport systems, which are mainly used for rapid transport of road traffic crash victims, may cause some institutions to treat predominantly maxillofacial injuries caused by MVC. This appears to be the case in our institution, where the number of facial fractures increased over an 11-year period and the mechanism of injury remained predominantly MVC. Some urban trauma centres serving an inner city area may see a greater proportion of facial fractures due to BA in their emergency departments. A nation-wide surveillance system is needed to monitor national trends in the incidence and aetiology of facial fractures.

Seat belts have been shown to reduce both the frequency and severity of facial injuries that occur secondary to motor vehicle accidents [11–13]. This study confirms a significant reduction in facial fracture incidence when comparing restrained and unrestrained patients. Only 9.5% of seat-belted patients suffered facial fractures compared to 15.4% of non-restrained patients. Despite the proven protective effects of seat belts, lack of compliance continues to be a concern. Improved education on the importance of seat belt use should be implemented. This, along with a national mandatory seat belt law and its strict enforcement can serve to further lower the incidence of facial fractures and the associated morbidity sustained secondary to MVC.

Motorcycle helmets have also been shown to protect motorcyclists and reduce the incidence of maxillofacial fractures [14]. Bachulis et al. [15] found a facial fracture rate that was two times greater in non-helmeted patients, and Johnson et al. [16] reported non-helmeted motorcyclists are three times more likely to suffer facial fractures than those wearing helmets. This study shows a similar trend with only 4.26% of helmeted motorcyclists sustaining facial fractures compared to 18.38% of non-helmeted riders. A mandatory helmet law does not currently exist in our state and voluntary helmet use is low. Recent studies have shown the positive effect of mandatory helmet use laws on mortality and morbidity [17–19]. Clearly, a national mandatory helmet use law is needed to reduce the associated morbidity and mortality associated with riding a motorcycle without a helmet.

The association between alcohol consumption and facial fractures has been documented previously [20,21]. Our study found 45% of patients with facial fractures were legally intoxicated upon arrival to the trauma centre, confirming a relationship between facial fractures and alcohol. Additionally, patients who suffer facial fractures from BA are twice as likely to be legally intoxicated as MVC patients are (73.5 vs. 39.6%). Alcohol use by assailants and non-patient motor vehicle operators is difficult to identify but obviously plays a causative role in sustaining facial fractures. Legislation to increase legal drinking age, stricter enforcement of drunk driving laws with more severe punishment for violators and an increased societal awareness of alcohol related morbidity may assist with reducing alcohol related facial fractures.

The relationship between alcohol consumption and protective device use was also identified. Unrestrained MVC patients who suffered facial fractures were almost four times more likely to be legally intoxicated compared to those restrained with facial fractures. Nelson et al. [22] has shown a clear association between alcohol consumption and helmet use, finding that non-helmeted motorcyclists are more likely to be legally intoxicated than helmeted cyclists. Our data confirmed this finding. We found non-helmeted motorcyclists with facial fractures were almost 40 times more likely to be legally intoxicated as compared to helmeted motorcyclists with facial fractures. While not statistically significant due to the small sample size for the helmeted cyclists, this finding is clinically significant as demonstrated by the remarkable actual difference between the helmeted and non-helmeted groups. The current study found that alcohol plays an important role in the compliance with protective device usage. These findings clearly stress the importance of continued education on the dangers of alcohol consumption and motor vehicle use.

Strict laws, rigid enforcement and severe punishment for violators must be implemented on a national level to reduce the significant morbidity and mortality associated with drunk driving. Societal attitudes and behaviours must be modified before a significant reduction in injuries will be seen.

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References

[1] Schultz RC. Facial Injuries, 3rd ed. Chicago: Year Book Medical Publishers, 1988.
[2] Vetter JD, Topazian RG, Goldberg MH, Smith DG. Facial fractures occurring in a medium-sized metropolitan area: recent trends. Int J Oral Maxillofac Surg 1991;20:214–6.
[3] Scherer M, Sullivan WG, Smith DJ, Phillips LG, Robson MC. An analysis of 1423 facial fractures in 788 patients at an urban trauma center. J Trauma 1989;29:388–90.
[4] Starkhammar H, Olofsson J. Facial fractures: a review of 922 cases with special reference to incidence and aetiology. Clin Otolaryngol 1982;7:405–9.

[5] Brook IM, Wood N. Aetiology and incidence of facial fractures in adults. Int J Oral Surg 1983;12:293–8.
[6] Luce EA, Tubb TD, Moore AM. Review of 1000 major facial fractures and associated injuries. Plast Reconstr Surg 1979;63:26–30.
[7] Covington DS, Wainwright DJ, Teichgraeber JF, Parks DH. Changing patterns in the epidemiology and treatment of zygoma fractures: 10-year review. J Trauma 1994;37:243–8.
[8] Afzelius LE, Rosen C. Facial fractures: a review of 368 cases. Int J Oral Surg 1980;9:25–32.
[9] Haug RH, Prather J, Indresano AT. An epidemiologic survey of facial fractures and concomitant injuries. J Oral Maxillofac Surg 1990;48:926–32.
[10] Beck RA, Blakeslee DB. The changing picture of facial fractures. Arch Otolaryngol Head Neck Surg 1989;115:826–9.
[11] Price JD. Facial fractures and seat belts. Br Dent J 1983;155:112.
[12] Afzelius LE, Rosen C. Influence of seat belt upon maxillofacial fractures. ORL J otorhinolaryngol Relat Spec 1980;42:277–81.
[13] Huelke DF, Compton CP. Facial injuries in automobile crashes. J Oral Maxillofac Surg 1983;41:241–4.
[14] Luna GK, Copass MK, Oreskovitch MR, Carrico CJ. The role of helmets in reducing head injuries from motorcycle accidents: a political or medical issue? West J Med 1981;35:89–92.
[15] Bachulis BL, Sangster W, Gorrell GW, Long WB. Patterns of injury in helmeted and nonhelmeted motorcyclists. Am J Surg 1988;155:708–11.
[16] Johnson RM, McCarthy MC, Miller SF, Peoples JB. Craniofacial trauma in injured motorcyclists: the impact of helmet usage. J Trauma Injury Infect Crit Care 1995;38:876–8.
[17] Sosin DM, Sacks JJ, Holmgreen P. Head injury-associated deaths from motorcycle crashes. Relationship to helmet-use laws. J Am Med Assoc 1990;264:2395–9.
[18] Muelleman RL, Mlinek EJ, Collincott PB. Motorcycle crash injuries and costs: effect of a reenacted comprehensive helmet use law. Ann Emerg Med 1992;21:266–72.
[19] Kraus JF, Peek C, McArthur DL, Williams A. The effect of the 1992 California motorcycle helmet use law on motorcycle crash fatalities and injuries. J Am Med Assoc 1994;272:1506–11.
[20] Busuito MJ, Smith DJ, Robson MC. Mandibular fractures in an urban trauma center. J Trauma 1986;26:826–9.
[21] McDade AM, McNicol RD, Ward-Booth P, Chesworth J, Moos KF. The aetiology of maxillo-facial injuries, with special reference to the abuse of alcohol. Int J Oral Surg 1982;11:152–5.
[22] Nelson D, Sklar D, Skipper B, McFeeley PJ. Motorcycle fatalities in New Mexico: the association of helmet nonuse with alcohol intoxication. Ann Emerg Med 1992;21:279–83.