

Jaw Injuries of Independence Victims from the 1991 War in Croatia

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ABSTRACT

In the aetiology of maxillofacial injuries, car accidents, violence, sports injuries and lately war injuries are frequently mentioned. The purpose of this study was to exhibit and analyse types of jaw injuries on bodies exhumed from massive and individual graves located in regions temporarily occupied during the War in Croatia that lasted from 1991 to 1995. The sample was the post-mortem documentation of the orofacial region (set of teeth, photographs, radiographic images) of 1068 victims exhumed from massive grave sites in Croatia. The jaw traumatism was analysed on the whole sample as well as on individual graves, whilst the analysis of trauma frequency was performed separately. Descriptive statistics were computed and the value of $P < .05$ was accepted as statistically significant. Results of this study showed that out of 1068 examined corpses, 332 had midface and lower face fractures, which was 31.1% of the total number. Lower face fractures were more frequent with 28.1%. Age related frequency analysis showed a significant dependency. There were 34.6% of fractures in the under 30 age group, 34.2% in those aged 30–60, while 21.3% of fractures were noted in the over 60 age group. Female bodies had the lowest number of jaw fractures regardless of the osteoporotic changes. The results of this study suggest that younger and middle aged persons were molested more. Jaw fractures suggest ante-mortem molestation. In females, the more likely fracture causes were the falls of the bodies into the graves or body to body hits.

Key words: maxillofacial injury, jaw fracture, maxillary fracture, mandibular fracture, war crime, exhumation

Introduction

The Croatian War of Independence resulted in more than 16000 killed and missing people¹. There were 11834 people killed and 1283 are still considered missing. In the aftermath of war, Croatia was faced with a gargantuan task of finding both mass and individual grave sites and body identification issues. Mass graves usually contained piled up corpses, mostly unclothed and with no identification or with clothes altered in some manner while victims were still alive. Most of the exhumed bodies were mutilated, which made the identification more difficult, especially on the sites where the process of identification took place ten or more years post mortem^{2,3,4}. At the time, autopsies and exhumations determined the causes of death for 5140 people. From the year 1995 on, 3388

corpses were exhumed, out of whom 2805 were identified⁵.

The purpose of this study was to analyse mid and lower face bone traumatic injuries in exhumed bodies as well as to determine the underlying mechanisms of the traumatic injuries from post-mortem records of the exhumed victims.

Materials and Methods

We have analysed exhumed bodies from grave sites throughout the territories temporarily occupied during the war in Croatia. Approval from the Ethical Commi-

tee of the School of Dentistry was obtained and we collected data from post-mortem records, which contained dental status, radiographs and photographs. These records were stored at the Department of Dental Anthropology, School of Dental Medicine, University of Zagreb and The Department of Criminal and Forensic Medicine, School of Medicine, University of Zagreb, Croatia.

We have examined the records of 1068 casualties and analysed the following data: exhumation sites, age, gender, maxillary and mandibular fractures. The exhumation sites were divided into five locations with reference to the geographic location of the graves, while the sixth group incorporated the graves that did not belong to any of these locations or the exhumation sites that had been unknown (Table 1).

TABLE 1
EXHUMATION SITES DIVIDED BY LOCATION

Location	Exhumation sites
1. Eastern Slavonia	Lovas, Antunovac, Marinovci, Karadžičevo, Bogdanovci, Dalj, Tenja, Marinci, Negoslavci, Erdut, Darda, Ilok, Berak, Antin, Maruševac, Aljmaš, Pačetin, Ernestinovo, Donje Novo Selo
2. Western Slavonia	Pakrac, Okučani, Daruvar, Čelije, D. Hrastovac, Gr. Šnjegavić, Gredani, Šamarica, Novo Selo, N. Gradiška, Sl. Brod, Sl. Šamac, Batinjani, Kusunje
3. Banovina	Petrinja, H. Dubica, H. Kostajnica, Topusko, Glina, Svinica, Majur, Skela, Glavica, Hrastovica
4. Vukovar	
5. Ovčara	
6. Other locations	Dubrovnik, Gospić, Rakovica, Benkovac, Islam Grčki, unknown

The analysis of jaw injuries was based on geographic location, gender and age of the exhumed bodies. The bodies were divided into three age groups: 30 and under, 31 to 60, and over 60 years old. Dingman and Natvig classifications⁶ were used to assess mandibular fractures, while Le Fort classification⁷ was used to assess maxillary fractures. We have also analysed the frequencies of jaw injuries. Statistical analysis was performed by use of χ^2 -test or Fisher's exact test. A value of $p < 0.05$ was considered significant.

Results

1068 victims were analysed, which was 31.5% of the grand total of 3388 exhumed bodies and 38% of the identified individuals from 1995 to present day (Figure 1). The majority of the bodies were male (88%) and between the age of 31 and 60 (49%).

Jaw fractures were found in 332 bodies (31.1%), where mandibular fractures were found more common (28.1%) than maxillary fractures (4.1%). Both maxillary and mandibular fractures were found in 12 bodies (1.1%).

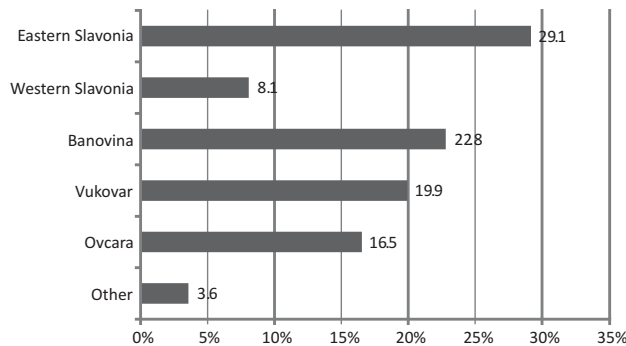


Fig. 1. Exhumed bodies regarding grave locations.

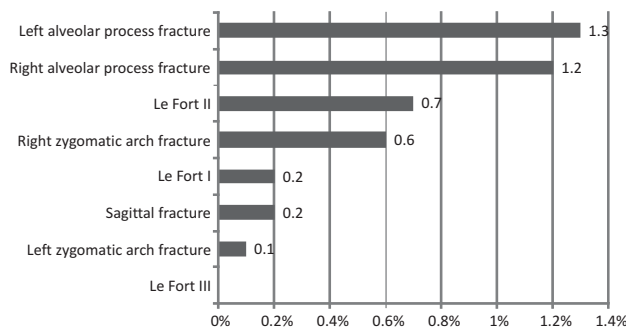


Fig. 2. Maxillary fracture frequencies.

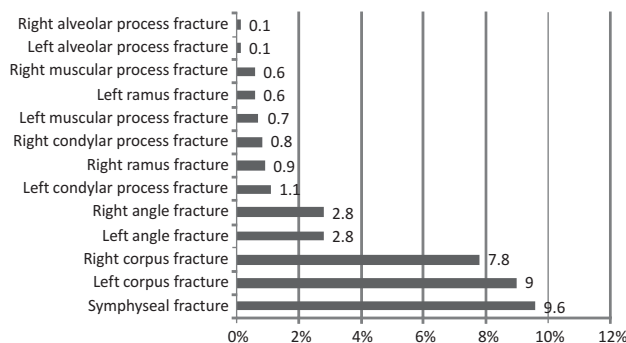


Fig. 3. Mandibular fracture frequencies.

Regarding maxillary fractures, the most common was the left alveolar process fracture in 14 bodies (1.3%) (Figure 2). The mandibular symphyseal fracture was the most common fracture in the mandible (103 bodies; 9.6%), followed by the left corpus fracture (96 bodies; 9%) and right corpus fracture (83 bodies; 7.8%) (Figure 3).

Multiple fractures in the maxilla were found in 2 bodies (4.5%).

Regarding mandibular fractures, we have found multiple fractures in 81 bodies (7.6%). In 70 bodies (6.6%) double fractures were found, followed by triple fractures in 9 bodies (0.8%) and quadruple fractures in 2 bodies (0.04%). Additionally a corpse with a total number of 5 fractures was found, having four fractures in the mandible and a single fracture in the maxilla.

Furthermore, we have analysed the combinations of the mandibular fractures. Out of 103 symphyseal fractures, 69 (67%) were single, while 34 (33%) were multiple (symphyseal fracture along with another fracture). Out of 96 left corpus fractures, 49 (51%) were single, and 47 (49%) were multiple fractures (left corpus along with another fracture).

Frequencies of maxillary and mandibular fractures were compared. There were no significant differences ($p > 0.05$). The maxillary fracture was presented equally in the group of bodies that had a mandibular fracture and in the group of bodies that had no mandibular fractures.

Furthermore, we have compared the distribution of fracture counts in the maxilla and the mandible per person. It was noted that 736 bodies (69.9%) had neither of the fractures. Out of those who had a single mandibular fracture, 7 bodies (3.2%) also had an maxillary fracture, while 3 bodies (33%) who had a triple mandibular fracture also had a maxillary fracture (Table 2).

The differences in fracture frequency regarding the age of the bodies was significant ($p = 0.0014$). Jaw fractures were more common in younger and middle aged bodies when compared to the bodies of the people aged 60

and above, where fractures were noted in merely more than one fifth of the cases (21.3%).

Age and gender distribution of the exhumed bodies was significantly related to the exhumation sites ($p < 0.001$) (Table 3). Most of the female bodies were found in the Banovina site (53 bodies; 21.7%) and Western Slavonia (15 bodies; 17.4%), while the least number of female bodies was found in the graves in Ovčara (2 bodies; 1.1%), Vukovar (6 bodies; 2.8%) and Eastern Slavonia (15 bodies; 4.8%). Regarding the estimated age, most of the younger bodies, under the age of 30, were found in Ovčara (91 bodies; 51.7%), while the most of the elder ones were found in the graves in Banovina (85 bodies; 34.8%).

There was an almost equal number of female bodies in the group without fractures (54 bodies; 22%) and in the group with fractures (53 bodies; 21.7%).

There was a significant correlation between fracture frequency and corpse age in both genders. In Eastern Slavonia and Banovina sites, fractures were more common in middle aged bodies, while in Western Slavonia, Vukovar and Ovčara there were more fractures in younger bodies (under 30 years of age). There was a significant difference between fracture frequencies regarding the exhumation sites. Half of the victims exhumed in

TABLE 2
THE INTERDEPENDENCE OF MAXILLARY AND MANDIBULAR FRACTURE COUNTS

Maxillary fracture count	Mandibular fracture count												p*
	0		1		2		3		4		Total		
	N	%	N	%	N	%	N	%	N	%	N	%	
0	736	95.8	212	96.8	69	98.6	5	55.6	2	100.0	1024	95.9	0.002
1	31	4.0	7	3.2	1	1.4	3	33.3	0	0.0	42	3.9	
2	1	0.1	0	0.0	0	0.0	1	11.1	0	0.0	2	0.2	
Total	768	100.0	219	100.0	70	100.0	9	100.0	2	100.0	1068	100.0	

* Fisher's exact test P-value

TABLE 3
AGE AND GENDER OF EXHUMED BODIES REGARDING EXHUMATION SITES

	Eastern Slavonia		Western Slavonia		Banovina		Vukovar		Ovčara		Other		Total		p*
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
	Gender														
Male	288	92.6	70	81.4	183	75.0	195	91.5	174	98.9	33	86.8	943	88.3	<0.001
Female	15	4.8	15	17.4	53	21.7	6	2.8	2	1.1	5	13.2	96	9.0	
Unknown	8	2.6	1	1.2	8	3.3	12	5.6	0	0.0	0	0.0	29	2.7	
Age (Years)															
30 and under	93	29.9	21	24.4	39	16.0	61	28.6	91	51.7	7	18.4	312	29.2	<0.001
31 to 60	170	54.7	41	47.7	113	46.3	98	46.0	79	44.9	25	65.8	526	49.3	
Over 60	41	13.2	23	26.7	85	34.8	46	21.6	6	3.4	6	15.8	207	19.4	
Unknown	7	2.3	1	1.2	7	2.9	8	3.8	0	0.0	0	0.0	23	2.2	

* χ^2 -test P-value

Ovčara (88 bodies) had either a mandibular or a maxillary fracture, which was then followed by Eastern Slavonia (110 bodies; 35.4%) and Vukovar (68 bodies; 31.9%) regarding fracture frequency. We have noted a similar relationship regarding mandibular fractures as 86 bodies (48.9%) exhumed in Ovčara had a mandibular fracture. The most common maxillary fractures were found in unspecified locations (3 bodies; 7.9%) and Eastern Slavonia (21 bodies; 6.8%).

The total number of fractures per person regarding the exhumation site was analysed separately. There were 3 groups defined by the number of fractures per person: no fracture, single fracture and multiple fractures. The percentage of multiple fractures significantly differed throughout the exhumation sites, ranging from 2% (5 bodies) in Banovina to 14.2% (25 bodies) in Ovčara ($p < 0.001$).

Discussion

War injuries, along with traffic accidents, violence and sports injuries, are nowadays becoming more common in the aetiology of maxillofacial trauma. In a study by Taher et al.⁸ authors have analysed 1135 patients with maxillofacial traumatism caused by various weapons in the 1984–1990 period. There have been 9.1% of patients with soft tissue injuries, 18.2% with bone fractures and 72.7% with combined injuries that included bone fractures and soft tissue injuries. The number of male patients was significantly greater than female number (1123 male compared to 12 female patients), which was also noted in our study. The highest number of injuries was noted in the lower third of the face (72.6%), followed by the middle third (36.3%) and upper third of the face (20%). These findings concur with results of our study. Mandibular fractures were the most common of all recorded fractures. More than half of the injured patients (52.4%) suffered bullet injury.

In another study by Taher et al.⁹ 1110 patients with lower third face injury examined for mandibular fractures. Combined injuries (both soft tissue injuries and fractures) were the most common (72%) and the most common fracture location was the mandibular corpus (26.1%). In our study we have noted a great number of symphyseal fractures (9.6%), left (9%) and right corpus (7.8%) fractures, left (2.8%) and right angular (2.8%) fractures and a small number of condylar process fractures. These findings point out the fact that mandibular fracture is a predilection site for fractures.

We have analysed the mandible and noted 67% of single fractures and 33% of multiple fractures in 103 symphyseal fractures. Out of 96 left corpus fractures, 51% were single and 49% were multiple (i.e. a direct symphyseal fracture and an indirect corpus or condylar process fracture). One third of symphyseal fractures and nearly 2/3 of corpus fractures in exhumed victims were multiple and lead us to the conclusion that mandibular fracture mechanism was specific and that it differed from other craniofacial bones, such as maxilla.

Over the last few decades, many articles have been published on maxillofacial war injuries. These articles

have analysed head and neck injury frequencies in wars in Vietnam, Lebanon and other warring locations throughout the world^{10–14}. The frequency of head and neck injury in the Vietnam war was 20%, in Lebanon war 29%, and in World War II 4%^{15–17}. Authors have concluded that the most common cause of maxillofacial injuries had been a shrapnel^{18,19}. In the analysis of maxillofacial injury aetiology after the Iran-Iraq war²⁰ authors have also concluded that the most common cause had been a shrapnel (in 80.7% of the cases), followed by bullet injury (in 19.3% of the cases). Most of the fractures were noted in the lower face region (mandible in 40.3% of the cases), and in the midface region (24.3%). As for mandibular fractures, the most common was mandibular corpus fracture, followed by symphyseal and ramus fracture. Our study results concur with these findings with most corpus fractures, followed by symphyseal, angle and ramus fractures. The frequency of maxillofacial war injuries in the territory of former Yugoslavia ranged from 5% to 17%, which was significantly less than in Croatia during nineties where 20% of midface and lower face injuries^{21,22}.

Aljinović-Ratković et al.²³ studied 220 hospitalized patients; 23% of them were civilian, 74% soldiers and policemen and 3% UN protection forces. The highest fracture rate was observed in the mandible (45% civilian and 36% official personnel). Midface fractures have been found in 35% of the civilians and 32% of official personnel, while bilateral lower face and midface fractures were seen in 13% of the civilians and 17% of official personnel. The age analysis determined that more than 2/3 of civilian patients were older than 36 and 81.6% of official personnel was aged from 25 to 35.

The aforementioned authors analysed the causes of maxillofacial injuries. The most common cause in both groups was a shrapnel (70% civilian, 65% official personnel), followed by a bullet (22% civilian, 22% official personnel). There have been 12 persons (5.5%) in both groups that had been injured by violence in Serbian prisons. Lower face fractures were more common than midface fractures (38%–32%).^{23,24} In our study, we have found 332 (31.1%) bodies with midface and lower face fractures. There was a significantly higher frequency of mandibular fractures (28.1% of mandibular fractures compared to 4.1% of maxillary fractures). The results showed that almost half of the victims (49.3%) were middle aged. Our findings concur with the results of previously mentioned study.

There was a significant correlation between fracture frequency and age of the corpses.

In the first two age groups, the under 30 years of age group and the 31–60 years of age group, there were 34.6% and 34.2% of fractures, respectively. The fracture frequency was significantly lower in the over 60 group, where there were 21.3% of fractures noted. That led us to the conclusion that younger and middle aged persons were molested more. Female bodies, regardless of age related osteoporotic changes, had the lowest number of jaw fractures. That fact can lead us to the conclusion that women were not beaten prior to execution and that the

more likely fracture cause was the fall of the body into the grave or a body to body hit in the overall fracture incidence in the mass grave sites.

Regarding the estimated age, most of the younger bodies (51.7%) were exhumed in the Ovčara site, where half of the bodies had at least one fractured jaw, that was, judging by the fracture sites, fractured by direct hits (in a fight). Most of the male bodies were exhumed there as well. All of the previous indicated that where vehement battles and highest resilience took place, the violence and the crimes were the most severe, particularly against the younger male population.

Conclusions

The highest exhumed body count was in the Eastern Slavonia site. Most of the exhumed bodies were male, with nearly half of them aged from 31 to 60. We can con-

clude that younger and middle aged persons were molested more. The gender related exhumed body distribution differed throughout the exhumation sites. The highest percentage of female bodies was in the Banovina and the lowest in the Ovčara site. Female bodies, regardless of the age related osteoporotic changes, had the lowest number of jaw fractures, which lead us to the conclusion that the more likely fracture cause was the fall of the body into the grave or a body to body hit. Jaw fracture frequencies differed throughout the exhumation sites. Half of the bodies in Ovčara had a jaw fracture, with nearly half of them in the mandible, which confirms the testimonials of surviving witnesses that described ante-mortal physical molestation (hitting with blunt objects and punching). Multiple fracture frequencies have also differed throughout the exhumation sites, ranging from 2% in Banovina to 14.2% in Ovčara, confirming the proofs about the worst atrocities in the Vukovar region.

REFERENCES

- BRKIC H, STRINOVIC D, KUBAT, PETROVECKI V, Int J Legal Med, 114 (2000) 19. DOI: 10.1007/S004149900130. — 2. SLAUS M, STRINOVIC D, PECINA SLAUS N, BRKIC H, BALICEVIC D, PETROVECKI V, CICVARA PECINA T, Forensic Sci Int, 171 (2007) 37. DOI: 10.1016/J.FORSINT.2006.10.003. — 3. BRKIC H, SLAUS M, KEROS J, JEROLIMOV V, PETROVECKI M, Coll Antropol, 28 (2004) 259. — 4. BRKIC H, STRINOVIC D, SLAUS M, SKAVIC J, ZECEVIC D, MILICEVIC M, Int J Legal Med, 110 (1997) 47. DOI: 10.1007/S004140050029. — 5. STRINOVIC D, SKAVIC J, ZECEVIC D, KUBAT M, PETROVECKI V, BRKIC H, SLAUS M, GUSIC S, CADEZ J, Alpe-Adria-Panonia, Supp. (2001) 55. — 6. DINGMAN RO, NATVIG P, Surgery of facial fractures (WB Saunders, Philadelphia, 1964). — 7. LE FORT R, Rev Chir, 23 (1901) 208. — 8. TAHER AA, J Craniofac Surg, 9 (1998) 371. DOI: 10.1097/00001665-199807000-00015. — 9. TAHER AA, J Craniofac Surg, 3 (1992) 90. — 10. HOR HT, Rev Stomatol Chir Maxillofac, 75 (1974) 1021. — 11. MALPASS CP, WINTER JS, Br J Surg, 63 (1976) 482. DOI: 10.1002/BJS.1800630621. — 12. ODHIAMBO WA, GUTHUA SW, MACIGO FG, AKAMA MK, Int J Oral Maxillofac Surg, 31 (2002) 374. DOI: 10.1054/IJOM.2001.0199. — 13. BAJEC J, GANG RK, LARI AR, Injury, 24 (1993) 517. DOI: 10.1016/0020-1383(93)90026-3. — 14. BEHNIA H, MOTAMEDI MH, J Cranio-maxillofac Surg, 25 (1997) 220. DOI: 10.1016/S1010-5182(97)80079-0. — 15. ANDREWS JL, J Oral Surg, 26 (1968) 457. — 16. DOBSON JE, NEWELL MJ, SHEPARD JP, Br J Oral Maxillofac Surg, 27 (1989) 441. DOI: 10.1016/S0266-4356(89)80001-4. — 17. HADDAD FS, Can J Surg, 21 (1978) 233. — 18. AL-SHAWI A, Br J Oral Maxillofac Surg, 24 (1986) 244. — 19. GARFIELD RM, NEUGUT AL, JAMA, 266 (1991) 688. DOI: 10.1001/JAMA.266.5.688. — 20. SADDI RS, Int J Oral Maxillofac Surg, 32 (2003) 209. — 21. JOVIC N, CVETINOVIC M, MIRKOVIC Z, STOSIC S, Vojnosanit Pregl, 53 (1997) 9. — 22. STANEC Z, SKRBIC S, DZEPINA I, HULINA D, IVRLAC R, Acta Med Croatica, 48 (1994) 123. — 23. ALJINOVIC-RATKOVIC N, VIRAG M, MACAN D, ZAJC I, BAGATIN M, UGLESIC V, KNEZEVIC G, GRGUREVIC J, KOBLEK P, SVAJHLER T, Mil Med, 160 (1995) 121. — 24. CAR M, JURETIC M, ZGALJARDIC Z, CEROVIC R, LUCEV A, Lijec Vjesn, 118 (1996) 194.

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TRAUME ČELJUSTI NA ŽRTVAMA RATA U HRVATSKOJ 1991.

SAŽETAK

U etiologiji maksilofacijalnih ozljeda najčešće se spominju prometne nesreće, nasilje i sportske ozljede, a u novije vrijeme sve češće i ratne ozljede. Svrha ovog istraživanja bila je prikazati i analizirati vrste trauma čeljusti na tijelima ekshumiranim iz masovnih i individualnih grobnica nastalih za vrijeme rata u Hrvatskoj od 1991. do 1995. godine u područjima koja su bila privremeno okupirana. Uzorak je činila posljedsmrtna dokumentacija stomatognatog sustava (status zubala, fotografije i rentgenske snimke) 1068 žrtava ekshumiranih iz masovnih grobnica u Hrvatskoj. Analiziran je traumatizam čeljusti na cijelom uzorku te po pojedinim grobnicama, a posebno je analizirana učestalost traumatizma. Napravljena je deskriptivna statistika uz vrijednost $p < 0.05$ prihvaćenu kao signifikantnu. Rezultati našeg istraživanja pokazuju da je na 1068 pregledanih tijela fraktura srednjeg ili donjeg lica nađena kod 332 osobe, što je 31.1% od ukupno analiziranih tijela. Značajno učestalija je bila fraktura donjeg lica s 28.1%. Analiza učestalosti frak-

ture u odnosu na dob pokazala je značajnu ovisnost. U dobnoj skupini do 30 i od 31–60 godina primijećena je fraktura kod 34.6%, odnosno 34.2% ekshumiranih, za razliku od 21.3% kod skupine iznad 60 godina. Žene, bez obzira na moguće osteoporotične promjene s obzirom na dob, imale su najmanji udio fraktura čeljusti. Rezultati ovog istraživanja upućuju na to da su mlade i sredovječne osobe mučene više. Frakture čeljusti predmnijevaju predsmrtno mučenje. Kod ženskih osoba vjerojatni uzrok fraktura bila su padanja tijela u grobnice te udarci tijelo o tijelo.