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Article

Frequency and patterning of bone trauma in the late medieval population (13th–16th century) from Dugopolje, southern Croatia

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With 5 figures and 6 tables

Summary: The aim of this paper is to test the hypothesis of an increased level of interpersonal violence in Dugopolje during the late medieval period as testified by written sources. In order to accomplish this, an analysis and comparison of frequencies and patterning of long bone and craniofacial fractures between sex and age categories in the Dugopolje skeletal sample was performed. In total 209 excellently preserved adult skeletons were analysed: 111 males and 98 females. The total long bone fracture frequency is 1.5 % (29/1910) with a significantly higher frequency in males compared to females. Most of the long bone injuries occurred as a result of accidents, probably due to rugged mountainous terrain, while a certain portion of trauma resulted from deliberate violence. Significantly higher fracture frequencies in males could be a result of a strict sexual division of labour where males performed more physically demanding and risky tasks, as witnessed by historical sources. 26 out of 119 complete adult crania (21.8 %) exhibit skeletal trauma with significantly higher frequencies in males. Perimortem trauma was observed in one individual while antemortem healed sharp force lesions were registered in five individuals (all males). The predominance of frontal craniofacial injuries, as well as the presence of perimortem trauma and sharp force lesions, suggests the presence of deliberate violence in this community. Although the indicators of deliberate violence were recorded predominantly in males, suggesting that intentional violence in Dugopolje was exclusively males' prerogative, the presence of nasal fracture in a female skeleton might point to a male towards female violence. Presented bioarchaeological data are in accordance with the written documents thus corroborating the claims of an increased level of deliberate interpersonal violence in the late medieval population from Dugopolje.

Key words: Dugopolje, late medieval period, deliberate violence, perimortem injury.

Introduction

In the past, bone fractures observed in osteological material from archaeological sites were usually presented as descriptive portrayals of individual skeletons that accompanied archaeological publications until Lovejoy & Heiple (1981) published their comprehensive analysis of bone injuries from the North American Libben site with the methodology that was later adopted and modified by numerous authors (e.g. Walker 1989, Bridges 1996, Grauer & Roberts 1996). Today, skeletal trauma are, together with osteological and dental indicators of subadult stress, alveodental and

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vertebral pathologies, one of the most studied pathological conditions in archaeological samples, and one of the most reliable indicators of living conditions and quality of life of an archaeological population (e.g. Domett & Tayles 2006, Djurić et al. 2006, Jurmain et al. 2009).

Since the beginning of the Zagreb-Split motorway construction during the last decade there has been an increased interest in bioarchaeological research of Croatian skeletal samples. Unfortunately, bone injuries have rarely been the primary objects of bioarchaeological analyses, and so far, only three papers have been published (Šlaus & Novak 2006, Novak & Šlaus 2010, Šlaus et al. 2010) predominantly addressing the issue of bone trauma in Croatian archaeological populations. The lack of such analyses prompted us to perform this investigation, in which we present the results of the analyses of the frequency and distribution of traumatic skeletal injuries in the late medieval (13^{th}–16^{th} century) skeletal sample from Dugopolje.

The settlement of Dugopolje was mentioned for the first time in 1283 in a document describing the village boundaries (Kužić 2001). Its history throughout the late medieval period is strongly connected with the nearby Klis fortress, the most important fortification in southern Croatia. This period in Croatia was marked by the end of the rule of the Hungarian-Croatian kings from the Arpad dynasty and the subsequent feudal anarchy, the constant skirmishes with the Venetians for the control of Dalmatia, and the incursion of foreign elements such as the Mongols in the 13^{th} century and the Ottomans in the 15^{th} and 16^{th} century.

The aim of this paper is twofold: to present frequencies and patterning of long bone and craniofacial fractures in the late medieval (13^{th}-16^{th} century) Dugopolje skeletal sample, and to test the hypothesis of an increased level of interpersonal violence in the Dugopolje region during the late Middle Ages as proposed by historic documents, based on the results of the comprehensive bioarchaeological analysis.

Material and methods

Dugopolje is located in southern Croatia, the contemporary region of Dalmatia, 20 km northeastern from Split (Fig. 1). The municipality of Dugopolje is surrounded by numerous hills and characterised by large fertile karst fields. The Mosor Mountain with its highest peak of 1331 m a.s.l. dominates the region while its massif separates Dugopolje from the Adriatic Sea which is only ten kilometres away (Rogošić 2001). Most of the region is made of the rocky soil thus giving the whole territory the character of the Dalmatian karst, covered by almost impassable macchia shrubbery and thickets composed of mostly thorny species (Rogošić 2001). During history the inhabitants of this region were engaged in transhumant pastoralism and extensive form of agriculture, with the diet based on meat and animal products, as well as cereals such as barley, rye and oats (Jurin-Starčević 2008, Šarić 2008).

The late medieval cemetery at the Dugopolje-Vučipolje site was excavated in 2004/2005 as a part of rescue archaeological excavations on a section of the future Zagreb-Split high-speed motorway conducted by the Museum of Archaeological Monuments in Split under the leadership of archaeologist H. Gjurašin. A total of 170 graves were uncovered, 70 of which were covered with *stećci* – monumental tombstones depicting various decorative motifs.

The grave finds consisted of three-bead earrings, coins dated between the 14^{th} and 16^{th} century, pins, silver buttons, rings, glass pearls, two knives, one belt buckle, and remnants of textile with golden threads. Based on the finds, the use of this cemetery can be dated from the end of the 13^{th} to the 16^{th} century (Gjurašin 2007). State of preservation of 362 skeletons excavated from this site varies between very good and excellent.

Fig 1. Map of Croatia with geographical location of Dugopolje.

Only adult skeletons (over 15 years of age) were analysed. Sex and age at death were determined based on methods described by Buikstra & Ubelaker (1994). Adults were grouped into three composite age categories: “young” (between 15 and 30 years), “middle” (between 31 and 45 years), and “old” (45+ years).

All skeletons were examined macroscopically for the possible presence of trauma using the methods proposed by Lovell (1997) and Maples (1986). The location of the injury on the skeletal element was recorded, as well as the shape, dimensions and possible complications. Additionally, the distinction between ante-, peri-, and postmortem skeletal injuries was established. Antemortem injuries were identified by the evidence of healing and remodelling of the bone (Sauer 1998), while perimortem injuries were identified using the criteria of the absence of healing and formation of new bone (Sauer 1998), fragments remaining attached to one another (Sauer 1998), internal bevelling (Fachinni et al. 2007), defined or sharp edges (Wheatley 2008), flat or polished surfaces and macroscopically visible striations (Wakely 1997). Since ground pressure and postmortem damage can mimic perimortem injuries (Murphy et al. 2010), a differential texture and colour of the lesion were used to differentiate perimortem from postmortem trauma (Sauer 1998, Facchini et al. 2007).

Given the varying degrees of preservation of the skeletons, and with the intent to obtain a more objective picture of the prevalence and distribution of bone trauma in the analysed sample, the fracture frequencies were calculated for each long bone and cranium. The presence of fracture on long bones was assessed on clavicle, humerus, radius, ulna, femur, tibia and fibula. Only long bones preserved to an extent of at least two thirds of their surface and with major articular surfaces preserved were analysed. The presence of trauma was determined by checking for bilateral bone asymmetry, angular deformities, and the presence of bone callus. Analysis of cranial injuries was carried out only on crania with all major bones (frontal, both parietal, both temporal, occipital, facial bones, and mandible) preserved in at least two thirds of their extent. Cranial injuries were divided into three categories: piercing injuries, blunt force, and sharp force trauma.

According to Jurmain et al. (2009), patterns of interpersonal aggression can be better understood through analysis of correlations among varied osseous indicators. So, in the analysis were included craniofacial injuries (facial and frontal regions combined), sharp force lesions, 'parry' fractures of the ulna, and perimortem trauma. In cases when a skeleton exhibited a craniofacial fracture which is also a sharp force lesion or a perimortem trauma, only one aspect of this injury was taken into consideration; in cases when in a skeleton besides a perimortem cranial injury an antemortem cranial fracture was present both trauma were recorded. For the purpose of this paper a Judd's (2008) definition of 'parry' fracture was used – the absence of radial involvement, a transverse fracture line, a location below the midshaft, and either minor unalignment ($\leq 10°$) in any plane or horizontal apposition from the diaphysis (< 50 %).

Data gathered in this study were statistically analysed using SPSS 14.0 for Windows. The observed differences were evaluated with the χ^2 test using Yates correction when appropriate, and statistical significance was defined by probability levels of $p \leq 0.05$.

Results

The sex and age distribution of the analysed skeletons is displayed in Table 1. The Dugopolje sample consists of 209 adult skeletons: 111 males and 98 females – the male/female ratio is 1:0.88. Age distributions between sexes are similar with males exhibiting somewhat longer average life span compared to females (38.6 vs. 36.7 years).

Long bone fracture frequencies are shown in Table 2. The total long bone fracture frequency in the analysed sample is 1.5 % (29/1910). Males exhibit significantly higher total frequency compared to females ($\chi^2 = 7.596$, df = 1, $p = 0.005$). There is almost no difference between the right and the left side involvement (right side 1.6 % vs. left 1.5 %). Long bone fractures were most frequent in the ulna (3.2 % or 8/252), followed by the radius (3.1 % or 8/257), and the tibia (1.6 % or 5/308). No concomitant fractures of radius and ulna were recorded. The comparison between the sexes with regards to long bone elements reveals significantly higher frequencies in males in ulnar fractures ($\chi^2 = 4.348$, df = 1, $p = 0.04$). A positive correlation between the total long bone trauma frequencies and advanced age is present ($\chi^2 = 10.317$, df = 2, $p = 0.006$) (Table 3).

Given that the ulnar 'parry' fractures are often used as an indicator of intentional violence this type of skeletal injury is of special interest in the trauma analysis. In total, eight ulnar fractures were recorded (all males), but only five of these fit into Judd's (2008) definition of a 'parry' fracture (Fig. 2) and as such indicate deliberate violence as a most probable cause.

The Dugopolje skeletal sample is represented by 119 adult complete crania, 26 of which (21.8 %) exhibit some kind of skeletal injury (Table 4). Males exhibit significantly higher frequencies of craniofacial injuries compared to females ($\chi^2 = 6.498$, df = 1, $p = 0.01$). Similar to the long bone fractures, the analysed sample displays a positive correlation between the total craniofacial trauma frequency and the advanced age ($\chi^2 = 14.568$, df = 2, $p < 0.001$). In the Dugopolje sample a total of 38 cranial injuries were detected – 17 crania displayed one trauma, seven crania displayed two traumas, one cranium displayed three traumas, and one cranium displayed four injuries.

Table 1. Sex and age distribution.

Age	Males	Females
15–30	19	26
31–45	72	56
45+	20	16
Total	111	98

Table 2. Long bone fracture frequencies by bone element.

	Left side			Right side		
	N	n	%	N	n	%
Clavicle						
Men	62	0	0.0	60	2	3.3
Women	51	0	0.0	48	0	0.0
Humerus						
Men	78	1	1.3	76	1	1.3
Women	60	0	0.0	66	0	0.0
Radius						
Men	77	3	3.9	70	2	2.9
Women	52	1	1.9	58	2	3.4
Ulna						
Men	70	5	7.1	76	3	3.9
Women	52	0	0.0	54	0	0.0
Femur						
Men	90	0	0.0	87	0	0.0
Women	69	0	0.0	76	0	0.0
Tibia						
Men	84	2	2.4	83	1	1.2
Women	71	0	0.0	70	2	2.9
Fibula						
Men	78	2	2.6	75	2	2.6
Women	57	0	0.0	60	0	0.0
Men	539	13	2.4	527	11	2.1
Women	412	1	0.2	432	4	0.9
Total	951	14	1.5	959	15	1.6

Table 3. Long bone fracture frequencies by sex and age.

Age	Males	Females	Total
		n/N (%)	
16–30	0/190 (0.0)	0/229 (0.0)	0/419 (0.0)
31–45	15/673 (2.2)	4/453 (0.9)	19/1126 (1.7)
45+	9/203 (4.4)	1/162 (0.6)	10/365 (2.7)
Total	24/1066 (2.2)	5/844 (0.6)	29/1910 (1.5)

Fig 2. 'Parry' fracture of the left ulna. Grave 166G, male, 36–40 years.

Table 4. Craniofacial fracture frequencies by sex and age.

Age	Males	Females	Total
		n/N (%)	
16–30	0/10 (0.0)	1/12 (8.3)	1/22 (4.5)
31–45	8/38 (21.0)	4/31 (12.5)	12/69 (17.4)
45+	12/15 (8.0)	1/13 (7.7)	13/28 (46.4)
Total	20/63 (31.7)	6/56 (10.7)	26/119 (21.8)

Distribution of craniofacial injuries by cranial element is shown in Table 5 and Fig. 3. The frontal bone was most affected (36.8 %), followed by the right parietal (26.3 %), and the left parietal bone (15.8 %). Differentiation by sex shows that the largest difference between males and females is present in the right parietal bone, but without statistical significance. Regarding the side, both sexes exhibit right side predominance compared to the left, and on the level of the complete sample this difference is statistically significant (right side 25/38 vs. left side 13/38; $\chi^2 = 6.368$, df = 1, $p = 0.01$). The types of recorded fractures include small circular and/or larger irregular depressions, sharp force lesions, nasal and mandibular fractures.

The recorded skeletal indicators of intentional violence include perimortem trauma, sharp force lesions, craniofacial injuries (only facial and frontal regions), and 'parry' fractures. The skeletal evidence of intentional violence in Dugopolje was recorded in 18 individuals – perimortem trauma was discovered in one individual

Table 5. Distribution of craniofacial fractures by cranial element.

	FR		LP		RP		LT		RT		OCC		FA		TO
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N
Males	12	40.0	5	16.6	6	20.0	1	3.3	2	6.7	2	6.7	2	6.7	30
Females	2	25.0	1	12.5	4	50.0	0	0.0	0	0.0	0	0.0	1	12.5	8
Total	14	36.8	6	15.8	10	26.3	1	2.6	2	5.3	2	5.3	3	7.9	38

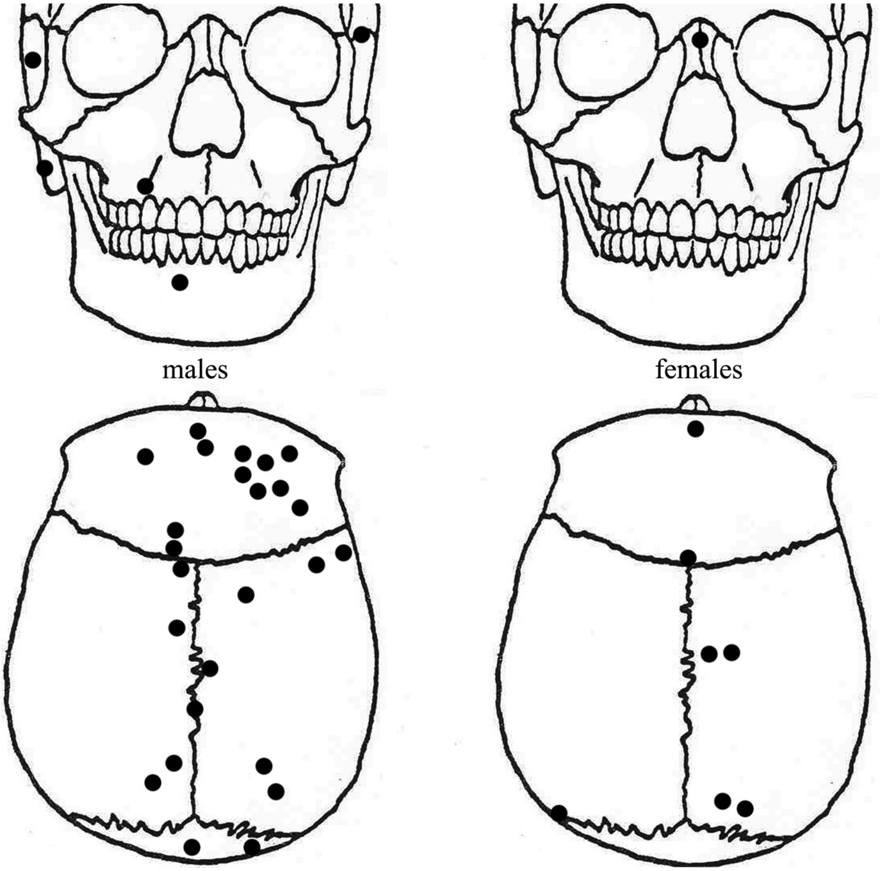

Fig 3. Distribution of craniofacial injuries by sex in the Dugopolje sample.

(Fig. 4), sharp force lesions were recorded in five skeletons (Fig. 5), frontal and facial cranial injuries were present in eleven skeletons, while 'parry' fractures were observed in five individuals (Table 6). Of all skeletons showing skeletal evidence of intentional violence three individuals exhibit more than one indicator – older male from grave 4 with three antemortem cranial fractures and one antemortem sharp force lesion, older male from grave 8D has one sharp force lesion and 'parry' fracture of the right ulna, while the middle-aged male from grave 81 exhibits combination of perimortem injuries and sharp force lesions. Among the individuals exhibiting indicators of deliberate violence only two skeletons belong to females – individual from grave 44B with antemortem nasal fracture, and the individual from grave 136B with antemortem depressed cranial fracture.

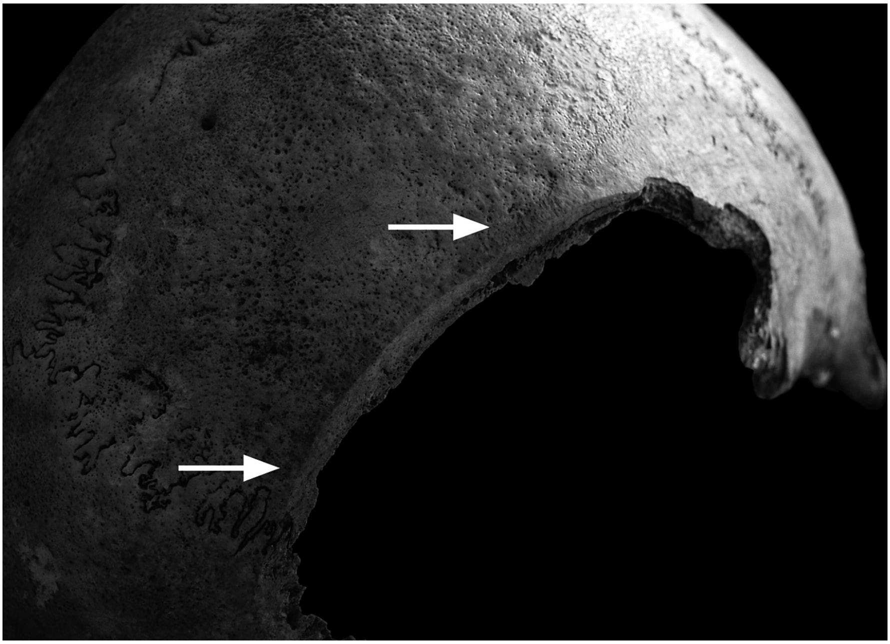

Fig 4. Perimortem sword cut on the right parietal bone. Grave 81, male, 31–40 years.

Discussion

The late medieval history of the Dugopolje region if full of numerous outbreaks of violence occurring mostly as a result of fights for the control over a nearby Klis fortress or due to numerous Ottoman incursions in the area during the 15th and 16th century. Considering the violent history of the late medieval period in the region of Dalmatia and its hinterland (e.g. Budak & Raukar 2006), and the presence of the osteological indicators of intentional violence in the nearby late medieval cemetery of Koprivno (Novak 2011) a certain number of cases of intentional violence in the cemetery of Dugopolje was expected as well.

The recorded total long bone trauma frequency in Dugopolje fits into values observed in numerous archaeological sites from the region of Croatia, Serbia, Hungary, and Austria where the frequencies range between 0.4 % and 2.8 % (Heinrich 1991, Djurić et al. 2006, Šlaus & Novak 2006, Novak et al. 2007, 2009, Gilmoure 2010, Novak & Šlaus 2010).

When comparing the differences between sexes one can notice that males in Dugopolje exhibit significantly higher fracture frequencies compared to females. This trend was observed in numerous archaeological populations regardless of their chronological and geographical determination (e.g. Robb 1997, Judd 2004, Djurić et al. 2006). Djurić et al. (2006) suggested that males in past populations may have been more exposed to injuries from various aspects of their life, such as interpersonal conflict, horse riding, hunting, and agricultural work, while Standen & Arriaza (2000)

Fig 5. Antemortem sword cut on the left parietal bone and the left temporal bone. Grave 8D, male, 56–60 years.

Table 6. Co-occurrence of the skeletal indicators of intentional violence.

Grave number/sex/age	Craniofacial	Perimortem	Sharp force	'Parry'
4, male, 51–55	X		X	
8D, male, 56–60			X	X
22B, male, 46–50	X			
28A, male, 51–55			X	
33, male, 46–50	X			
44, female, 41–45	X			
81, male, 31–40		X	X	
82, male, 41–45				X
85B, male, 31–40				X
89B, male, 46–55	X			
113A, male, 41–45	X			
115, male, 41–50	X			
136B, female, 41–45	X			
137B, male, 31–40	X			
147E, male, 51–60				X
154A, male, 51–55			X	
166E, male, 31–35	X			
166G, male, 36–40				X

proposed that male individuals are expected to exhibit higher overall frequencies of trauma because they tend to get involved in more physically demanding and risky jobs than females. Robb (1997) suggested that the higher trauma frequencies in males in prehistoric Italy are not a direct result of violence but are related to the development of gender roles that prescribed violent behaviour for males and reinforced a sexual division of labour in which women were not expected to perform activities considered heavy or dangerous, including warfare. Clinical studies indicate that most fractures in modern societies occur due to daily activities rather than interpersonal violence or unusual events – most fractures in females occur at home while most fractures in males occur at work or during sports (Lovell 1997).

The historical and ethnographic data indicate a strict sex division of labour in rural communities of the Adriatic hinterland during the late medieval period. In these communities males performed physically more demanding tasks such as ploughing, hoeing, mowing, clearing land, carpentry, preparation and treatment of hides, woodcutting, loading carts, work with large domestic animals and transhumant pastoralism (Ivanišević 1987, Vojnović Traživuk 2001), while women regularly performed all tasks related with milk and textile processing (milking, production of cheese, washing, screening and wool spinning, weaving and production of clothes and other textile items), and all activities related to the house such as gardening, fetching water, washing and cleaning, cooking, animal feeding, as well as taking care of children (Muraj 2004, Šestan 2008). The data of strict sex division of labour and significantly higher long bone fracture frequencies in males from Dugopolje support the hypothesis claiming that higher fracture frequencies in males in archaeological and modern samples are mostly a result of everyday activities where males performed more physically demanding and risky tasks rather than the interpersonal violence. Nevertheless, additional studies are needed if our conclusions are to be verified.

A slightly higher long bone fracture frequencies were recorded on the right side of the body compared to the left. The predominance of fractures in the right extremities might be an indication of handedness in the population. According to Ruff & Jones (1981), the majority of people are right limb dominant, and it could be expected that in stressful situations individuals would use their right, stronger limb for support or defence, ending in higher fracture frequencies on the right side.

In order to get a clearer picture of long bone trauma pattern, an effort was made to distinguish long bone fractures that were the result of accidents from those that resulted from deliberate violence. In the Dugopolje sample radial fractures are among the most common – all of these injuries are fractures to the distal radius (mostly Colles' fractures). This type of trauma is usually associated with accidents when a falling individual extends the arms to break the fall. A large number of Colles' fractures occur in the elderly, particularly in women, and are likely related to osteoporosis (Brickley 2002). Beside radial fractures the Dugopolje sample exhibits relatively high frequencies of tibial fractures that are most probably a result of a high risk of falls due to rugged terrain of the Adriatic hinterland – vast majority of these are oblique and spiral midshaft fractures and fractures of the proximal and distal epiphyses. Oblique tibial fractures are usually associated with accidents, suggesting falls from a low height (Russell et al. 1991), while spiral fractures, also accident-related, occur when the foot is stable and the body is twisted over the foot (Trafton 2003). Fractures of the proximal and distal epiphysis of the tibia result from repeated loading (Abel 2004) or are caused by a fall from a height (Bartlett et al. 1997).

The part of the skeleton that has frequently been utilized as an indicator of deliberate violence is the ulna, particularly the presence of 'parry' fractures, although the problem of attributing such fractures exclusively to intentional violence was raised and thoroughly explained by Smith (1996) and Judd & Roberts (1999). When criteria established by Judd (2008) are applied to the ulnar fractures analysed in this paper five cases fit into the definition of the 'parry' fracture. The presence of 'parry' fractures only in males suggests that interpersonal violence in Dugopolje was mostly men's prerogative. However, all conclusions based on 'parry' fractures frequencies has to be additionally tested, because as Jurmain et al. (2009, 469) suggested 'until the etiopathogenesis of forearm fracture is more firmly established through more detailed and well-documented clinical series, its inclusion in evaluation of interpersonal aggression should be used with extreme caution'.

Several authors (Walker 1989, Alvrus 1999, Standen & Arriazza 2000, Jurmain et al. 2009) point out that high frequencies of head and face trauma are conclusive proof of intentional violence. The Dugopolje sample exhibits a relatively high frequency of craniofacial trauma (21.8 %) which is in accordance with the data observed in other Croatian archaeological samples where the frequencies range between 15 % and 25 % (Šlaus & Novak 2006, Novak et al. 2007, 2009, Novak & Šlaus 2010). Males from Dugopolje exhibit higher frequencies of craniofacial injuries compared to females, which, according to Jurmain (1999), might be a result of division of labour according to sex, where more difficult and hazardous activities are performed by males, as well as a cultural behaviour that associates virility with aggressiveness (Ember & Ember 1997, Robb 1997).

Most of the craniofacial injuries in Dugopolje are located on the right side, which might indicate that injuries were sustained while the victims were fleeing their attacker or perhaps while lying prone (Larsen 1999). Usually, the cranial injuries in most archaeological samples are found on the left side because the left side of the skull is the most frequent injury site in a face to face combat with a right-handed aggressor (Boylston 2000, Djurić et al. 2006, Owens 2007, Jiménez-Brobeil et al. 2009). The fact that over one third of the craniofacial injuries in Dugopolje are located on the frontal bone could indicate an increased level of interpersonal violence in this sample, especially since Walker (1989, 1997) relates the frontal location predominance to deliberate violence. The presence of a nasal fracture is in accordance with the predominance of frontal injuries in Dugopolje. Nasal fractures have a high specificity for a clinical diagnosis of assault (Lovell 2008), as well as the presence of a mandibular fracture which is an additional head injury that may have been the result of interpersonal violence (Lukacs 2007). Walker (1997, 160) states that 'from a strategic standpoint, the head and especially the face are attractive targets because injuries of this area can be very painful. Well placed blows to the head are also likely to produce bleeding and conspicuous bruises that serve as a highly visible symbol of the aggressor's social dominance'.

The vast majority of the recorded craniofacial injuries are depressed fractures, as depressed injuries of the cranial vault are probably most common type of head injury in an archaeological context (Roberts & Manchester 1995). Beside the depressed fractures, the Dugopolje sample exhibits a relatively high percentage of sharp force injuries (five cases), mostly inflicted by swords which is another indicator of the presence of deliberate violence in the late medieval Dugopolje.

Perimortem injuries on the skeleton provide the most direct evidence of lethal conflict (Merbs 1989, Alvrus 1999). In Dugopolje the presence of perimortem injuries, most probably caused by a sword, was observed in a male skeleton from grave 81. The distribution of perimortem injuries in this skeleton reveals that the upper third of the body was the primary target, especially the region of head and neck, which is similar to the distribution of perimortem injuries recorded in skeletal samples from battle sites of Aljubarrota (Cunha & Silva 1997), Sandbjerget (Bennike 1998), Towton (Novak 2000), and Uppsala (Kjellström 2005). The similarity between the male from Dugopolje and lesions observed in other battle sites is a clear indication that the perimortem injuries from Dugopolje occurred as a result of deliberate violence. Could the male from grave 81 represent one of the victims killed in the numerous sieges of the nearby Klis fortress? Unfortunately, we will never know for sure, but it is obvious that a further multidisciplinary research involving historians, anthropologists and archaeologists is necessary if we want to clarify this issue.

An additional support to the hypothesis of the presence of deliberate violence in Dugopolje between the 13th and 16th century might provide the analysis of co-occurrence of skeletal indicators of deliberate violence: injuries of facial and frontal region of the cranium, sharp force lesions, 'parry' fractures, and perimortem trauma. The presence of five skeletons with sharp force lesions, one skeleton with perimortem trauma, as well as the presence of three individuals exhibiting multiple indicators of deliberate violence could be a definitive confirmation of the hypothesis of an increased level of deliberate violence in Dugopolje, as proposed by historic sources. The predominance of male skeletons exhibiting indicators of deliberate violence points to an almost exclusively male-directed interpersonal aggression. However, the nasal fracture recorded in the female skeleton from grave 44 could suggest a female-directed violence such as domestic assault, since this type of fracture is a typical skeletal indicator of domestic abuse, as observed in various bioarchaeological and clinical studies (e.g. Fonseka 1974, Shermis 1982, Walker 1997, Novak 2009). The presence of a female-directed violence in the eastern Adriatic hinterland during the late medieval period is also mentioned in historic documents. Namely, 'The Statute of the Principality of Poljica', a legal document dated to 1440 that codifies the ancient customs of a small self-governing region located just eastern of Split, in one of its paragraphs entitled 'On beating women' prescribes fines for a man beating another man's wife, sister or daughter, while the paragraph entitled 'On the abuse of women' prescribes penalties for raping, usually death penalty (Junković 1968).

Conclusions

A detailed study of frequency and patterning of bone trauma in the late medieval skeletal sample from Dugopolje revealed valuable data concerning the quality of life of the inhabitants of the Dugopolje region between the 13nd and 16th century. Available historical documents suggest a constant presence of deliberate violence in the area during the late medieval period, mostly due to sieges of the neighbouring Klis fortress, the strategic key point of southern Croatia.

Majority of the long bone fractures in Dugopolje probably occurred due to accidents, mostly due to rugged mountainous terrain, although some of the injuries point to interpersonal violence. Significantly higher fracture frequencies in males could be the result of a strict sexual division of labour where males performed more physically demanding and risky tasks, the fact witnessed by historic and ethnographic sources. The frontal predominance of craniofacial injuries again points to an increased level of deliberate violence in the analysed sample. The perimortem trauma and sharp force lesions additionally confirm the hypothesis of the presence of deliberate violence in medieval Dugopolje. Since almost all skeletal indicators of interpersonal violence were recorded in males, with few exceptions, this fact strongly suggests the predominance of a male-directed aggression.

The presented bioarchaeological data is in accordance with historic documents thus confirming their claims of an increased level of interpersonal deliberate violence in Dugopolje between the 13th and 16th century. However, additional multidisciplinary studies and further collaboration with other specialists are necessary for our conclusions are to be verified.

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