

SOCIO-HISTORICAL IMPLICATIONS OF TRAUMA PATTERNS: DATA FROM 15TH TO 17TH CENTURY BURIALS FROM IVANEC

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Editors: Juraj Belaj, Zsolt Hunyadi, Tatjana Tkalčec, Siniša Krznar,
Tajana Sekelj Ivančan, Tena Karavidović, Tea Kokotović, Sebastijan Stingl

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FOREWORD

Considering the network of military orders in medieval European society, their arrival on the territory of present-day Croatia was immensely important. This was especially the case since they were not only temporarily present in this region, but with their knowledge and skills, as well as in co-operation with other social actors, they were involved in the development of this region on several levels. They contributed to strengthening the ties with Western European traditions, and brought innovations from the West, where they came from, and the East, where they operated. Of course, we have to ask ourselves whether we can still find traces of these influences after all these centuries and to what extent. We must also bear in mind that their influences manifested not only at the time of their presence and activity in our region, but also much later.

In the project *Development and Heritage of the Military Orders in Croatia – milOrd* (HRZZ, IP-2019-04-5513, funded by the Croatian Science Foundation), we took a multidisciplinary and interdisciplinary approach to the military orders, their activities and influences on society, and the development of their sites, by observing the transformations of various categories of artefacts and features from selected archaeological sites. We also explored the making of the heritage of medieval military orders in today's society.

Human activity continued at most of the sites of military orders, even after they had left Croatian territory. Thus, the attention of the project researchers was drawn to a variety of different archaeological, historical, historical art, osteological, archaeobiological and other materials, not always closely related to the military orders and sometimes extending beyond the late medieval period. However, these materials have become unavoidable when examining the transformations of the estates and facilities once governed by military orders. In addition to researching these later changes, the materials from the period before their arrival were also analysed in order to gain as comprehensive an insight as possible. A diachronic study of changes on the gathered materials in combination with comparative analyses provided us with clues to the presumed influences of the military orders. Besides, the influence of the past

of the military orders on the Croatian territory was also observed in contemporary cultural practices. The goal was achieved through simultaneous research on several levels. The study of artefacts and features from different contexts was complemented by the analysis and interpretation of various historical sources. The art-historical sources were examined by art historians, osteological finds were analysed by biological anthropologists, samples from various archaeological contexts were subjected to archaeobiological analyses, and the contemporary making of the heritage of the medieval military orders was analysed from a cultural anthropological perspective.

The multitude of wide-ranging and multi-layered results obtained through our research prompted the scientific conference entitled *Military Orders and Their Heritage*, which was organised by the Institute of Archaeology as a part of this project. The conference aimed not only at presenting the results of the research project to a wider scientific community, but also at the participation of other scholars dealing with medieval military orders and their heritage, as well as at mutual dialogue within the topic. The conference was held at the Institute of Archaeology in Zagreb on the 9th and 10th of November 2022. It was the eighth conference in the field of mediaeval archaeology organised by the Institute, this time in cooperation with our colleagues from Hungary, i. e. from the Institute of History, University of Szeged. The cooperation resulted primarily from the fact that both the Knights Templar and Hospitaller acted in the joint Hungarian-Croatian province, but at the same time it relies on the interdisciplinary and international collaboration established within this project, particularly with Dr Zsolt Hunyadi, Associate Professor. As far as the original intention is concerned, the conference was a success, with 27 participants from 20 institutions and three countries attending and presenting a total of 19 papers. These conference papers were developed into 15 articles composing this book. All articles were separately peer-reviewed by two carefully selected experts from the international academic community with regard

to their specific field of expertise and research perspective. Most of the articles were published in English in order to achieve broad visibility in the international scientific community.

Once again, I would like to thank all conference participants for their constructive and fruitful cooperation. My gratitude also goes to the reviewers of individual articles and the book as a whole for their efforts, expertise and contributions. I would like to thank my colleagues at the Institute of Archaeology for their help in organising the

conference and publishing this book. My special thanks go to the PhD candidates working on the project *Development and Heritage of the Military Orders in Croatia*, funded by the Croatian Science Foundation, for their commitment and help in the realisation of this book.

We sincerely hope that the contributions gathered in this publication will inspire our colleagues from various scientific fields, especially young scholars, to research the phenomenon of military orders further.

Juraj Belaj

SOCIO-HISTORICAL IMPLICATIONS OF TRAUMA PATTERNS: DATA FROM 15TH TO 17TH CENTURY BURIALS FROM IVANEC

Original scientific paper

This study presents the results of the analysis of human osteological material from the site of Ivanec–Stari Grad (Castle), located in northwestern Croatia. Archaeological excavations at the site were carried out by the Institute of Archaeology from 1998 until 2012, finding 326 graves inside and around the two churches: one from the Romanesque period and the other from the Gothic period. Based on the finds and stratigraphy, graves can be dated from the 11th until the beginning of the 17th century and are divided into five burial phases. This study includes skeletal remains from the last two burial phases, i.e. the period from the 15th to the beginning of the 17th century. The analysis was conducted on 91 of 93 graves, as two graves were excluded from the study. Trauma analysis was carried out on the crania and the postcranial skeleton where more than 50% of the bone was present. All the recorded traumas were identified as antemortem; a possible cause of their occurrence is suggested on the basis of their location on the skeleton. Results show the complete absence of trauma in subadults and females and a low frequency of cranial and long bone traumas in males. Most of the traumas were recorded on the ribs and vertebrae; all the recorded traumas were the result of accidental injuries. The obtained results are consistent with historical records, which do not speak of major conflicts in the considered area during what was generally a turbulent period in Croatia. However, they reflect the changes in estate ownership and indicate an increase in inequality between different social classes, which is also suggested by the occurrence of trauma in the considered sample.

KEY WORDS: BIOARCHAEOLOGY, HUMAN SKELETAL REMAINS, LATE MIDDLE AGES, EARLY MODERN PERIOD, ACCIDENTAL INJURIES, OTTOMAN CONQUESTS, SOCIAL STATUS, PEASANT REVOLT



INTRODUCTION

Trauma analyses are recognized as an important subdiscipline of bioarchaeology and palaeopathology, as they can help understand the cultural, social, or environmental causes of traumatic injuries. They can also indicate their correlation to sex, age, social or cultural systems, and temporal and geographical variation.

Based on the time of occurrence, traumas can be classified into antemortem and perimortem traumas. Antemortem trauma occurs during life and is distinguished by healing and remodelling (Aufderheide, Rodríguez-Martín 1998). Perimortem trauma happens at or near the time of death and shows no signs of healing (Sauer 1998); the colouring between the fracture surface and the surrounding bone is consistent (Ubelaker, Adams 1995) and the edges of the fracture are well defined and sharp (Wheatley 2008).

Usually, trauma analyses are just one component of comprehensive bioarchaeological analyses and publications. Less often, they deal solely with the frequency and distribution of trauma. Several papers and theses from Croatia encompassing the late medieval and early modern periods have been published in recent decades (e.g. Krznar et al. 2010; Šlaus et al. 2010; 2012; Novak, Šlaus 2012; Joksimović et al. 2019; Bedić et al. 2019, Bedić 2021; Adamić Hadžić 2021).

Therefore, the purpose of this study is to observe the trauma pattern and frequency in Ivanec in the period from the 15th to the beginning of the 17th century, which is known as a turbulent and unstable time, and to contribute to the knowledge of socio-political circumstances and interpersonal relations of that time.

MATERIAL AND METHODS

Archaeological excavations at the site of Ivanec–Stari Grad (*Castle*),¹ located in northwestern Croatia (Map 1), in the cultural and historical region of Hrvatsko Zagorje, revealed the remains of a Renaissance *castellum*, a Baroque chapel, and Gothic and Romanesque churches with the associated cemetery (Belaj 2013). 326 graves were discovered at the site, dating from the beginning of

the 11th until the beginning of the 17th century. As they were marked by clear changes in mortuary practices, they could be divided into five burial phases (Belaj 2009; Belaj, Sirovica 2010; 2011; 2012; 2016; 2023). This study is focused on the 4th and 5th phases, i.e. the last two burial phases identified at the site and belonging to the final part of the Late Middle Ages and the beginning of the early modern period.

The 4th burial phase, associated with 82 graves,² is dated to the 15th and the first half of the 16th century. Compared to the previous phase, we can clearly distinguish the newly introduced elements of funeral practices. This phase is characterized by the appearance of coffins and nails, while the deceased individuals were buried with arms crossed on the chest or stomach. At the same time, iron belt buckles became the most common find (Belaj, Sirovica 2016: 61), established in the original position in 19 male graves and 7 graves of subadults.

The 4th burial phase shares most of its characteristics with the last phase, in which belt buckles are only found in backfills. The last phase is a relatively short period between the second half of the 16th and the beginning of the 17th century, associated with only eleven graves, which are separated because their burials took place after extensive earthworks that were clearly identified at the site (Belaj, Sirovica 2016: 61). That is why we considered the skeletal remains from both phases as one sample, which is also suitable for further comparisons with other chronologically concurrent sites.

Sex and age of the skeletons were estimated using several standard anthropological criteria. Sex was estimated only for individuals over 15 years of age, based on the morphology of the skull (Krogman, Işcan 1986) and pelvis (Bruzek 2002). Age at death was estimated based on the morphology of the pubic symphysis of the pelvis (Gilbert, McKern 1973; Brooks, Suchey 1990), the morphology of the auricular surface of the pelvis (Lovejoy et al. 1985), the degree of obliteration of ectocranial sutures (Meindl, Lovejoy 1985), the sternal rib end morphology (Işcan et al. 1984; 1985), and the degree of tooth wear in adults (Smith 1984). In total, there are 36 males and 20 females. Among them, the remains of one individual were determined as probable male and the remains of another as probable female. Sex could not be determined for the insufficiently preserved skeletal remains of one adult, which were excluded from

1 — Archaeological excavations were conducted from 1998 until 2012 by the Institute of Archaeology, first under the supervision of Željko Tomičić and then under the supervision of Juraj Belaj (from 2002).

2 — The number of graves attributed to a particular phase in this paper differs from the numbers in the paper of Belaj, Sirovica 2016 because of newly conducted radiocarbon analyses and a reevaluation of the stratigraphic sequence.



Map 1 – Location of the town of Ivanec (made by: F. Sirovica)

further analyses. The same was done for a grave which contained only reburied remains belonging to an earlier truncated grave.

Also, the skeletal remains of 35 subadults were identified. Their age was estimated based on the degree of the length and width of the long bone diaphyses, the fusion between the epiphysis and the diaphyses, and the degree of development and eruption of deciduous and permanent teeth (Moorrees et al. 1963; Scheuer, Black 2000).

Finally, the skeletal remains of 91 individuals were further analysed to determine the presence of trauma. Traumas were examined macroscopically; the location, shape, dimensions, and possible complications were recorded during the procedure (Lovell 1997; Wakely 1997; Facchini et al. 2007; Wheatly 2008). Preservation of more than 50% was the precondition

for a skull or a long bone to be included in the analysis. Only 33 of the 56 adults (20 males and 13 females) had sufficiently preserved skulls for the analysis.

The following long bones were analysed: clavicles, humeri, radii, ulnae, femora, tibiae and fibulae. The 56 adults had 436 long bones that were adequately preserved for the analysis, of which 293 belonged to males and 143 to females. Traumas on short, flat, and irregular bones were only listed and described.

RESULTS

Of the 326 graves excavated at the site of Ivanec–Stari Grad, human skeletal remains from 236 graves have been analysed thus far: 78 males or probable males, 60 females or probable

Sex	Phase 4	Phase 5	Total
Males	33	3	36
Females	16	4	20
Subadults	31	4	35
Total	80	11	91

Tab. 1 – Sex distribution in the Ivanec sample by observed burial phases (made by: Ž. Bedić and F. Sirovica)

females, 90 subadults, and 8 individuals of undetermined sex. The last two phases comprise 28.5% of the total number of excavated graves. Among them, those analysed were 33 males, 16 females, and 31 subadults belonging to the 4th burial phase, and three males, four females, and four subadults belonging to the 5th burial phase (Tab. 1). Mean age at death for all adults is 44.1 years, 45.4 for males and 41.8 for females, which is not a statistically significant difference.

The analysis found that neither subadult nor female skeletal remains have recorded traumas. However, 12 out of 36 males (33.3%) exhibited at least one trauma, and a total of 43 traumas were recorded on male skeletons (Tab. 2). It can also be noted that all the traumas were recorded on the skeletal remains of individuals attributed to the 4th phase, so the percentage in that phase becomes somewhat higher (36.4%). Six males had only one trauma (five on one rib and one on the left talus), while the remaining six had multiple traumas. In this regard, we can single out graves 98 and 158, both older males. The male in grave 98 had fractures on eleven ribs and four vertebrae. There was one fracture on the 11th and 12th left rib and the 3rd and 4th right rib, two fractures on the 5th right and 9th left rib, and three fractures on the 10th left rib. The fracture closest to the sternal end is characterised by non-union and mild active periostitis. Rib fractures were mostly located on the rib shafts. Vertebral fractures were recorded on the spinous processes of the 4th, 5th, 6th, and 7th vertebra; on the last two vertebrae, the fractures resulted in the shift of the spinous process to the left side.

The male from grave 158 exhibited eight traumas – one cranial trauma on the right side of

Grave	Trauma location	Mean age at death	Number of traumas
7	10 th left rib	43	1
14	8 th left rib	38	1
15	6 th –10 th left ribs	48	5
32	T8, T12	53	2
36	9 th left rib	48	1
87	left talus	58	1
95	10 th right rib	48	1
98	9 th (×2), 10 th (×3), 11 th , 12 th left rib; 3 rd , 4 th , 5 th (×2) right rib; T4–T7	58	15
102	2 nd left and 4 th –7 th right ribs	58	5
118	5 th or 6 th right rib	33	1
158	frontal, 2 on right radii, 1 on right ulnae, 4 metacarpal bones	58	8
205	left ulna, 7 th or 8 th left rib	38	2
Total		48.4	43

Tab. 2 – The number and distribution of traumas on the human skeletal remains from Ivanec (made by: Ž. Bedić and F. Sirovica)

the frontal bone (Fig. 1: A), two on the right radii, one on the right ulnae (Fig. 1: B), and four on the metacarpal bones (Fig. 1: C). The cranial injury is a healed depressed fracture measuring 18×8 mm with a smooth resorbed surface and rounded edges. The first fracture on the radius is located in the middle third of the diaphysis. This oblique fracture manifests in a posterior-medial displacement and bone overlap. The two parts of the diaphysis were joined only by a remodelled callus, and the diaphyses at the broken ends remained open. On the distal third of the diaphysis there is another fracture, characterised by a slight posterior displacement. Mild healed periostitis is visible in both fractures. On the distal third of the ulna there is a poorly healed fracture corresponding to a larger fracture on the radius. It manifests in a posterior-lateral displacement and overlapping of the bone, as well as a large remodelled callus and mild healed periostitis. Fractures on the four metacarpal bones

of the right hand (MC 2-5) resulted in osteoarthritis on the bones of the wrist and four ankyloses: two phalanges (intermediate and proximal); two carpal bones with two metacarpal bones (probably MC2 with trapezoid and MC3 with capitate); and two metacarpal bones (MC4 and MC5) were fused at the bases.

Looking at the traumas by location on the skeleton, out of the 20 male skulls there is only one cranial trauma (5.0%), which accounts for 2.3% of all traumas (1/43). On the 293 long bones there were four traumas (1.4%), making 9.3% of all traumas (4/43). All the other traumas (38/43 or 88.4%) were recorded on metacarpal bones, talus, ribs, and vertebrae. Most of these traumas were found on the ribs (27/38 or 71.1%), followed by fractures of the vertebrae (6/38 or 15.8%). The 4th and 5th rib on the right side and the 8th, 9th, and 10th rib on the left side were the ribs most often affected by trauma (Fig. 2).



Fig. 1 – Traumas recorded on the skeletal remains of a male from grave 158 (photo by: S. Krznar)

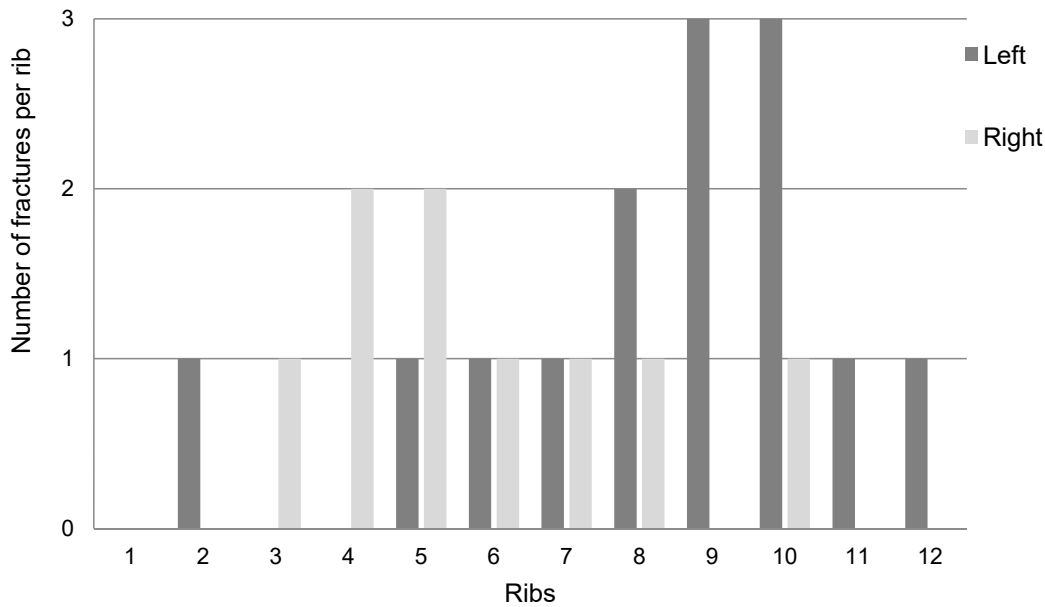


Fig. 2 – Frequency and distribution of rib fractures (made by: Ž. Bedić and F. Sirovica)

DISCUSSION

Ivanec in the historical context

The results obtained from the Ivanec sample cannot be considered a reflection of the wider historical events that were taking place in most of continental Croatia, where everyday life from the middle of the 15th century was marked by constant threats and fears of war, destruction, loss of freedom, and all other forms of physical and psychological violence (Grgin 2002: 102). These circumstances, which were primarily caused by the Ottoman conquests, have been reflected in certain bioarchaeological studies that show a high rate of perimortem trauma: Bijela (Bedić et al. 2019), Udbina (Bedić, Šlaus 2016), and Čepin (Šlaus et al. 2010). This state of affairs remained unchanged until the end of the 16th century, when the Croatian forces finally managed to inflict a heavy defeat on the Ottoman forces in the battle of Sisak (1593), and the beginning of the 17th century, when a peace treaty (Peace of Zsitvatorok) was signed between the Habsburg Monarchy and the Ottomans in 1606 (Kruhek 2001: 80; Klaić 1975: 580–581).

There are no historical sources on Ottoman attacks in the area of Ivanec, although they were recorded in the immediate vicinity. Ottoman raids in the region of Hrvatsko Zagorje began in the 1470s; in 1479 they devastated the area around the nearby town of Lepoglava, after which the Pauline monastery in Lepoglava was fortified with towers and moats (Petrić 2010: 98). In the period between 1540 and 1545 they carried out numerous robberies and

burned several villages in the Varaždin area, especially around Varaždinske Toplice and Bela. The proximity of occupied territories and occasional robberies spread fear among the population and encouraged migrations, but the Ottomans never occupied the area (Budak 1994: 117–118, 163). Although the crisis and stagnation gradually waned during the second half of the 16th century, there was still concern about military security, and a crew of 20 soldiers was stationed in Ivanec at the end of the century (Budak 1994: 117). At that time (in 1598), the population of Ivanec was estimated at 42 families (Petrić 2010: 100), i.e. approximately 240–270 people (Budak 1994: 168).

Even though they were only marginally affected by the Ottoman conquests, Ivanec and its inhabitants in the 15th and 16th centuries went through several processes that affected their daily lives. In 1439, the ownership of the Bela estate, and thus of Ivanec, passed into the hands of Croatian Ban Matko Talovac, who transferred the estate from the church (Knights Hospitaller) to secular ownership (Kraš 1997: 66). Around 1502, Ban Ivaniš Korvin pledged Bela and Ivanec to counts Ladislav, Toma, and Franjo Petheo de Gerse for 5,600 ducats (Kraš 1997: 67; Belaj 2008: 7). The new owners built a *castellum* around the Gothic church, so that it was inside the castle courtyard (Šaban 1977: 150–151; Budak 1994: 121; Kraš 1997: 67). In 1558 Ivanec became the administrative and economic centre of the family and remained in their property until 1738.

With the new owners of the estate, the rights of the residents of Ivanec were increasingly reduced, while

their obligations increased, gradually turning them into serfs (Hrg 1975a: 130). They started a rebellion on April 5, 1568, attacked the castellum, defeated the official, Juraj Lančić, and left for the "German state", probably Styria, the next day. After negotiations, they returned to Ivanec at the end of May, but as their demands were not met, protests continued until March 1569, when a final agreement was reached. Although the nobility demanded a military response and violent suppression of the revolt, Croatian Ban Juraj Drašković was more inclined to negotiations and a peaceful solution (Adamček 1972–1973; Hrg 1975b), which can be considered consistent with the absence of trauma caused by violence in the analysed sample.

Causes of trauma in the 15th to 17th-century Ivanec

In the 15th to 17th-century Ivanec sample, there was only one depressed fracture, recorded in the left side of the frontal bone of a male from grave 158. These kinds of fractures occur as a result of falls or assaults (Galloway 1999). Although the cause of this trauma cannot be established, fractures caused by assault are usually located over the frontoparietal region because this position is easily accessible to an attacker (Walker 1997).

The male from grave 158 also exhibited three fractures on the right forearm, one ulnar and two radial. Some clinical studies mention them as the most frequent fractures of upper extremities (Karl et al. 2015; Patel et al. 2021: 345). According to the Orthopaedic Trauma Association Classification, the complex radius fracture with a simple ulna fracture is categorised as Type C2 (Radiology Key 2017). These kinds of fractures, which involve both the radius and ulna, are nowadays often the result of high-energy injuries such as motor vehicle crashes or athletic collisions, but they can also occur if sudden axial loading onto the radius and/or ulna is applied, such as a fall onto an outstretched hand with wrist extension (Patel et al. 2021: 345, 352). It is also possible that these were a result of two separate events: in one, the middle third of the diaphysis of the radius and ulna were injured; in the other, only the distal radius was injured. The second fracture recorded on the distal radius is known as Colles' fracture. These fractures are commonly located 2 cm above the distal articular surface, with the distal fragment posteriorly displaced. In clinical studies, this is the most common fracture in adults over the age of 40, and it is usually caused by the indirect trauma of a fall onto the hand (Lovell 1997: 161). Radius fractures in archaeological specimens most commonly result in malunion and seldom heal without deformities (Lovell 1997: 165; Grauer,

Roberts 1996: 540), as can be seen on the bones of the right forearm of the male from grave 158.

The fractures on the four metacarpal bones of the right hand are probably related to the fractures recorded on the right forearm. Apart from the ankyloses of the 2nd and 3rd carpometacarpal joints, there is no visible fracture line, callus or axis deviation at the macroscopic level, so it is possible that the fractures occurred at the metacarpal bases. The occurrence of these fractures is associated with a forced flexion of the wrist and a simultaneous extension of the arm, which happens because of a punch or a fall (Bushnell et al. 2008: 573). Although it is possible that the fractures recorded on the skeletal remains of the individual buried in grave 158 occurred during his long life and are the results of separate events, it should be noted that most of them can be explained as the result of a single traumatic event caused by a fall, for example.

Long bone fractures are represented in the Ivanec sample by one more ulnar fracture. The trauma in the distal third of the diaphysis of the left ulna was most probably a spiral fracture, which usually results from a twisting, forced pronation injury, such as a fall (Lovell 1997: 165). All the other traumas were recorded on the talus, and in the region of the torso – on vertebrae and ribs. Nowadays, talus fractures most often result from high-energy incidents such as motor vehicle collisions, falls from a height, vehicles striking pedestrians, crush injuries, and athletic injuries (Schwartz et al. 2020: 1). Vertebral fractures are usually the result of a fall, overexertion during lifting, or severe repetitive compression loads on the vertebral bodies (Myers, Wilson 1997: 30; Nevitt et al. 2005: 138). Rib fractures in modern populations can be caused by traffic accidents, falls, assaults, and work-related accidents, and the ribs most affected with trauma are the 4th–9th ribs (Sirmali et al. 2003: 133–134), which corresponds to the results of this study.

It should be noted that traumas of the vertebrae, distal parts of the radii, and rib fractures are common in older people with osteoporosis (Brickley 1997; 2006). The mean age at death is 48.4 years for males with trauma and 43.9 years for males without trauma, but the difference is not statistically significant ($\chi^2=0.665$; $P=0.420$). However, seven out of eleven individuals with fractures of ribs, vertebrae, or distal radii were older than 45 years at the time of death, and Fisher's exact test showed a statistical difference ($\chi^2=11.000$; $P=0.003$), so the possibility that osteoporosis may have played a role in the increased frequency of this type of trauma cannot be ignored.

Trauma in contemporaneous samples

The analysis showed that men in Ivanec were subject to trauma relatively often in the final part of the Late Middle Ages; however, there were no trauma traces in the following period. The lack of trauma traces on subadults under 15 years of age was previously noted in many archaeological populations (Judd 2004: 35; Šlaus 2008: 461; Scott, Buckley 2010: 511), while the complete absence of trauma in adult females can be considered somewhat unusual. As the sample contains an almost equal number of males and subadults, while females are noticeably underrepresented (1.8:1), the absence of trauma in females may be a consequence of their low representation, while a somewhat shorter lifespan cannot be completely ruled out either. The observed difference between sexes in the frequency of trauma was previously noted in other Croatian and European medieval and early modern sites (Djurić et al. 2006; Šlaus et al. 2007; Novak, Šlaus 2012; Milner et al. 2015; Dittmar et al. 2021; Adamić Hadžić 2021). These authors most often explain the higher trauma frequency in males by their involvement in more demanding physical activities, such as agricultural and livestock work, horse riding, hunting, working with heavy objects etc.

In general, Ivanec is characterised by a relatively low frequency of trauma among adults, even if considering only the 4th burial phase of the 15th and the first half of the 16th century. This is especially noticeable when compared to the findings obtained by the analysis of human skeletal remains from late medieval graves from continental Croatia dated from the 13th to the 16th century (Šlaus et al. 2007: 232). Data on the higher frequency of trauma were also obtained from graves buried in the area of the sacristy of the Church of the Assumption of the Blessed Virgin Mary in Gora near Petrinja (Bedić et al. 2022). Comparable data comes from the 4th burial phase, dated between the first quarter of the 15th century to the end of the 16th or the beginning of the 17th century (Belaj et al. 2021). Although the total sample was quite small – only eight adults and eleven subadults – the fractures were distributed uniformly by sex, while no trauma was recorded on the skeletal remains of subadults (Bedić et al. 2022: 184). Only one cranial trauma on nasal bones and one long bone fracture (radius) were noted. Other fractures were found on the metatarsal bones, ribs, and vertebrae. Again, most of the traumas could be

related to accidents, while only the trauma on the nasal bones of a female could suggest a violent episode.

However, the findings from Ivanec correspond to the data from the contemporary burials at the cemetery around the Church of the Discovery of the Holy Cross in Zrin. The small sample from Zrin consisted of only 24 adults and 8 subadults (Novak et al. 2021); fractures were recorded on the skeletal remains of only three males, and none of them were on the cranium or long bones. Similarly to Ivanec, the torso was the most common trauma location (four ribs and one vertebra), indicating that the observed injuries were the result of accidents associated with a rural lifestyle rather than violent episodes (Novak et al. 2021: 329).

The late medieval sample from the cemetery around the Church of St Francis in Zagreb (Šlaus et al. 2007) is also characterized by a low trauma frequency and a distribution consistent with accidental injuries. Furthermore, the frequency and distribution of pathological changes in bones and teeth, the unrealistically high proportion of males in the sample, and the significantly higher mean age at death suggest that it was a prestigious cemetery where socially privileged people were buried (Šlaus et al. 2007). Although no analyses of pathological changes on the skeletal remains from Ivanec have been carried out yet, there are some similarities with the cemetery of St Francis in Zagreb (the underrepresentation of females, a higher mean age at death, and the already mentioned low frequency of trauma).

In the context of historical events, it can be noted that the family of Petheö de Gerse built a new *castellum* in Ivanec in the middle of the 16th century, so that the Gothic church ended up in the castle courtyard (Šaban 1977: 150–151; Budak 1994: 121; Kraš 1997: 67). After this major intervention, coinciding with the end of the 4th burial phase, the number of burials decreased significantly; it is very likely that it was not in the interest of the new owners of the *castellum* to have the burial ground in the courtyard of the castle. While the historical sources show a gradual neglect of the church until its demolition in 1674 (Szabo 1919: 74; Šaban 1977: 145), the abandonment of the cemetery is confirmed by the small number of burials (only 11), all of them inside the church. Therefore, the dead from the 5th burial phase were most probably the inhabitants of the castle and members of local clergy. This coincides with the complete absence of trauma on the skeletal remains, characteristic of higher

social status, but other bioarchaeological data will have to provide additional confirmation for these assumptions. The data obtained for the previous period suggests that those dead were people of lower social status, whose hardships in life are attested by the peasant revolt that took place in 1568–1569; their injuries were most likely caused by demanding physical activities, probably in different domains of agriculture and livestock farming.

CONCLUSION

Trauma analysis of human skeletal remains from the site of Ivanec–Stari Grad included 91 graves dating from the 15th to the beginning of the 17th century. The analysis was conducted on the crania and the postcranial skeleton where more than 50% of the bone was present; a total of 43 traumas were recorded on 12 male skeletons, all of them from the 15th and the first half of the 16th century. The traumas were recorded mostly on the ribs and vertebrae and only sporadically on the crania and long bones. In general, the results show a low frequency of trauma in males and the complete absence of trauma in subadults and females and in males from the latter period.

The obtained results are consistent with the historical records from that turbulent period, which do not speak of major conflicts but mention changes in estate ownership and indicate an increase in inequality between different social classes. Although the situation in Croatia during the second half of the 15th century and in the 16th century was generally poor, we can conclude that the area of Ivanec was marked by harsh life, but was spared any major conflicts or more direct threats. This is evident in the low frequency of traumas and their distribution on the skeleton, suggesting that they were mostly caused by everyday accidental events. However, changes in estate ownership, followed by the construction of the *castellum*, led to changes that are attested in the archaeological record, which indicates the abandonment of the cemetery. The dead, buried exclusively inside the church from that time, were most probably the inhabitants of the castle and members of local clergy. New bioarchaeological data gained

from the Ivanec sample could additionally clarify the considered issues. This study demonstrates how a systematic analysis of archaeological and bioarchaeological data, combined with the existing historical records, can provide a deeper insight into the daily life of the studied communities.

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Radiology Key 2017 – The Radius and Ulna, <https://radiologykey.com/the-radius-and-ulna-2/> (3. 3. 2023.)

BIBLIOGRAPHY

Adamček, J. 1972–1973, Seljačka buna na posjedima Bele i Ivanca 1568–1569, *Historijski zbornik*, Vol. XXV–XXVI, 243–249.

Adamić Hadžić, A. 2021, *Komparativna analiza trauma na ljudskom koštanom materijalu s područja Hrvatske od ranog srednjeg vijeka do ranog novog vijeka*, Unpublished PhD thesis, Sveučilište u Zadru, Zadar.

Aufderheide, A. C., Rodríguez-Martín, C. 1998, *The Cambridge Encyclopedia of Human Paleopathology*, Cambridge University Press, Cambridge.

Bedić, Ž. 2021, Evidence of interpersonal violence at two sites of the Bijelo Brdo culture in eastern Croatia, *Vjesnik Arheološkog muzeja u Zagrebu*, Vol. 54, 387–396. <https://doi.org/10.52064/vamz.54.1.21>

Bedić, Ž., Šlaus, M. 2016, Anthropological analysis of perimortem trauma in the skeletal sample from Udbina - St. Jacob site, Croatia, in: *International Ancient Warfare Conference*, Gothenburg, 28 June – 1 July 2016, Abstract book, Gothenburg University, Sweden.

Bedić, Ž., Janeš, A., Šlaus M. 2019, Anthropological Analysis of Trauma Frequencies and Distribution in the Skeletal Series from the Benedictine Monastery of St Margaret in Bijela, Croatia, *Collegium antropologicum*, Vol. 43 (2), 141–146.

Bedić, Ž., Belaj, J., Sirovica, F. 2022, Bioarheološka studija populacije iz Gore kraj Petrinje / Bioarchaeological study of the population of Gora near Petrinja, Croatia, Hrvatska, *Prilozi Instituta za arheologiju u Zagrebu*, Vol. 39(1), 173–198. <https://doi.org/10.33254/piaz.39.1.5>

Belaj, J. 2008, *Ivanec kroz slojeve prošlosti, Deset godina arheoloških istraživanja u Ivancu*, Grad Ivanec, Ivanec.

Belaj, J. 2009, Arheološka istraživanja crkve Sv. Ivana Krstitelja u Ivancu 2008. g., *Annales Instituti Archaeologici*, Vol. V, 90–94.

Belaj, J. 2013, Ivanec – Stari grad: osvrt na arheološku prošlost nalazišta, in: *Dnevnik jednog arheologa, Prof. dr. sc. Željku Tomičiću uz 70. rođendan*, Buzov, Marija (ed.), Institut za arheologiju, Zagreb, 25–32.

Belaj, J., Sirovica, F. 2010, Arheološka istraživanja na lokalitetu Stari grad u Ivancu godine 2009., *Annales Instituti Archaeologici*, Vol. VI, 59–63.

Belaj, J., Sirovica, F. 2011, Arheološka istraživanja na lokalitetu Stari grad u Ivancu godine 2010., *Annales Instituti Archaeologici*, Vol. VII, 65–69.

Belaj, J., Sirovica, F. 2012, Arheološka istraživanja na lokalitetu Stari grad u Ivancu godine 2011., *Annales Instituti Archaeologici*, Vol. VIII, 90–94.

Belaj, J., Sirovica, F. 2016, Kamenom obloženi grobovi na nalazištu Ivanec - Stari grad, in: *Groblja i pogrebni običaji u srednjem i ranom novom vijeku na prostoru sjeverne Hrvatske*, Zbornik radova prvog međunarodnog znanstvenog skupa srednjovjekovne arheologije Instituta za arheologiju, Zagreb, 4. lipnja 2014, Krznar, S., Sekelj Ivančan, T., Tkalčec, T., Belaj, J. (eds.), Institut za arheologiju, Zagreb, 57–73.

Belaj, J., Sirovica, F., Bedić, Ž. 2021, Crkva Uznesenja Blažene Djevice Marije u Gori kraj Petrinje i faze ukopavanja grobova na prostoru sakristije / Church of the Assumption of the Blessed Virgin Mary in Gora near Petrinja and the phases of the burials in the area of sacristy, *Prilozi Instituta za arheologiju u Zagrebu*, Vol. 38 (2), 89–114. <https://doi.org/10.33254/piaz.38.2.3>

Belaj, J., Sirovica, F. 2023, Disappearance of grave goods: changes in burial practices in 14th century Ivanec, Croatia, in: *Homines, Funera, Astra 3–4: The Multiple Faces of Death and Burial. Proceedings of the International Symposium on Funerary Anthropology, '1 Decembrie 1918' University (Alba Iulia, Romania)*, Kogălniceanu, R., Gligor, M., Soficaru, A., Stratton, S. (eds.), Archaeopress, Oxford, 135–151. <http://doi.org/10.32028/9781803275253>

Brickley, M. B. 1997, *Age-Related Bone Loss And Osteoporosis In Archaeological Bone: A Study Of Two London Collections, Redcross Way and Farringdon Street*, Unpublished PhD thesis, University College London, London.

Brickley, M. 2006, Rib fractures in the archaeological record: a useful source of sociocultural information?, *International Journal of Osteoarchaeology*, Vol. 16 (1), 61–75. <https://doi.org/10.1002/oa.809>

Brooks, S. T., Suchey, J. M. 1990, Skeletal age determination based on the os pubis: A comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods, *Human Evolution*, Vol. 5 (3), 227–238. <https://doi.org/10.1007/BF02437238>

Bruzek, J. 2002, A method for visual determination of sex, using the human hip bone, *American Journal of Physical Anthropology*, Vol. 117 (2), 157–168. <https://doi.org/10.1002/ajpa.10012>

Budak, N. 1994, *Gradovi Varaždinske županije u srednjem vijeku*, Nakladnička kuća Dr. Feletar, Zagreb-Koprivnica.

Bushnell, B. D., Draeger, R. W., Crosby, C. G., Bynum, D. K. 2008, Management of Intra-Articular Metacarpal Base Fractures of the Second Through Fifth Metacarpals, *The Journal of Hand Surgery*, Vol. 33 (4), 573–583. <https://doi.org/10.1016/j.jhsa.2007.11.019>

Dittmar, J. M., Mitchell, P. D., Cessford, C., Inskip, S. A., Robb, J. E. 2021, Medieval injuries: Skeletal trauma as an indicator of past living conditions and hazard risk in Cambridge, England, *American Journal of Physical Anthropology*, Vol. 175(3), 626–645. <https://doi.org/10.1002/ajpa.24225>

Djurić, M. P., Roberts, C. A., Rakočević, Z. B., Džonić, D. D., Lešić, A. R. 2006, Fractures in late medieval skeletal populations from Serbia, *American Journal of Physical Anthropology*, Vol. 130(2), 167–178. <https://doi.org/10.1002/ajpa.20270>

Facchini, F., Rastelli, E., Belcastro, M. G. 2007, Peri mortem cranial injuries from a medieval grave in Saint Peter's Cathedral, Bologna, Italy, *International Journal of Osteoarchaeology*, Vol. 18(4), 421–430. <https://doi.org/10.1002/oa.949>

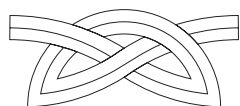
Galloway, A. 1999, *Broken Bones: Anthropological Analysis of Blunt Force Trauma*, C.C. Thomas, Springfield, Illinois.

Gilbert, B. M., McKern, T. W. 1973, A method for aging the female Os pubis, *American Journal of Physical Anthropology*, Vol. 38(1), 31–38. <https://doi.org/10.1002/ajpa.1330380109>

Grauer, A. L., Roberts, C. A. 1996, Paleoepidemiology, healing, and possible treatment of trauma in the medieval cemetery population of St. Helen-on-the-Walls, York, England, *American Journal of Physical Anthropology*, Vol. 100 (4), 531–544. [https://doi.org/10.1002/\(SICI\)1096-8644\(199608\)100:4<531::AID-AJPA7>3.0.CO;2-T](https://doi.org/10.1002/(SICI)1096-8644(199608)100:4<531::AID-AJPA7>3.0.CO;2-T)

- Grgin, B.** 2002, The Ottoman influences on Croatia in the second half of the fifteenth century, *Povijesni prilozi*, Vol. 21 (23), 87–103.
- Hrg, M.** 1975a. Ivanec prvi puta u povijesnom dokumentu od 22. lipnja 1396. godine, in: *Ivanečki kalendar '75*, Kraš, M., Kušen, E. (eds.), Novinsko izdavačko i štamparsko poduzeće Varaždin, Varaždin, 128–130.
- Hrg, M.** 1975b. Seljačka buna u Ivanču i Belu, in: *Ivanečki kalendar '75*, Kraš, M., Kušen, E. (eds.), Novinsko izdavačko i štamparsko poduzeće Varaždin, Varaždin, 131–132.
- Işcan, M. Y., Loth, S. R., Wright, R. K.** 1984, Age estimation from the rib by phase analysis: White males, *Journal of Forensic Sciences*, Vol. 29 (4), 1094–1104.
- Işcan, M. Y., Loth, S. R., Wright, R. K.** 1985, Age estimation from the rib by phase analysis: White females, *Journal of Forensic Sciences*, Vol. 30 (3), 853–863. <https://doi.org/10.1520/JFS11776J>
- Joksimović, M., Mogorović Crljenko, M., Novak, M.** 2019, Sex, Lies and Marital Violence. Divorce Case from the Records on Visit of Bishop Valier to Istria in 1580 and its Historical and Anthropological Context, *Acta Histriae*, Vol. 27 (3), 417–438.
- Judd, M.** 2004, Trauma in the City of Kerma: Ancient versus Modern Injury Patterns, *International Journal of Osteoarchaeology*, Vol. 14(1), 34–51. <https://doi.org/10.1002/oa.711>
- Karl, J. W., Olson, P. R., Rosenwasser, M. P.** 2015, The Epidemiology of Upper Extremity Fractures in the United States, 2009, *Journal of Orthopaedic Trauma*, Vol. 29 (8): e242–4. <https://doi.org/10.1097/bot.0000000000000312>
- Klaić, V.** 1975, *Povijest Hrvata*, sv. 5, Matica hrvatska, Zagreb.
- Kraš, M.** 1997, Prilozi povijesti Ivanca od prvoga pisanoga spomena 1396. do 1940. godine, in: *Zbornik 600 godina Ivanca*, Mohorovičić A. (ed.), Ivanec, 57–89.
- Krogman, W. M., Işcan, M. Y.** 1986, *The Human Skeleton in Forensic Medicine*, Charles C. Thomas, Springfield.
- Kruhek, M.** 2001, Kostajnica u protuturskoj obrani Hrvatskoga kraljevstva, *Povijesni prilozi* Vol. 20 (21), 71–94.
- Krznar, S., Belaj, J., Bedić, Ž.** 2010, Prilog poznavanju nasilja u kasnosrednjovjekovnom Ivanču (grobovi 202 i 204) / A Contribution to the Knowledge of Violence in the Late Middle Ages in Ivanec (graves 202 and 204), *Prilozi Instituta za arheologiju u Zagrebu*, Vol. 27, 225–240.
- Lovejoy, C. O., Meindl, R. S., Pryzbeck, T. R., Mensforth, R. P.** 1985, Chronological metamorphosis of the auricular surface of the ilium: A new method for the determination of age at death, *American Journal of Physical Anthropology*, Vol. 68 (1), 15–28. <https://doi.org/10.1002/ajpa.1330680103>
- Lovell, N. C.** 1997, Trauma analysis in paleopathology, *American Journal of Physical Anthropology: Supplement Yearbook of Physical Anthropology*, Vol. 104 (S25), 139–170. [https://doi.org/10.1002/\(SICI\)1096-8644\(1997\)25+<139::AID-AJPA6>3.0.CO;2-%23](https://doi.org/10.1002/(SICI)1096-8644(1997)25+<139::AID-AJPA6>3.0.CO;2-%23)
- Meindl, R. S., Lovejoy, C. O.** 1985, Ectocranial suture closure: A revised method of the determination of skeletal age at death based on the lateral-anterior sutures, *American Journal of Physical Anthropology*, Vol. 68 (1), 57–66. <https://doi.org/10.1002/ajpa.1330680106>
- Milner, G. R., Boldsen, J. L., Weise, S., Lauritsen, J. M., Freund, U. H.** 2015, Sex-related risks of trauma in medieval to early modern Denmark, and its relationship to change in interpersonal violence over time, *International Journal of Paleopathology*, Vol. 9, 59–68. <https://doi.org/10.1016/j.ijpp.2015.02.002>
- Moorrees, C. F. A., Fanning, E. A., Hunt, E. E.** 1963, Age variation of formation stages for ten permanent teeth, *Journal of Dental Research*, Vol. 42, 1490–1502. <https://doi.org/10.1177/0022034563042006270>
- Myers, E. R., Wilson, S.** 1997, Biomechanics of osteoporosis and vertebral fracture, *Spine*, Vol. 22 (24), 25S–31S.
- Nevitt, M. C., Cummings, S. R., Stone, K. L., Palermo, L., Black, D. M., Bauer, D. C., Genant H. K., Hochberg, M. C., Ensrud, K. E., Hillier T. A., Cauley J. A.** 2005, Risk factors for a first-incident radiographic vertebral fracture in women ≥65 years of age: The study of osteoporotic fractures, *Journal of Bone and Mineral Research*, Vol. 20 (1), 131–140. <https://doi.org/10.1359/JBMR.041003>
- Novak, M., Šlaus, M.** 2012, Frequency and patterning of bone trauma in the late medieval population (13th–16th century) from Dugopolje, southern Croatia, *Anthropologischer Anzeiger*, Vol. 69 (3), 335–350. <https://doi.org/10.1127/0003-5548/2012/0181>
- Novak, M., Bedić, Ž., Los, Dž., Premužić, Z.** 2021, Bioarchaeological analysis of the 15th–17th century population from Zrin, continental Croatia, *Arheološki radovi i rasprave*, Vol. 20, 317–336. <https://doi.org/10.21857/y7v64t0wxy>
- Patel, D. S., Statuta, S. M., Ahmed, N.** 2021, Common Fractures of the Radius and Ulna, *American Family Physician*, Vol. 103 (6): 345–354.
- Petrić, H.** 2010, O nekim naseljima u porječju rijeke Bednje tijekom srednjeg i početkom ranoga novog vijeka, *Kaj*, Vol. 43(3), 91–116.
- Sauer, N.** 1998, The timing of injuries and manner of death: Distinguishing among antemortem, perimortem, and postmortem trauma, in: *Forensic Osteology: Advances in the Identification of Human Remains*, Reichs, K. J. (ed.), 2nd ed., Charles C. Thomas, Springfield, Illinois, 321–332.
- Scheuer, L., Black S.** 2000, *Developmental Juvenile Osteology*, Academic Press, Elsevier. <https://doi.org/10.1016/B978-0-12-624000-9.X5000-X>
- Scott, R. M., Buckley, H. R.** 2010, Biocultural interpretations of trauma in two prehistoric Pacific Island populations from Papua New Guinea and the Solomon Islands, *American Journal of Physical Anthropology*, Vol. 142(4), 509–518. <https://doi.org/10.1002/ajpa.21250>
- Sirmali, M., Türüt, H., Topçu, S., Gülhan, E., Yazıcı, U., Kaya, S., Taştepe, I.** 2003, A comprehensive analysis of traumatic rib fractures: morbidity, mortality and management, *European Journal of Cardio-Thoracic Surgery*, Vol. 24 (1), 133–138. [https://doi.org/10.1016/S1010-7940\(03\)00256-2](https://doi.org/10.1016/S1010-7940(03)00256-2)
- Smith, B. H.** 1984, Patterns of molar wear in hunter-gatherers and agriculturalists, *American Journal of Physical Anthropology*, Vol. 63 (1), 39–56. <https://doi.org/10.1002/ajpa.1330630107>
- Szabo, Gj.** 1919, Spomenici kotara Ivanec, *Vjesnik Arheološkog muzeja u Zagrebu*, Vol. 14, 22–97.

- Šaban, L.** 1977, Pogled u prošlost Ivanca, in: *Ivanečki calendar '77*, Kušen, E. (ed.), Novinsko izdavačko i štamparsko poduzeće Varaždin, Ivanec, 143–158.
- Šlaus, M.** 2008, Osteological and dental markers of health in the transition from the Late Antique to the Early Medieval period in Croatia, *American Journal of Physical Anthropology*, Vol. 136(4), 455–469. <https://doi.org/10.1002/ajpa.20829>
- Šlaus, M., Novak, M., Bedić, Ž., Vyroubal, V.** 2007, Antropološka analiza kasnosrednjovjekovnog groblja kraj crkve Sv. Franje na Opatovini u Zagrebu, *Arheološki radovi i rasprave*, 15, 211–247.
- Šlaus, M., Novak, M., Vyroubal, V., Bedić, Ž.** 2010, The harsh life on the 15th century Croatia-Ottoman Empire military border: Analyzing and identifying the reasons for the massacre in Čepin, *American Journal of Physical Anthropology*, Vol. 141 (3), 358–372. <https://doi.org/10.1002/ajpa.21152>
- Schwartz, A. M., Runge, W. O., Hsu, A. R., Bariteau, J. T.** 2020, Fractures of the Talus: Current Concepts, *Foot & Ankle Orthopaedics*, Vol. 5(1), 1–10. <https://doi.org/10.1177/2473011419900766>
- Ubelaker, D., Adams, B. J.** 1995, Differentiation of perimortem and postmortem trauma using taphonomic indicators, *Journal of Forensic Sciences*, Vol. 40(3), 509–512.
- Wakely, J.** 1997, Identification and analysis of violent and non-violent head injuries in osteoarchaeological material, in: *Material harm. Archaeological studies of war and violence*, Carman J. (ed.), Cruithne Press, Glasgow, 24–46.
- Walker, P. L.** 1997, Wife Beating, Boxing, and Broken Noses: Skeletal Evidence for the Cultural Pattering of Violence, in: *Troubled Times. Violence and Warfare in the Past*, Frayer D. W., Martin D. L. (eds.), Routledge, Amsterdam.
- Wheatley, B. P.** 2008, Perimortem or Postmortem Bone Fractures? An Experimental Study of Fracture Patterns in Deer Femora, *The Journal of Forensic Sciences*, Vol. 53 (1), 69–72. <https://doi.org/10.1111/j.1556-4029.2008.00593.x>



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