

Case study

She was not spared: Evidence of interpersonal violence on a Langobard female from the Ferrovia necropolis in Cividale, NE Italy (6th–7th century CE)

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ABSTRACT

Objective: This study aims to document and contextualize cranial trauma attributable to interpersonal violence in one Langobard individual from the Ferrovia necropolis in Cividale del Friuli (NE Italy).

Materials: The study examines one human skeleton: a middle-aged female dated between 590 and 630 CE.

Methods: Osteological and palaeopathological analyses were conducted to assess trauma, age-at-death, and activity-related markers. Sex estimation was confirmed through amelogenin analysis.

Results: The individual presents healed antemortem cranial lesions consistent with interpersonal violence: one sharp-force and one blunt-force.

Conclusions: This case represents documented paleopathological evidence of interpersonal violence affecting a Langobard female.

Significance: The finding challenges assumptions regarding the exclusively male nature of interpersonal violence in Langobard society and provides a rare bioarchaeological correlate to legal and historical sources acknowledging female involvement in violent contexts.

Limitations: The identification of interpersonal violence is constrained by preservation biases and the limited visibility of soft-tissue injuries in the skeletal record. Moreover, the interpretation of interpersonal violence from the cranium only is limiting.

Suggestions for further research: Future studies integrating palaeopathological, biomolecular, and contextual archaeological data across larger samples are needed to refine interpretations of violence and gender roles in Langobard populations.

1. Introduction

Since their departure from north-eastern Europe, the Langobards were known as a warrior people (Rotili, 2010), an image reinforced by both written and archaeological evidence. Classical and early medieval sources, though separated by considerable chronological and cultural distance, consistently portray the Langobards as fierce and warlike (Azzara and Gasparri, 2005; Paterculus, 1924). Archaeological evidence complements this picture, revealing clear osteological traces of violent injury from numerous Langobard cemeteries across Italy and Europe

(Alt et al., 2014; Bedini and Bertoldi, 2004; Bedini and Petiti, 2014; Belcastro, 2001; Bocchini and Belcastro, 2012; Giusberti, 1991; Micarelli, 2020; Micarelli et al., 2021; Rubini and Zaio, 2011; Zeppilli et al., 2023). Skeletal remains from these contexts show both cranial and postcranial trauma, broadly consistent with violent encounters. To date, however, all cases confidently attributed to interpersonal violence involve male individuals.

Warfare and armed conflict were therefore culturally framed as male domains, yet legal sources demonstrate that women were not exempt from violence. The *Edictum Rothari* and later additions by King Liutprand

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(713–744 CE) (Azzara and Gasparri, 2005) explicitly address the killing or wounding of women, including cases where they voluntarily took part in violent encounters. Although such participation was condemned as improper, it was acknowledged as possible and evidently common enough to require explicit regulation.

However, to date, the only reported palaeopathological case of traumatic cranial lesions in a Langobard female comes from Castel Trosino (individual CT1953 from burial T67) (6th–8th c. CE), where antemortem cranial lesions were documented but cannot be linked to violence (Micarelli et al., 2021, 2023). This absence of female cases of interpersonal violence in the Langobard bioarchaeological record is striking given the repeated legal recognition of women's involvement in violent contexts, and it raises important questions about both the lived experiences of Langobard women and the preservation, recognition, and reporting of trauma in the archaeological record.

In this paper, we present palaeopathological evidence of interpersonal violence affecting a Langobard female individual, whose remains were recovered from the necropolis of Ferrovia in Cividale del Friuli (northeastern Italy). The study aims to document and evaluate the cranial lesions observed in the individual in conjunction with her overall health status, and to assess their significance within the broader palaeopathological and historical framework of Langobard society.

2. Materials

A Langobard necropolis (Ferrovia) located near the railway in Cividale del Friuli (Fig. 1), the first Langobard duchy in Italy, has been known since the second half of the 19th century, but systematic excavations were only conducted in 2012 (Borzacconi and Giostra, 2018).

These excavations uncovered 79 burials (including a collective burial and some secondary burials) for a total of 81 individuals (52 adults and 29 non-adults) (Borzacconi et al., 2016) (Fig. 2). Based on burial typology and associated grave goods, the site was in use for over a century, from the late 6th to the early 7th century CE, and four main burial clusters were identified (Borzacconi and Giostra, 2018).

Of the adults recovered from the necropolis, cranial preservation allowed macroscopic assessment in 30 cases (58%). Of these, two individuals exhibited clear signs of cranial trauma: individual T26 (see [Supplementary Information: S1](#)) and individual T46, both situated in the northern cluster (IV). Burial T46 is attributed to the first occupational phase of the necropolis (ca. 590–630 CE), but no grave goods were recovered, likely because the grave is only partially preserved, as it was first cut into by burial T26 (Phase II) and later by T27 (Phase III), which in turn intersected both T46 and T26 (Fig. 3). For this reason, the skeletal remains are poorly preserved and incomplete as well (Fig. 4).

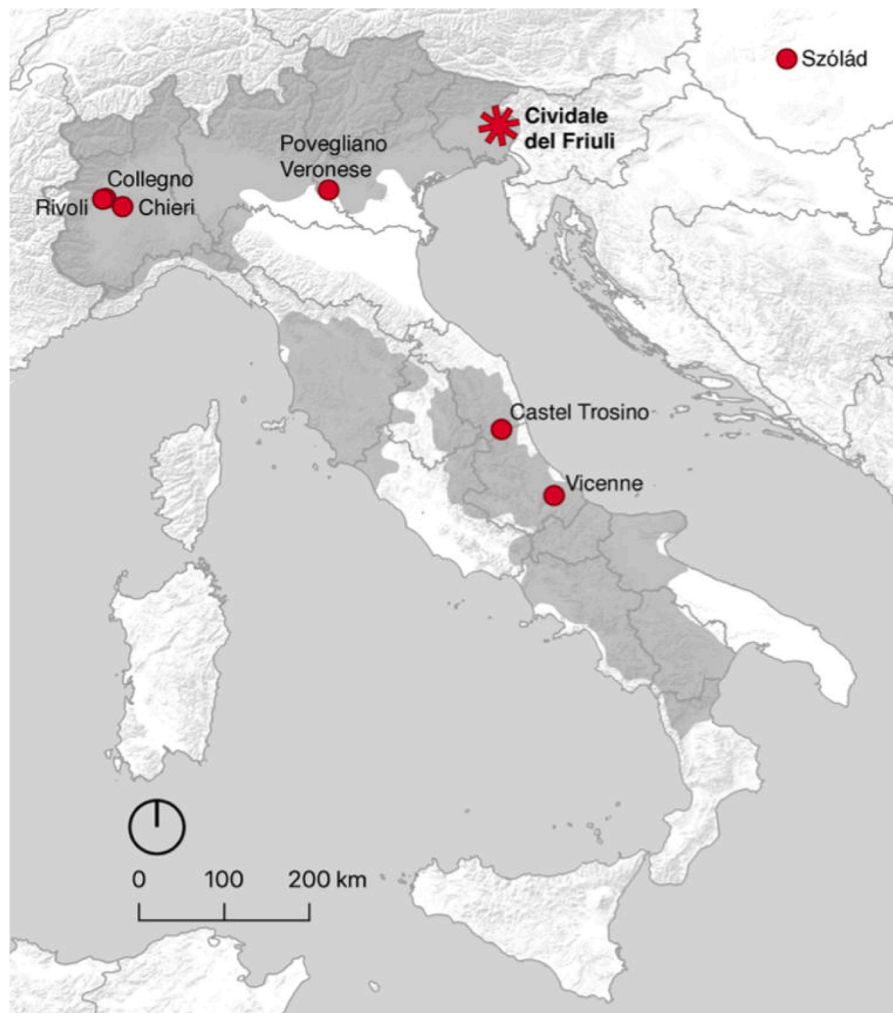


Fig. 1. Location of Cividale del Friuli in NE Italy and other published Langobard sites mentioned in this paper. Grey lines indicate present-day state and regional boundaries, while shaded areas show the territory of the Langobard Kingdom in Italy in the early phase of their conquest (ca. 6th-7th century CE).

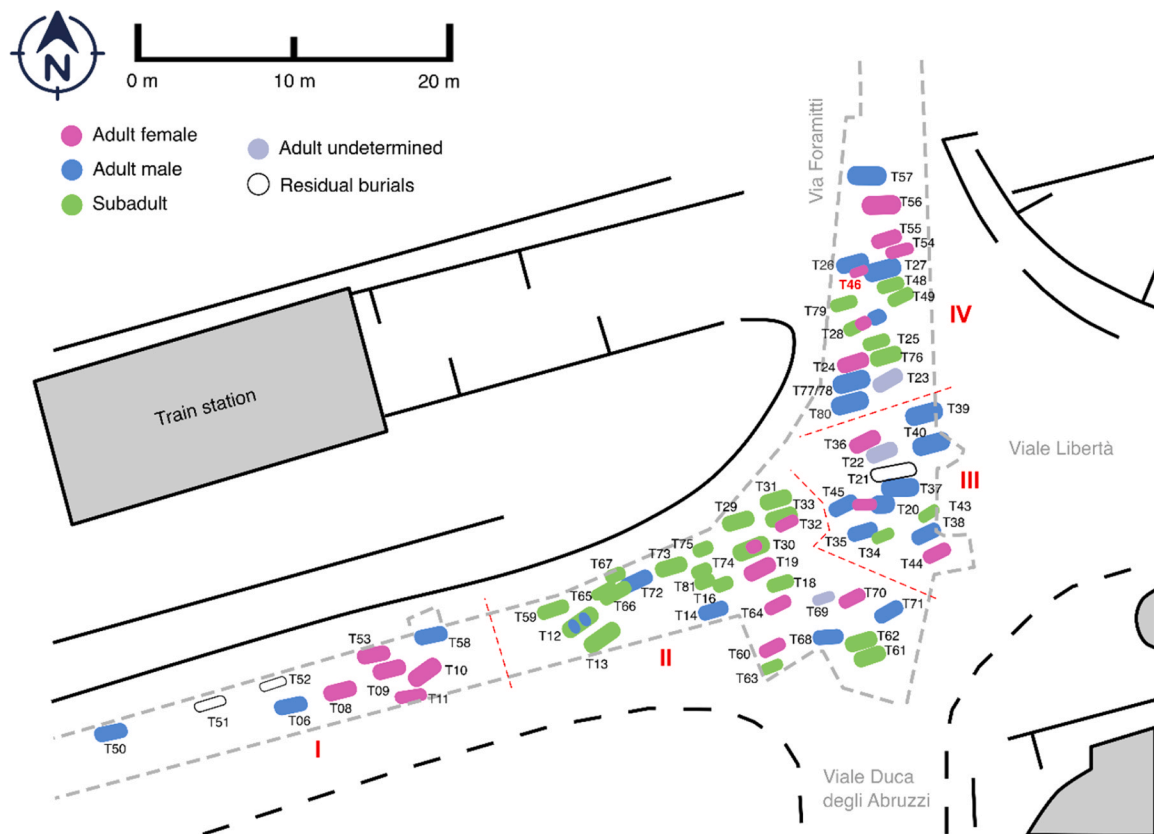


Fig. 2. Plan of the Ferrovia necropolis in Cividale (modified and corrected from: [Borzacconi and Giostra, 2018](#)). The four burial clusters identified based on burial typology and grave goods are identified by dotted lines and Roman numerals in red. The tomb of individual T46, considered in this paper, is highlighted in red.

3. Methods

Sex estimation was performed analyzing standard cranial and post-cranial morphological traits ([Buikstra and Ubelaker, 1994](#); [DiBennardo and Taylor, 1979](#)). The morphology of the few preserved elements (including the mastoid process and the root of the zygomatic process) suggested, but did not confirm, a probable female sex. Proteomic sex determination was therefore undertaken through amelogenin analysis on the first inferior right premolar (see [Supplementary Information: S2](#)).

Age-at-death was estimated based on dental wear patterns and the degree of cranial suture fusion ([Brothwell, 1981](#); [Mays et al., 2022](#); [Ruengdit et al., 2020](#)). Although these methods are associated with relatively low accuracy and broad age ranges ([Mays et al., 2022](#); [Ruengdit et al., 2020](#)), the highly fragmentary condition of the remains precluded the application of other, more reliable morphological approaches.

Within the constraints imposed by preservation, morphological analyses were undertaken to assess stress markers, including enthesal changes (following [Mariotti et al., 2007](#)) and patterns of dental wear ([Capasso et al., 1999](#); [Cardoso and Henderson, 2010](#); [Milella et al., 2015](#)), as well as pathological alterations to evaluate the health of the individual.

Cranial lesions were assessed macroscopically. Criteria used to distinguish sharp-force and blunt-force trauma included lesion shape, cross-sectional profile, edge morphology, fracture pattern, and the presence or absence of radiating fractures or plastic deformation ([Boylston, 2002](#); [Dyer and Fibiger, 2017](#); [Moreno-Ibáñez et al., 2023](#); [Tumler et al., 2019](#); [Vazzana et al., 2018](#)). In cases of blunt-force trauma, the hat brim line rule was applied to assist in evaluating injury dynamics and likelihood of interpersonal violence ([Guyomarc'h et al., 2010](#); [Kremer et al., 2008](#); [Kremer and Sauvageau, 2009](#)). The distinction between accidental and non-accidental trauma was assessed through

consideration of lesion morphology, distribution, and location ([McNulty, 2016](#)).

Lastly, the timing of injury (antemortem vs. perimortem) was evaluated based on the presence of healing, rounding of lesion margins, and bone remodeling ([Botella et al., 2000](#); [Sauer, 1998](#); [Travan and Saccheri, 2011](#)).

4. Results

Dental wear suggests an age-at-death of > 45 years, while the degree of cranial suture closure is consistent with an age above 40 years. Taken together, these observations support an overall estimation of age-at-death of > 40 years. However, the absence of additional diagnostic features prevents further refinement, and the estimate derived from the methods applied here should be interpreted with caution. Proteomic analysis of dental enamel detected no AMELY peptides, a finding consistent with the individual being female ([Fig. 5](#)).

Indicators of occupational and physiological stress were considered in order to contextualize the individual's general health. The attachment areas of the pectoralis major exhibited a high development score on both humeri according to the criteria proposed by [Mariotti et al. \(2007\)](#). The deltoid insertion displayed a medium development score on the right humerus, while the costoclavicular ligament insertion showed a high development score on the left clavicle. These represent the only regions available for assessment.

Marked wear was present on the only maxillary central incisor but not on the lower preserved dental elements ([Fig. 4c](#)). No carious lesions were observed, but mild periodontal disease was present.

Two distinct antemortem cranial lesions were identified on the frontal bone. The first lesion ([Fig. 4b](#)) consists of a linear defect measuring approximately 21 × 4 mm on the left frontal squama. The lesion exhibits well-defined margins and a narrow, elongated



Fig. 3. Burial T46 (pink dashes), burial T26 (blue dashes) in relation to the nearby burial T27 (green dashes). Grey continuous line represents a modern wall, which cut burial T27 in half and probably also damaged burial T46.

morphology. The edges are rounded and show evidence of remodeling, indicating that the injury was sustained during life and that the individual survived the traumatic event. The cutting plane is clearly visible and has a right-to-left direction.

The second lesion is located on the right frontal bone, above the hat brim line (Guyomarc'h et al., 2010; Kremer et al., 2008; Kremer and Sauvageau, 2009), and measures approximately 17×9 mm (Fig. 4a). This defect is irregular in shape and displays evidence of bone remodeling, including surface irregularity and localized bone reaction suggestive of healing. The morphology is consistent with a healed blunt-force injury. Signs of localized infection are present in association with this lesion.

The endocranial surface of individual T46 is poorly preserved, but no lesions or changes are observable. There are only some depressed areas, referring to granulations of Pacchioni/arachnoid granulations, along the sagittal sulcus (see [Supplementary Information: S3](#)).

No additional cranial or postcranial traumatic lesions attributable to interpersonal violence were identified on the preserved skeletal elements, although the preservation of the remains limits the assessment.

5. Discussion

Due to the poor preservation of the skeletal remains, we have few clues regarding the lifestyle of individual T46. The development of the few observable musculoskeletal markers suggests that the individual engaged in notable physical activity involving the upper limbs. However, given the individual's estimated age, the pronounced enthesal changes could also reflect age-related remodeling rather than activity alone. The only feature potentially indicative of one of her activities is the pronounced wear observed on the maxillary central incisor,

consistent with occupational dental wear (Fig. 4c). Similar wear patterns are present in approximately 19% of the adult individuals available for evaluation from the Ferrovio necropolis, the majority of whom are female.

The two cranial lesions identified on the frontal bone differ in morphology, size, and appearance, yet both show clear signs of healing, indicating survival following traumatic injury. The presence of bone remodeling and rounded margins confirms that the injuries were sustained antemortem and excludes postmortem damage as a plausible explanation.

The linear lesion on the left frontal bone exhibits a narrow, elongated morphology with well-defined margins, consistent with sharp-force trauma (Boylston, 2002; Tumler et al., 2019; Vazzana et al., 2018). Its location and orientation are comparable to cranial injuries documented in male individuals from other Langobard cemeteries (e.g., Bedini and Petiti, 2014), suggesting that the mechanisms of injury were similar. Based on the morphology and orientation of the linear cut, the wound was inflicted with considerable force, possibly by a left-handed assailant positioned in front of the victim and from a higher stance. The weapon may have been a bladed instrument, such as a scramasax (i.e., a long single-edged knife typical of Germanic warrior equipment).

The healed crushing lesion on the right frontal bone, interpreted as blunt-force trauma (i.e., a depressed and penetrating fracture consistent with impact from a wide, flat-surfaced object delivered with considerable force, likely involving a high-velocity blow) (Dyer and Fibiger, 2017; Moreno-Ibáñez et al., 2023), displays surface irregularity and localized bone reaction, including signs of infection that were associated with a skin cut, indicating a prolonged healing process.

Considering the forensic and bioarchaeological evidence indicating that intentional violence more frequently involves cranial (and other flat) bones (Bhandari et al., 2006; McNulty, 2016; Novak, 1999; Sheridan and Nash, 2007), whereas accidental injuries tend to affect the appendicular skeleton (Crandall et al., 2004; Petridou et al., 2002; Sheridan and Nash, 2007; Wu et al., 2010), the blunt-force trauma observed in individual T46 is more consistent with interpersonal, non-accidental violence than with an accidental mechanism. This interpretation is further supported by the lesion's position above the hat brim line, as injuries in this region have been shown to correlate with intentional assault (Guyomarc'h et al., 2010; Kremer et al., 2008; Kremer and Sauvageau, 2009). While blunt-force trauma alone cannot automatically be classified as non-accidental, its cranial localization, combined with the presence of a sharp-force lesion in the same individual, strengthens the interpretation of intentional violence inflicted on individual T46.

The coexistence of sharp and blunt-force injuries on the same individual raises the possibility of repeated traumatic events or a single violent episode involving multiple impacts. However, the fragmentary preservation of the remains prevents us from identifying other lesions that may be linked to sustained domestic violence (e.g., parry fracture) (Judd, 2008), as has been documented at Borgo San Genesio (San Miniato, Pisa, 7th–9th centuries), where parry fractures have been reported in women (Cantini and Viva, 2022), offering an important contextual parallel for violence affecting women in early medieval Italy.

When the evidence from Cividale Ferrovio is placed alongside the wider dataset of Langobard necropolises, the rarity of our finding becomes even more striking. Table 1 summarizes the currently published cases of confirmed cranial wounds attributable to interpersonal violence, excluding instances classified as only “probable/possible” and those interpreted as potential surgical interventions. Across published sites, only 33 individuals show skeletal evidence of cranial violence.

From the cross-analysis of published cases, it also emerges that cranial injuries are by far the most frequent, accounting for 75.2% of all recorded lesions attributable to interpersonal violence (see [Supplementary Information: S4](#)). This pattern is not unexpected, as cranial injuries are both more frequent in violent encounters and more readily distinguishable from accidental trauma, making them the most reliable

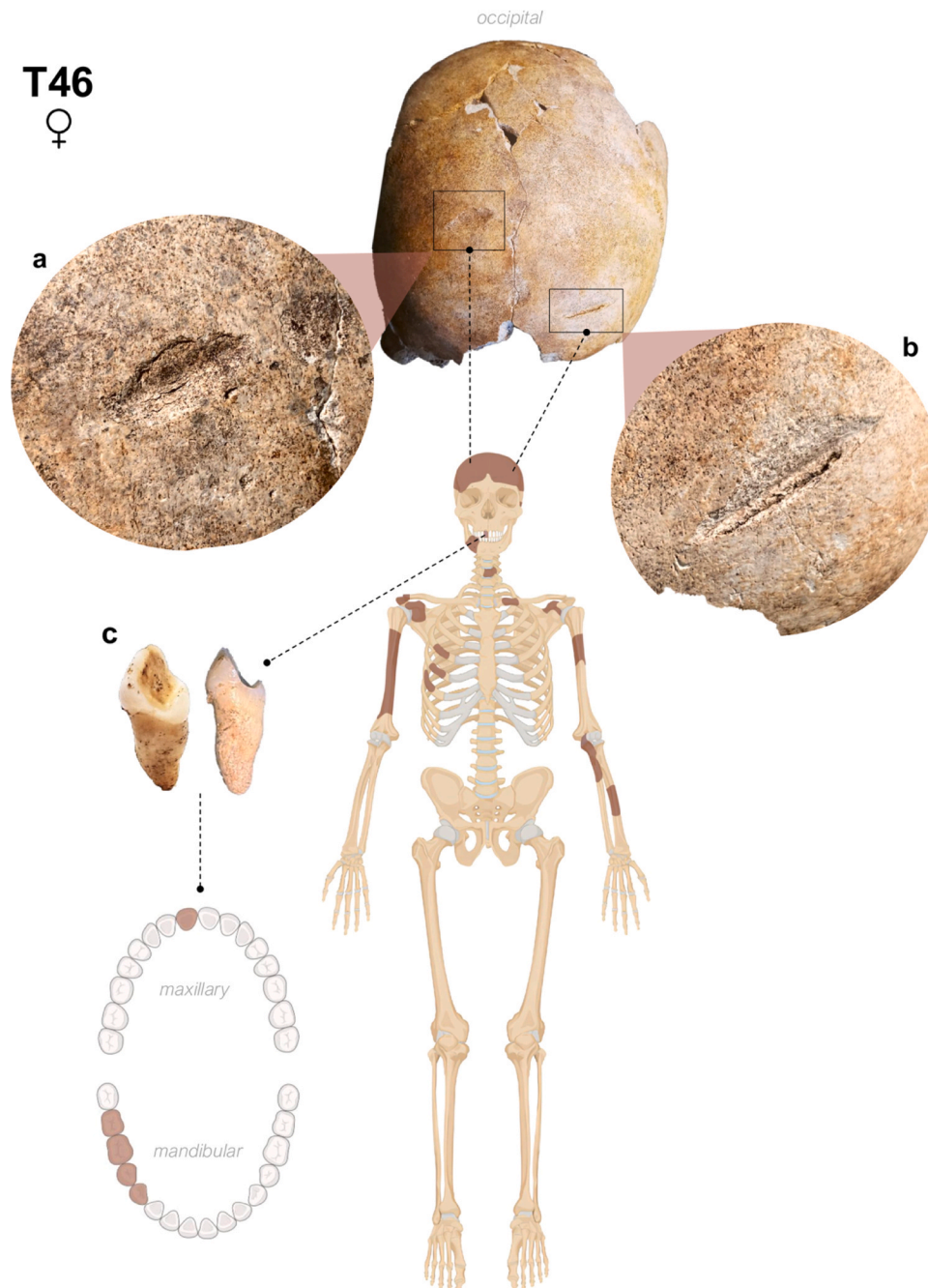


Fig. 4. Cividale Ferrovia, individual T46. Darkened areas show present skeletal elements. Cranium in superior view showing two clear antemortem tangential lesions, one on the right frontal (a) and one on the left frontal (b). Maxillary right first incisor showing occupational wear (c).

indicators of interpersonal violence in the osteological record (Buikstra, 2023). It must be stressed, however, that cranial injuries represent only a portion of the possible evidence for violent encounters. Many lethal traumas could have affected only soft tissues, leaving no skeletal trace.

In crania where the location is identifiable, 49% involve the parietal bones and 33% the frontal bone. This distribution suggests that most of these traumas were sustained in face-to-face confrontations between assailant and victim. No clear lateral preference is evident: 52% of the lesions occur on the right side and 48% on the left. Notably, five individuals (15% of the total) exhibit multiple simultaneous lesions, and in 60% of these cases, the injuries are perimortem.

In terms of the type of lesions, 72.5% of the traumas are sharp-force injuries, 25% result from blunt-force impact with objects of variable surface area, and only one perforating (pointed) lesion has been

documented (Bedini and Petiti, 2014). The latter, characterised by a relatively wide diameter, is inconsistent with an arrow wound. The predominance of sharp-force injuries aligns with the composition of weapon assemblages in Langobard cemeteries, which are dominated by bladed weapons such as swords and scramasax, though arrowheads are not uncommon. Spears are also relatively frequent and could produce a range of injuries, from complete cranial perforations to mixed lesions combining cutting and crushing components, as seen in Collegno (Bedini and Petiti, 2014). Conversely, no weapons capable of producing blunt-force cranial lesions have been recovered from Langobard assemblages. Nonetheless, it is worth noting that blunt injuries may also result from objects not specifically designed as weapons, such as stones, which represent some of the most common sources of broad-surface blunt trauma.

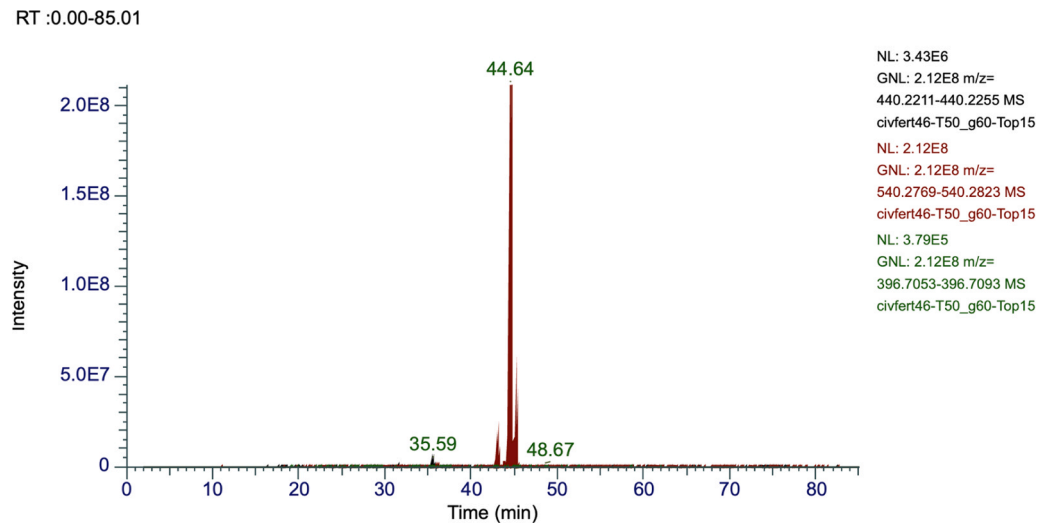


Fig. 5. Ion chromatograms for individual T46. The red peak corresponds to the peptide SIRPPYPSY (AMELX; $[M+2H]^2 + 540.2796 \text{ m/z}$). The strong ion signals of AMELX ($\sim 2 \times 10^8$) and the absence of AMELY peptides identify the individual as a female.

However, when both weapon assemblages and grave goods are considered, no clear correlation emerges between burial wealth, armament, and evidence of violent injury. Among the individuals showing signs of cranial lesions, five were buried with low-status, non-armed assemblages (LS), five with simple warrior assemblages (A), and four with high-ranking warrior equipment (HA). Chronologically, evidence of violent encounters spans the entire duration of Langobard presence in Italy and Pannonia, with no indication that such injuries were confined to a single phase of occupation.

Lastly, all individuals from published cases are adults (mostly between 25 and 45 years), and all males, with the exception of individual T46, who therefore represents a clear exception within the context of Langobard palaeopathology. The secure biological sex determination obtained for individual T46 through enamel peptide analysis is of critical importance, as it overcomes a common limitation in the assessment of fragmentary skeletal remains and allows this individual to be confidently identified as female.

Although it is true that relatively few laws in the *Edictum Rothari* explicitly address violence against women (about 1.5% of the total: to put this into context, it is nearly three and a half times less than laws devoted to horses) (Azzara and Gasparri, 2005), their presence demonstrates that such occurrences were not merely hypothetical (see [Supplementary Information: S5](#)). The discrepancy between the legal acknowledgments of violence against women and the near absence of corresponding bioarchaeological evidence is unlikely to reflect an actual lack of violence in Langobard society. Rather, several factors may account for this gap. Cultural norms may have limited women's participation in contexts such as warfare, raids, or armed disputes, activities more likely to result in skeletal trauma and more commonly associated with male individuals. Violence affecting women may instead have occurred within domestic or interpersonal settings, including episodes of household abuse, which would not leave lasting evidence on the skeleton, except in rare cases (e.g., Zeppilli et al., 2023). Some forensic studies (e.g., Crandall et al., 2004; Sheridan and Nash, 2007) identified blunt-force trauma as the most frequently encountered mechanism in domestic assaults. Demographic analyses (Petridou et al., 2002; Sheridan and Nash, 2007) also suggest that female victims of domestic assault are often younger than those experiencing accidental trauma, with a marked decrease in incidence after approximately 50 years of age.

Individual T46, estimated to be over 40 years of age and possibly older, would therefore not fall within the demographic profile usually associated with domestic assault in modern forensic datasets. However, caution is required when extrapolating contemporary patterns to early

medieval populations, whose social structures and life expectancy differed substantially. While the cranial localization and blunt-force nature of the lesion are compatible with interpersonal assault, the available osteological evidence does not permit differentiation between domestic, intra-community, or conflict-related violence.

The broader trauma dataset also highlights another important aspect: survival. Of all cranial lesions, more than half (64.5%) show signs of healing, while 35.5% represent perimortem injuries. Examples of survival have been documented in male Langobard individuals, including cases involving severe injuries and even surgical intervention (Micarelli et al., 2018, 2023; Rubini and Zaio, 2011). While the present case does not allow for detailed assessment of medical treatment, the presence of remodeling and infection suggests that individual T46 lived for a considerable period after injury, implying access to care or at least a degree of social support during recovery.

6. Conclusions

The analysis of individual T46, a middle-aged female from the Ferrovio necropolis in Cividale del Friuli provides bioarchaeological evidence of blunt force cranial trauma attributable to interpersonal violence in a Langobard female. The secure sex determination obtained through amelogenin analysis was crucial in this case, underscoring the importance of molecular approaches when morphological and aDNA evidence are inconclusive or cannot be performed due to preservation issues.

Overall, the case of individual T46 from Cividale Ferrovio contributes a crucial piece to the broader understanding of violence in Langobard society, confirming that interpersonal violence in Langobard populations was not limited to male individuals and that female violence among the Langobards, though less frequently visible in the archaeological record, should not be overlooked. Future research integrating palaeopathological, biomolecular, and contextual archaeological data will be essential to clarify whether the pattern observed at Ferrovio reflects local, isolated circumstances or rather a broader feature of Langobard communities and their changing social dynamics over time.

CCRediT authorship contribution statement

Paola Saccheri: Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Valentina Martinoia:** Writing – original draft, Visualization, Investigation, Data curation, Conceptualization. **Federico Lugli:**

Table 1

Summary of published cases of confirmed cranial trauma resulting from interpersonal violence from various Langobard necropolises in Italy and Hungary.*

Site	Sample	Individual	Sex	Age at death	Type of trauma	Localization	Time of trauma	Chronology	Grave goods	References
Szólád (Hungary)	45 ind:	4	M	30–40 y	sharp-force	R parietal bone	A	6th CE	A	(Alt et al., 2014)
	19 NAd	13	M	35–50 y	sharp-force	L half of the frontal bone	P		HA	
	25 A (12 F, 13 M)	27	M	40–55 y	sharp-force	L parietal bone	A		A	
Cividale del Friuli - Ferrovia (Friuli-Venezia Giulia, NE Italy)	81 ind:	T26 (see Supplementary Information S1)	M	35–45 y	blunt-force	L parietal bone	A		LS	This study
	29 NAd		M	25–35 y	sharp-force (double)	R and L parietal bone	P	630–670	A	
	52 A (22 F, 25 M, 5 ND)	T46	F	> 40 y	sharp-force blunt-force	L half of the frontal bone R half of the frontal bone	A	590–630		
Povegliano Veronese (Veneto, NE Italy)	224 ind:	T 29 D	M	> 50 y	blunt-force	L parietal	A	620–720	LS	(Micarelli, 2020)
	55 NAd					between the sagittal suture				
	169 A (44 F, 45 M, 80 ND)	US 378	M	35–49 y	fractures	R ramus of the mandible**		570–620	A	
Collegno (Piedmont, NW Italy)		T US 489	M	35–49 y	sharp-force	R half of the occipital bone	P	570–620	LS	
	138 ind	T41	M	young adult	blunt-force	L parietal	A	570 – early decades of the 7th century	A	
		T57	M	> 50	sharp-force	L side of the skull	P		LS	
Rivoli C.so Levi (Piedmont, NW Italy)		T70	M	> 50	sharp-force (double)	R temporo-occipital region	A		HA	(Bedini and Bertoldi, 2004; Bedini and Petiti, 2014; Micarelli, 2020)
					perforating fracture	R half of the lambdoid suture	P			
			M	young adult	sharp-force	center of the frontal bone	A			
Rivoli C.so Levi (Piedmont, NW Italy)	114 ind	T40	M		sharp-force	R half of the occipital squama	A	Late 7th/8th CE		(Bedini and Petiti, 2014)
		T75	M		blunt-force (double)	R half of the frontal bone squama and L parietal	P			
		T87	M		blunt-force	R parietal	A			
Rivoli La Perosa (Piedmont, NW Italy)			M		sharp-force	L frontal bone squama	A			
			M		sharp-force	skull	A			
			M		sharp-force	skull	A			
Rivoli La Perosa (Piedmont, NW Italy)			M		sharp-force	skull	A			
			M		sharp-force	skull	A			
			M		blunt-force	skull	A			
Rivoli La Perosa (Piedmont, NW Italy)	37 ind		M			R half of the occipital bone	P	Late 7th-8th/9th CE		(Bedini and Petiti, 2014)
Chieri ampliamento asl (Piedmont, NW Italy)	120 ind	US 306	M		sharp-force (double)	L parietal bone	P	7th CE		(Bedini and Petiti, 2014)
			M		sharp-force		A			
Castel Trosino (Marche, C Italy)	289 graves, only 19 skulls with mandibles preserved	CT1947	M	25–35 y	sharp-force	R parietal		End of 6th century		(Micarelli et al., 2021)
		T56	M	25–35 y	fractures	mandible (body and R ramus)**	A		Absent	
		CT1959								
Vicenne, Campochiaro (Molise) (S Italy)	130 ind:	T33	M	young adult	sharp-force	skull	P	640–670	HA	(Belcastro, 2001; Gasparini et al., 2022; Giusberti, 1991; Micarelli et al., 2021)
	32 NAd									
	98 A (42 F, 47 M, 9 ND)	T54	M	young adult	sharp-force	from the R half of the frontal bone to the L parietal bone	P			
Vicenne, Morione (Molise, S Italy)		T165	M		sharp-force	cranial base between the head and the neck				(Gasparini et al., 2022; Rubini and Zaio, 2011)
	234 graves	T20	M	> 55 y	blunt-force	L parietal with minor involvement of the R parietal	A	6th-8th CE		
		T102	M	50–55 y	blunt-force	R half of the frontal bone	A		HA	
		T108	M	> 50 y	sharp-force	L half of the of the frontal bone	P			

* F = female; M = male; ND = not determined; A = adults; NAd = nonadults; R = right; L = left; A = antemortem; P = perimortem; A = warrior assemblage; HA = high-ranking warrior assemblage; LS = low-status, non-armed assemblage.

** In clinical cases, direct trauma to the mandible are most frequently caused, in order of frequency, by road accidents, assaults, sports activities, or accidental falls (Copcu et al., 2004; Olson et al., 1982).

Writing – review & editing, Methodology. **Sara Bernardini**: Writing – review & editing, Formal analysis. **Angela Borzacconi**: Writing – review & editing, Resources. **Luciana Travan**: Investigation, Formal analysis. **Caterina Giostra**: Writing – original draft, Data curation.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ijpp.2026.04.008](https://doi.org/10.1016/j.ijpp.2026.04.008).

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