

Conflict in Pre-Hispanic Northwest Argentina: Implications Arising From Human Bone Trauma Patterns

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ABSTRACT The time span ranging from ca. 900 to 1450 A.D. in the South-Central Andes has been traditionally posited as a period of social unrest, political disintegration and large-scale conflict due to, primarily, environmental causes. However, the osteological record of traumatic injuries in a sample of 223 adult and subadult crania from different areas of Northwest Argentina does not clearly correspond to the expected scenario of pervasive and formalized armed attacks. Cranial trauma prevalence in the sample is low (17.48%), and no statistically significant differences were met between the sexes. No differences were found when comparing trauma prevalence between settlements or regions, suggesting that location or function of the sites may not have influenced in trauma frequencies. This information more comfortably agrees with a scenario of conflict where several sources of violence may have caused the record of traumatic injuries (i.e. raids, ambushes, etc). These results serve to problematize how conflict is expected to be expressed in the archaeological record, especially in osseous human remains, what sources of violence may have generated the traumatic patterns observed and the intensity of conflict in this region in particular and in the pre-Hispanic Andes in general. Copyright © 2013 John Wiley & Sons, Ltd.

Key words: bioarchaeology; cranial injuries; violence; Andes

Introduction

Although years ago, scholars posited war as an essential factor for social development (Chagnon, 1968; Carneiro, 1970; Webster, 1977), a renewed interest for the study of conflict and warfare in past societies has recently arose. In the Andean area, studies of variation of conflict in different historical trajectories suggest that violence was deeply rooted in time, although an escalation of violence is agreed for the Late Intermediate Period (LIP, ca. 900–1450 A.D.) (Arkush & Stanish, 2005; Arkush, 2006, 2009; Nielsen, 2007; Arkush & Tung, 2013). During this phase, a series of severe droughts (Thompson *et al.*, 1985; Shimada *et al.*, 1991) may have caused a reduction in food availability, leading to the collapse of the established exchange networks and generating competition over them and/or over key resources (Schiappacasse *et al.*, 1989; Nielsen, 2003, 2007). As part of the Andean region, Northwest Argentina's

(NWA) pre-Hispanic communities of the Period of Regional Developments (PRD, ca. 900–1450 A.D.) are supposed to have experienced a pervasive situation of inter-community conflict and this article investigates the presence and distribution of cranial traumatic injuries as possible evidence of violence in human remains from different NWA archaeological sites in order to assess the occurrence and intensity of conflict.

NWA can be geographically defined by the presence of the Andean mountain range that runs in a N–S direction as well as several intermountain valleys called *quebradas* (ravines) and a high altitude area (more than 3,500 m.a.s.l.) called *puna* that sustained the development of interconnected societies along its temporal occupation. The most important valleys from North to South are: Quebrada de Humahuaca, Quebrada del Toro, Calchaquí Valley, Santa María or Yokavil Valley, Cajón Valley and Hualfín Valley. Human occupation in the *puna* was concentrated on certain oasis such as Antofagasta de la Sierra in Catamarca province; Huachichocana, Inca Cueva and Rinconada in Jujuy province and Pastos Grandes in Salta province (Figure 1). Previous research signals that from about 900 A.D., a series of rapid changes in

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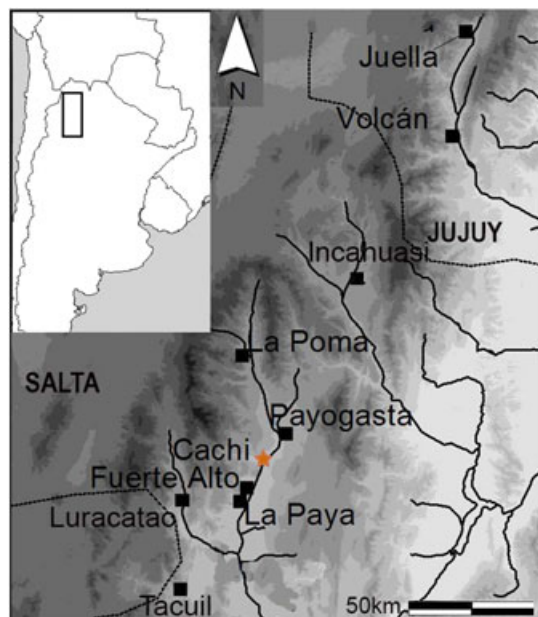


Figure 1. Map of the area showing the sites mentioned in the text. This figure is available in colour online at wileyonlinelibrary.com/journal/oa.

communities' lifestyle took place, characterized by the clustering in nucleated settlements, many of them located on defensible landforms; the intensification agriculture; the presence of growing conflict or its threat; a context of increasing social inequality and institutionalized economic stratification and political fragmentation (Ottonello & Lorandi 1987, Tarragó, 2000, Nielsen, 2003).

In this regard, the main goal of this paper is to evaluate how the proposed conflict scenario would have impacted on individuals' health, specifically by studying the presence and distribution of traumatic lesions in a sample of human crania from Calchaquí Valley, Quebrada de Humahuaca and Quebrada del Toro broadly corresponding to the time period between ca. 900 and 1450 A.D., although some part of the series may come from later this period. It is expected that trauma frequencies vary according to the location of settlements, so other important goal of this study was to compare trauma prevalence between and within clusters of settlements in order to start assessing the spatial distribution of lesions.

Although the warfare and conflict scenario has been posited for the entire Andean region, recent studies have shown subtle differences in the scale and local manifestations of its terms. According to Arkush (2006: 306–307), warfare started quite late during the LIP in the area comprehended by Southern Bolivia, Northern Chile and NWA. However, the analysis of cranial injuries performed by Torres-Rouff & Costa Junqueira (2006) in samples from San Pedro de Atacama (Northern Chile)

showed that the highest percentage of traumatic injuries was recorded towards the end of the Middle Horizon (ca. 600–950 AD) and the beginning of the LIP (ca. 950–1400 AD). Overall, fractures correspond to regenerated lesions and only two *perimortem* injuries were found in the entire sample ($N = 682$). Given this pattern, the authors suggest that armed warfare does not seem a plausible explanation. Instead, a combination of *raids*, ambushes and ritual violence such as *tinkus* may have caused the lesions observed, in close relation to a moment of environmental and social stress (Torres-Rouff & Costa Junqueira, 2006: 68). *Tinku* are formalized ritual battles held on an appointed day between communities or moieties. The fighters throw slingstones, whips or fists and occasionally are seriously injured or killed; their deaths are taken to augur prosperity for the coming year but are not typically avenged (Gorbak *et al.*, 1962) and may have been present for centuries as Standen & Arriaza (1999) posit that the pattern of non-lethal lesions found in the Chinchorro mummies (ca. 6000–1600 BC) of Chile may respond to simulated combats.

In NWA, the presence of traumatic lesions on human bone indicates that individuals were subjected to real violent events in different time periods. In Las Pirguas (ca. 500 A.D), a series of cave burials found in Salta Province, Baffi & Torres (1993) reported 55.5% of cranial fractures in males (15/27), 17.4% in females (4/23) and 13.4% in subadults (3/23). According to the authors, these figures are evidence of an aggressive conduct, especially carried out by the masculine members of the group and in a moment of severe social stress.

In the Quebrada de Humahuaca area, Bordach *et al.* (1999) found healed cranial trauma in two male individuals from the 'zanja Belgrano' internment in Tilcara (ca. 1440–1954 A.D). Mendonça *et al.* (1992) recorded premortem trauma on two female individuals from the important settlement Pukará de Tilcara, suggesting that women were involved in aggressive events. Also, Novellino *et al.* (1997) report the case of a subadult male from Quebrada de Humahuaca who showed an embedded projectile point in his tenth thoracic vertebrae with no signs of healing, indicating the immediate death of the individual. Recently, Gheggi & Seldes (2012) recorded *premortem* and *perimortem* trauma in a large sample of 423 crania from Calchaquí Valley (Andalhuata, Fuerte Quemado, Tolombón, Valle Calchaquí, La Poma, Molinos-Cachi, Payogasta, La Paya and Fuerte Alto) and Quebrada de Humahuaca (Los Amarillos, Campo Morado, Angosto Chico, La Huerta, Juella and Volcán) ca. 1000–1430 A.D. They found that 13.95% of the sample showed traumatic lesions possibly caused by several sources of violence.

Table 1. Sample considered for this study

Provenance	n	Collector/Year	Chronology (reference)	Curated at ^a
Juella	11	Casanova/1939	1182–1636 A.D. (Nielsen, 1997)	ME
Volcán	9	Gatto/1940	1031–1635 A.D. (Garay de Fumagalli, 1998)	ME
Incahuasi	7	Burmeister/1890	PRD and Inca (Vitry <i>et al.</i> , 2007)	ME
	6	Ten Kate/1896		MLP
La Poma	35	Zavaleta/1906	PRD, Inca and Hispanic-Indigenous	ME
	75	Ambrosetti/1906–1907	(Tarragó, 1978, DeMarrais, 1997, Gifford, 2003)	ME
	9	Gerling/1896		MLP
La Paya	27	Ambrosetti/1906–1907	1016–1465 A.D. (Baldini, 1980)	ME
Kipón/Payogasta	14	Ambrosetti/1906	PRD (Tarragó & Díaz, 1972: 55)	ME
Fuerte Alto	6	Ambrosetti/1906–1907	PRD (Tarragó & Díaz, 1972: 55)	ME
Luracatao	12	Zavaleta/1906	PRD, Inca (Baldini & De Feo, 2000)	ME
Tacuil	12	Zavaleta/1906	1288–1397 A.D. (Williams <i>et al.</i> , 2010)	ME

^aME: Museo Etnográfico/MLP: Museo de La Plata.

This brief review shows how the analysis of traumatic injuries has the sensitivity to address the presence, intensity and type of conflict. However, recording and interpreting traumatic lesions on skeletal material posit special challenges to the observer. On the one hand, traumatic injuries can be caused not only by intentional violence but also by accidents, except in the case of embedded projectiles that are undeniably the result of violent interactions (Lovell, 1997; Galloway, 1999; Walker, 2001; Tung, 2007). On the other hand, different sources of violence such as conflict resolution, domestic violence, physical punishment, ritual fights, formal battles, raids, ambushes, etc. can result in the pattern observed (Chagnon, 1968; Chagnon & Bugos, 1979; Counts *et al.*, 1992; Martin, 1997).

Finally, only a minor percentage of inflicted wounds have an impact on bone. As Walker (2001: 584) mentions, modern clinical literature on trauma shows that most violent assaults do not leave traces on bones. Only 16.6% of violent lesions in the United States were recorded as 'muscular/skeletal'. Also, the skeleton of a person in frontal view represents approximately 60% of the potential surface to be attacked, implying that half the times a projectile is thrown to a person it would not impact on bone (Walker, 2001: 584). Using an experimental approach, Gordón (2011: 153) concluded that marks on bones are underrepresented by a 13.86%, as only 31 impacts of the 36 made left a trace on the bone, and the rest of them were absorbed by soft tissues. Thus, it is important to highlight that the observed prevalence of traumatic lesions may correspond indeed to the minimum number of injuries observed, and other sources of evidence should be considered as well (e.g. health patterns).

Materials and methods

Crania were examined from nine sites or localities that belong to the Calchaquí Valle, Quebrada del Toro and Humahuaca. Although the complete sample was composed of 255 crania, 223 met the conservation criteria established (i.e. that at least 75% of the bones were present) and were considered for the present study. They form a particular universe, since in some cases, the archaeological site they belong to is known (e.g. La Paya, in the Calchaquí valley), while in others only the general locality is mentioned (e.g. Tacuil or La Poma). Moreover, in those cases where the site is known, the remains cannot be linked to any specific tomb or funerary context. Despite these shortcomings, museum collections have the advantage of being numerous, a requisite for a population-level approach. However, it is worth mentioning that this is an exploratory data analysis that served to formulate hypotheses and to evaluate how conflict presented in the area. When known, absolute chronological information¹ for the samples is shown in Table 1, and relative chronology is shown when no radiocarbon dating exists.

Juella corresponds to a dense archaeological site located over a 500 m long and 100 m wide plateau on the Quebrada de Juella, running transverse to the Río Grande in Jujuy. Crania from this site were recovered by Casanova, although there is not a publication concerning their finding. Pukará de Volcán lies over a plateau elevated 150 m.a.s.l. and corresponds to a complex installation with differentiated sectors (e.g. agricultural, funerary, residential). Osseous remains were obtained

¹ Chronological data are presented as ranges, encompassing the latest and younger radiocarbon dating reported by researchers. We refer the reader to the original text for more precise information.

by Gatto (1946) but could not be associated to any particular funerary unit. Both sites of the Quebrada de Humahuaca seem to have been occupied from 900/1000 A.D. and on (Table 1). Incahuasi is located in the Quebrada de Incamayo, affluent of the Quebrada del Toro and corresponds to an 8 ha settlement with architectural remains from different time periods. The Inca road passes through it and the site was probably important as a node connecting the *puna* area to the nearby valleys (Vitry *et al.*, 2007). Osseous remains from this site were collected by Burmeister in his 1890s expedition and they lack any contextual information. Nevertheless, Vitry *et al.* (2007) mention the existence of two discrete elevated sectors of the site with rounded stone structures that may correspond to funerary units.

Remains from La Poma, Tacuil and Luracatao were obtained towards the end of the XIX century by a professional looter named Manuel B. Zavaleta. La Poma corresponds to a locality that lies at the uppermost of the Calchaquí Valley, Tacuil is both the name of a valley and of an archaeological site located in the west sector of the Calchaquí valley, in an important *quebrada* connecting to the *puna*. The illustrations that accompany Zavaleta's catalogue suggest that the remains may belong to the Fuerte Tacuil, a small fort located 3550 m.a.s.l. and dated to the PRD (Table 1). Luracatao is a fertile valley that runs transverse to the main valley and where several archaeological sites were found. Zavaleta's pictures show that looting was performed on archaeological sites, without further information. Baldini and collaborators carried out research in this valley and report the existence of many archaeological sites, some of them with ostensible defensive locations (e.g. La Loma de Luracatao or San Lucas I) that guard important agricultural lands (e.g. La Puerta or Patapampa) (Baldini & De Feo, 2000; Baldini & Villamayor, 2007). Although the exact occupation of the sites is currently unknown, it is possible that they correspond to defensive settlements from the PRD.

Remains from La Paya, Fuerte Alto and Kipón/Payogasta were recovered during 1907 and 1908 by Ambrosetti and Debenedetti. La Paya corresponds to a dense fortified settlement of about 6 ha, which possesses a surrounding wall with bastions and was probably occupied from 900 A.D. on (1). More than 200 funerary units were excavated by Ambrosetti (1907) but no link could be established between the osseous remains and their context. Kipón was a village without defensive architecture as Debenedetti (1908) mentions and is located in a transverse ravine to the main valley. Architectural remains consist of double

filled wall enclosures and funerary units were diverse in their characteristics and locations (Debenedetti, 1908: 31–32). Fuerte Alto consist of residential architectural remains located on a river terrace at about 1.5 km from modern Cachi and Ardissonne (1942) mentions that tombs were located among them.

Two clusters of settlements were defined to evaluate how traumatic lesions were spatially distributed. Subset A comprises the following sites: Juella, Pukará de Volcán, Incahuasi and La Poma and Subset B comprises La Paya, Kipón/Payogasta, Fuerte Alto, Luracatao and Tacuil. According to data presented by Keeley (1996: 56), when territories of a community include great portions of land, it is feasible that fortifications were located on its borders, and only if they possess hostile neighbors. Therefore, trauma frequencies were compared between sites located in the borders of each subset which showed defensive locations, (i.e. Pukará de Volcán and La Poma for subset A; La Paya and Tacuil for subset B), and those settlements located in the interior of each subset which showed no defensive features (i.e. Juella and Incahuasi for subset A and Fuerte Alto, Kipón/Payogasta and Luracatao for subset B).

Sex was determined from the observation of macroscopic features of the cranium (i.e. glabella, supraorbital margin, mental eminence when possible, mastoid process and nuchal crest) (Buikstra & Ubelaker, 1994) and was carried out only for adult remains, since structures commonly used for sex determination in subadults (i.e. mandible and coxae) were absent (González *et al.*, 2005). Each cranium was assigned to a sex category as female, male or indeterminate. Rough age categories (i.e. Subadult (–18), young adult (19–34 years), middle adult (35–49 years), old adult (+50 years) and indeterminate adult (+19 years)) were created based on cranial suture closure following Meindl & Lovejoy (1985) for cranial sutures and Mann *et al.* (1987) for palatines sutures. Also, esphenobasilar suture closure was taken as an age indicator for incorporating individuals into the 'adult group' if the suture was totally closed or to the 'subadult group' if it was partially or totally opened. Subadult age was estimated considering the sequence of dental eruption as developed by Ubelaker (1989) (Table 2).

Several features of a traumatic lesion were recorded. The affected bone, side and state of healing were noted, as were the shape and number of injuries. Also, the size was measured and the exact location was recorded with reference to osteometric points as detailed in Walker (1989). *Premortem* or *perimortem* fractures were differentiated considering the presence of healing for the former and its absence for the latter (Ortner & Putschar, 1981; Aufderheide & Rodriguez Martín,

Table 2. Sex and age structure of the sample considered for the present study

Sex/Age	Male	Female	Indeterminate	Total
Infant	0	0	2	2
Child	0	0	14	14
Adolescent	0	0	0	0
Subadult	0	0	2	2
Young adult	12	12	0	24
Middle adult	16	9	0	25
Older adult	1	5	0	6
Indeterminate adult	63	85	2	150
Total	92	111	20	223

1998; Sauer, 1998). Several other diagnostic features were considered for *perimortem* injuries (i.e. fractures arising from it, adhering bone fragments, inner beveling, sharp margins, decoloration of the borders (Facchini *et al.*, 2007; Wakeley, 1997; Wheatley, 2008). Fisher's exact test was used to evaluate the correspondence between distributions only in those cases where a 2 x 2 contingency table showed a cell with a value equal or minor to 5. For all other cases, a chi-square test was used. The null hypothesis posits that there is not relationship between the variables analyzed and the significance level to reject it was $P < 0.05$. All statistical tests were performed using PAST version 2.12 (Hammer *et al.*, 2001).

Results

From the 223 individuals analyzed, including adults and subadults, 39 showed injuries that might be related to traumatic lesions (17.48%), corresponding to 15 females, 22 males and 2 individuals which could not be sexed. One of them is a subadult which presents a *premortem* lesion on the right parietal with regeneration at the time of death. Although cranial injuries were more prevalent in men there is not a statistically significant difference both for the entire sample ($X^2 = 1.86$; $df = 3$; $P = 0.602$) nor in each sample (Table 3). If we consider trauma prevalence only for the adult sample, it is therefore 18.53% (38/205).

Forty-nine lesions were present among the 39 traumatized individuals but most of them showed only one lesion (31 individuals). The remaining individuals presented two or more lesions. Thirty-seven individuals showed *premortem* injuries occurred some time before death as new bone was correctly deposited over the lesion (Figure 2).

Two cases of *perimortem* fractures were recorded, one in a female person from La Poma which shows a blunt force circular traumatic lesion in her left parietal bone

Table 3. Comparison of positive cases of traumatic lesions in males versus females per settlement

Provenance	AF/OB ^a Female	AF/OB ^a Male	<i>P</i> *
Volcán	0/6	2/3	0.083
La Poma	9/64	11/44	0.7819
La Paya	0/9	5/16	0.122
Kipón/Payogasta	2/8	1/6	1
Fuerte Alto	0/3	2/3	0.399
Luracatao	2/4	0/7	0.109
Tacuil	2/6	1/5	1
Total	15/100	22/84	

*This *P* value corresponds to Fisher's Exact Test. For La Poma, a chi-square test could be performed ($X^2 = 1.68$; $df = 3$; $P = 0.7819$).

^aAF: affected/OB: observed

(Figure 3A) and the other in a male individual from Pukará de Volcán (Figure 3B).

Most fractures are located in the anterior sector of the cranium (17 lesions, 34%), followed by the posterior sector (10 lesions, 21%), the right lateral sector (9 lesions, 18%), left lateral sector (8 lesions, 16%) and the superior sector of the cranium (5 lesions, 10%). Although the distribution of lesions suggests the anterior sector as the privileged location, the statistical evaluation of the differences did not show a significant result ($x^2 = 8.04$; $df = 4$; $P = 0.0901$).² However, it was noticed that for the anterior sector of the cranium, women presented injuries that affected only their nasal bones, while men showed lesions also in other bones as well. The comparison probed to be statistically significant ($P = 0.044$; Fisher's Exact Test).

Comparison of trauma frequencies between each subset was no statistically significant ($X^2 = 3$; $df = 3$; $P = 0.3916$) as were comparisons of each settlement inside the subsets (Tables 4 and 5). Comparison for border versus interior settlements between subsets was not significant ($X^2 = 1.3$; $df = 3$; $P = 0.7291$) as was the comparison for borders versus interior settlements into each subset ($P = 0.050$; Fisher's Exact Test for subset A; $X^2 = 0.14$; $df = 3$; $P = 0.9866$ for subset B).

Discussion

The question is how we can interpret the results obtained in light of the approaches that posit a period of endemic conflict for the Andes during the LIP or PRD in NWA.

² As mentioned in Tung (2003:219), the expected quantity of lesions was calculated by considering that each sector of the cranium had the same chance of being struck. Thus, a frequency of 9.8 lesions per sector would be expected (49/5). Then, the expected value was used against the observed value in a contingency table.



Figure 2. Examples of well healed premortem trauma. A) Individual 10281 from Tacuic: circular depression fracture located at lambda. B) Individual 14216 from Volcán: oval fracture located in the frontal bone. C) Individual 10163 from La Poma: linear trauma in the nasal bone. D) Individual 10119 from La Poma: fracture of the left zygomatic bone. This figure is available in colour online at wileyonlinelibrary.com/journal/oa.

Physical evidence presented here support the occurrence of violence in the sample studied, although not directed toward a specific group, as results signal that both women and men were involved in events that resulted in the generation of a cranial traumatic injury along their lives, although, in most cases, of a mild to moderate nature.

The presence of only two *perimortem* fractures suggests that wounding but not killing may have been the goal of the attacks. This may be the key aspect to understand the nature of violence represented in the sample under study and the trigger for some other issues as well. In this regard, both the low lethality of

injuries and the prevalence of traumatic injuries seen for the entire sample (17.48%) coincide with what can be expected for the type of conflicts that may have arose in societies like those present in the pre-Hispanic Andes. As Arkush & Stanish (2005) posit, these communities lacked professional armies (except for the Moche and Inca) and conflict was probably characterized for the presence of small war parties, raids, ambushes, assaults, or the taken of prisoners, food or goods and not for the conquest of territories. Additionally, the statistically significant difference in the presence of more nasal lesions in women than in men might be explained by the selection of this structure

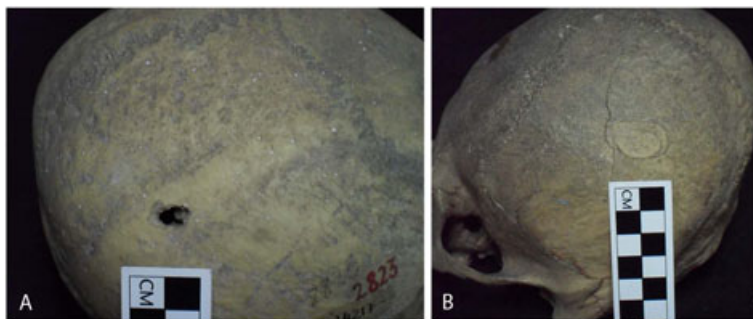


Figure 3. A and B. Examples of perimortem trauma. This figure is available in colour online at wileyonlinelibrary.com/journal/oa.

Table 4. Statistical comparison of trauma frequencies among each settlement of subset A. Fisher's Exact Test

Comparison	P
Juella versus Pukará de Volcán	0.18
Juella versus Incahuasi	1
Juella versus La Poma	0.21
Incahuasi versus Pukará de Volcán	0.15
Incahuasi versus La Poma	0.21
Pukará de Volcán versus La Poma	0

as physical punishment, as has been signaled by other researchers as well (Lessa & Mendonça de Souza, 2006; Martin *et al.*, 2010).

The prevalence of trauma recorded for the entire sample can be coherently encompassed in those reported for other Andean skeletal samples (Table 6), although our result is lower than those from nearby areas like San Pedro de Atacama, where a figure of 30.5% (46/151) was recorded for the LIP cemeteries of Yaye and Quito 6 (Torres-Rouff & Costa Junqueira, 2006) and 23.1% (3/13) were recorded for Azapa (Arkush & Tung, 2013). If we compare the percentage recorded for our sample with those presented by Arkush & Tung (2013) for entire LIP/LH period (27.4%, 152/555), it is markedly lower. This may imply, as these authors correctly suggest, that the intensity of warfare was quite varied over space. In this regard, they signal that there is stronger evidence of conflict in the Northern and Central regions than in the South and far South sectors of the Andes that cannot be comprehended by merely claiming differences in the intensity of research conducted (Arkush & Tung, 2013).

Additionally, bioarchaeological indicators of health recorded do not support a scenario of severe stress for the skeletal series studied (Gheggi, 2011). Assessing individuals' health is important since a situation of

Table 5. Statistical comparison of trauma frequencies among each settlement of subset B Fisher's Exact Test

Comparison	P
La Paya versus Kipón/Payogasta	1
La Paya versus Fuerte Alto	1
La Paya versus Luracatao	0.69
La Paya versus Tacuil	1
Kipón/Payogasta versus Fuerte Alto	0
Kipón/Payogasta versus Luracatao	1
Kipón/Payogasta versus Tacuil	1
Fuerte Alto versus Luracatao	0.56
Fuerte Alto versus Tacuil	1
Luracatao versus Tacuil	0.99

Table 6. Results from other studies in Andean populations showing the prevalence of traumatic injuries

Site/Region	Chronology	Trauma presence	Reference
Chuquibamba (Peruvian Northern Sierra)	Late Intermediate Period and Late Horizon	22% (N = 153)	Jakobsen <i>et al.</i> (1986–1987)
Kuelap (Peruvian Northern Sierra)	Late Intermediate Period	16% (N = 97)	Nystrom & Verano (2003)
San Damián, Cinco Cerros, Matucama and Huarichiri (Peruvian Central Sierra)	Middle and Late Horizon	55.7% (male) 31.6 (female) 26.9 (juveniles) (N = 212)	Verano (2003: 232)
Molino-Chilacachi (Titicaca, Bolivia)	Late Intermediate Period	15% (adults) (N = 44)	de La Vega <i>et al.</i> (2002)
Several sites from Cuzco and its periphery (Perú)	Pre-Inca	8.3%	Andrushko (2007)
	Early Inca	18%	
	Late Horizon	17.2%	
		N = 627	
Yaye, Coyo 3, Quito 6 and Catarpe (San Pedro de Atacama, Chile)	Late Intermediate Period	29.17% (Yaye, N = 144), 35.6% (Coyo 3, N = 45)	Torres-Rouff & Costa Junqueira (2006)
	Late Horizon	23.8% (Quito 6, N = 21) 6.98% (Catarpe 4–5, N = 43) 3.36% (Catarpe 1–2, N = 238) 6.89% (N = 29)	
Pukará de Tilcara (Northwest Argentina)	Period of Regional Development (1000–1430 A.D.) and Inca Period (1430–1550 A.D.)	14% (N = 423)	Mendonça <i>et al.</i> (1992)
Several sites from Quebrada de Humahuaca and Valle Calchaquí (Northwest Argentina)	Period of Regional Development (ca. 1000–1430 A.D.) and Inca Period (1430–1550 A.D.)		Gheggi & Seldes (2012)

warfare or conflict held in time surely had negative consequences as losing important group working members, agricultural fields destruction, forced movements, starvation and disease, temporary or permanent loss of traditional exchange networks among others, all of which would contribute to deteriorate living standards (Keeley, 1996: 89 and ss). Porotic lesions to the skull (i.e. cribra orbitalia and porotic hyperostosis) were found in 44 individuals (18.56%; $N = 237$) and infectious oral pathologies were found in a low percentage (caries: 11%, 11/100; periodontitis: 16.52%, 39/236; abscesses: 16%, 37/236). Nevertheless, some subsamples showed a higher prevalence of general indicators of health. Kipón and Fuerte Alto showed higher frequencies of porotic lesions than La Paya, and the difference was found to be statistically significant ($X^2 = 19.85$; $df 3$; $P = 0.0002$). It is possible that small farming villages like Kipón and Fuerte Alto coexisted with La Paya, a neighboring dense fortified settlement, and might have been economically and politically related to it. However, the lack of radiocarbon dating for both sites does not allow confirming that proposition.

The comparison of trauma prevalence between the subsamples was not statistically significant. This is important as it is not possible to posit that the inhabitants of the sites or localities studied had suffered from a differential prevalence of traumatic injuries according the function or location of the sites they lived in. This assertion can also be applied to those sites that possess defensive features in relation to those that have not, or those strategically located to defend territories to those that were not. This result reinforces the idea of the PRD as a moment of political fragmentation, in which each community was a small 'frontier' that delimited a protected territory and its resources and may imply two different, but not mutually exclusive, things: (i) that fortified settlements really fulfilled its function in protecting people and resources or that (ii) communities found a way of defusing conflict, for example by employing 'buffering zones' as proposed by Eerkens (1999) by maintaining an area of 'common pool resources' exploited by different ethnic groups. Baldini & De Feo (2000) posited the presence of two main clusters in the Central and Northern sector of the Calchaquí Valley during the PRD that could be interpreted in this light. Also, Lorandi & Boixados (1987–88) point that written sources mention that the *gualfines* had their 'sementeras' (agricultural lands) in Angastaco but also the *sichas* shared lands in this oases by the Calchaquí river, which may have acted as a 'common pool resource' area, unoccupied permanently but exploited by several groups.

Conclusion

A nuanced interpretation is arising from recent research of warfare and conflict during the LIP or PRD in the Andes and, although it is not possible to deny the clear appearance of archaeological correlates of increasing conflict during this period, it is important to critically question the impact it might have had on living populations.

Although this study does not deny that individuals underwent violent events in their lives, it suggests that several sources of violence might have generated the osteological record of lesions observed which could include raids, ambushes and assaults that were not intended to kill the adversary, thus the low prevalence of *perimortem* injuries. This is coherent with the environmental insecurity context argued for the area, where attacks would have been directed toward obtaining occasional resources and not toward the consolidation of territories or the capture of prisoners (Arkush & Stanish, 2005).

This research also contributes to the understanding of how conflict manifested regionally and, in this regard, no statistical differences were found when comparing trauma frequencies neither between the clusters defined nor even within them. This could imply that, although sharing cultural bounds, each community may have act as a 'frontier' within small and fragmented territories. All this information suggests that we are dealing with a complex mosaic of situations that requires to be studied through different research lines and finer temporal definition.

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References

- Ambrosetti JB. 1907. Exploraciones arqueológicas en la ciudad prehistórica de "La Paya" (Valle Calchaquí-Provincia

- de Salta). *Publicaciones de la Sección Antropología* 3 (1–2), Facultad de Filosofía y Letras de la Universidad de Buenos Aires. Buenos Aires.
- Andrushko VA. 2007. The Bioarchaeology of Inca Imperialism in the Heartland: An Analysis of Prehistoric Burials from the Cuzco Region of Peru. Unpublished Ph.D. Dissertation.
- Ardissone R. 1942. Un ejemplo de instalación humana en el Valle Calchaquí (el pueblo de Cachi). Instituto de Estudios Geográficos. Universidad Nacional de Tucumán.
- Arkush E. 2006. Collapse, conflict, conquest. The transformation of warfare in the Late Prehispanic Andean Highlands. In *The Archaeology of Warfare: Prehistories of raiding and conquest*, E Arkush, Mw Allen (eds.). University Press of Florida: Florida, 286–335.
- Arkush E. 2009. Pukaras de los Collas: Guerra y poder regional en la cuenca norte del Titicaca durante el Periodo Intermedio Tardío. *Andes* 7: 463–479.
- Arkush E, Stanish C. 2005. Interpreting conflict in the ancient Andes. Implications for the Archaeology of warfare. *Current Anthropology* 46(1): 3–27. DOI: 0011-3204/2005/4601-0001\$10.00
- Arkush E, Tung T. 2013. Patterns of War in the Andes from the Archaic to the Late Horizon: Insights from Settlement Patterns and Cranial Trauma. *Journal of Archaeological Research*. DOI: 10.1007/s10814-013-9065-1.
- Aufderheide A, Rodríguez-Martin C. 1998. *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge University Press: Cambridge.
- Baffi E, Torres MF. 1993. Una aproximación al análisis de pautas de actividad en una población prehispánica: Las Pirguas (Salta, Argentina). *Boletín de la Sociedad Española de Antropología Biológica* 14: 63–79.
- Baldini L. 1980. Dispersión y cronología de las urnas de tres cinturas en el Noroeste Argentino. *Relaciones de la Sociedad Argentina de Antropología* 14: 49–61.
- Baldini L, De Feo C. 2000. Hacia un modelo de ocupación del valle Calchaquí central (Salta) durante los Desarrollos Regionales. *Relaciones de la Sociedad Argentina de Antropología N. S.* 25: 75–98.
- Baldini L, Villamayor V. 2007. Espacios productivos en la cuenca del Río Molinos (Valle Calchaquí, Salta). *Cuadernos de la UNJu* 32: 35–51.
- Bordach MA, Dalerba LB, Mendonça OJ. 1999. Vida y Muerte en Quebrada de Humahuaca: Antropología Física Prehistórica del Sitio SJ Til 20. Universidad Nacional de Río Cuarto: Córdoba.
- Buikstra JE, Ubelaker DH. 1994. Standards for data collection from human skeletal remains. *Arkansas Archaeological Survey research Series No. 44*. Fayetteville, Arkansas.
- Carneiro RL. 1970. A Theory of the Origin of the State. *Science* 169:733–738.
- Chagnon NA. 1968. Yanomamo social organization and warfare. In *The anthropology of armed conflict and aggression*, M Fried, M Harris, R Murphy (eds.). The Natural History Press: Garden City; 109–159.
- Chagnon NA, Bugos PE. 1979. Kin selection and conflict: an analysis of a Yanomamo ax fight. In *Evolutionary biology and human social behavior: an anthropological perspective*, NA Chagnon, W Irons (eds.). Duxbury Press: North Scituate; 213–237.
- Counts DA, Brown JK, Campbell J. 1992. *Sanctions and sanctuary: cultural perspectives on the beating of wives*. Westview Press: Boulder.
- Debenedetti S. 1908. Excursión arqueológica a las ruinas de Kipón (Valle Calchaquí-Provincia de Salta). *Publicaciones de la Sección Antropológica* 4. Universidad de Buenos Aires.
- DeMarrais E. 1997. Materialization, ideology and power: the development of centralized authority among the pre-Hispanic polities of the Valle Calchaquí, Argentina. Unpublished Ph. D. Dissertation. University of California, Los Angeles.
- Eerkens JW. 1999. Common pool resources, buffer zones and the jointly owned territories: hunter-gatherer land and resource tenure in Fort Irwin, Southeastern California. *Human Ecology* 27(2): 297–318. DOI: 0300-7839/99/0600-0297\$16.0010
- Facchini F, Rastelli E, Belcastro M. 2007. Perimortem Cranial Injuries from a Medieval Grave in Saint Peter's Cathedral, Bolonia, Italy. *International Journal of Osteoarchaeology* 18: 421–430. DOI: 10.1002/oa.949
- Galloway A. 1999. Broken bones: anthropological analysis of blunt force trauma. CC. Thomas: Springfield.
- Garay de Fumagalli M. 1998. El Pucará de Volcán, historia ocupacional y patrón de instalación. In *Los desarrollos locales y sus territorios. Arqueología del N.O. Argentino y sur de Bolivia*, Cremonte MB (ed.). Universidad Nacional de Jujuy: Jujuy; 131–154.
- Gatto S. 1946. Exploraciones arqueológicas en el Pucará de Volcán. *Revista del Museo de La Plata* IV. La Plata.
- Gheggi MS. 2011. Un enfoque biocultural aplicado al estudio de entierros arqueológicos del Noroeste Argentino (ca. 1000-1550 A.D.). Unpublished Ph.D. thesis, Facultad de Filosofía y Letras, Universidad de Buenos Aires.
- Gheggi MS, Seldes V. 2012. Evidencias bioarqueológicas de conflicto ca. 1000-1432 A.D. en la Quebrada de Humahuaca y el Valle Calchaquí. *Intersecciones en Antropología* 13: 103–115.
- Gifford CH. 2003. Local matters: Encountering the Imperial Inkas in the South Andes. Ph.D. Thesis. Columbia University, Nueva York.
- González P, Bernal V, Barrientos G. 2005. Estimación del dimorfismo sexual en el esqueleto pélvico y mandibular de individuos subadultos: comparación de técnicas visuales y de morfometría geométrica. *Werken* 1(6): 49–61.
- Gorbak C, Lischetti M, Muñoz CP. 1962. Batallas rituales del Chiaraje y del Tocto de la Provincia de Kanas (Cuzco-Perú). *Revista del Museo Nacional de Lima* 31: 245–304.
- Gordon F. 2011. Dinámica Poblacional, Conflicto y Violencia en el Norte de Patagonia durante el Holoceno tardío: un Estudio Arqueológico. Tesis doctoral. Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, EdULP.
- Hammer Ø, Harper DAT, Ryan PH. 2001. PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaentologia Electronica* 4(1): 9.
- Keeley L. 1996. *War before civilization*. Oxford University Press: New York.

- Lessa A, Mendonça de Souza S. 2006. Broken noses for the gods: ritual battles in the Atacama Desert during the Tiwanaku period. *Memórias do Instituto Oswaldo Cruz* 101(II): 133–138.
- Lorandi AM, Boixados R. 1987–1988. Etnohistoria de los valles Calchaquíes en los siglos XVI y XVII. *RUNA* 17–18: 263–419.
- Lovell N. 1997. Trauma Analysis in Paleopathology. *Yearbook of Physical Anthropology* 40: 139–170.
- Mann RW, Symes SA, Bass WM. 1987. Maxillary suture obliteration: Ageing the human skeleton based on intact or fragmentary maxilla. *Journal of Forensic Sciences* 32: 148–157.
- Martin DL. 1997. Violence against women in the La Plata River valley (A.D. 1000–1300). In *Troubled times: violence and warfare in the past*. DL Martin, DW Frayer (eds.). Gordon and Breach Publishers: Australia; 45–75.
- Martin DL, Harrod RP, Fields M. 2010. Beaten Down and Worked to the Bone: Bioarchaeological Investigations of Women and Violence in the Ancient Southwest. *Landscapes of Violence* 11 (1): 1–19.
- Meindl RS, Lovejoy CO. 1985. Ectocranial suture closure: A revised method for the determination of skeletal age at death based on the lateral-anterior sutures. *American Journal of Physical Anthropology* 68(1): 57–66.
- Mendonça OJ, Bordach MA, Valdano SG. 1992. Reconstrucción del comportamiento biosocial en el Pukará de Tilcara (Jujuy). Una propuesta heurística. *Cuadernos de la FHyCS, UNJu* 3: 144–154.
- Nielsen AE. 1997. Tendencias temporales en la cultura material de la Quebrada de Humahuaca (Jujuy- Argentina) ca. 700–1650 d.C. *Avances en Arqueología* 3: 147–189.
- Nielsen AE. 2003. La edad de los Auca Runa en la Quebrada de Humahuaca (Jujuy, Argentina). *Memoria Americana* 11: 74–107.
- Nielsen AE. 2007. Armas significantes: tramas culturales, guerra y cambio social en el sur andino prehispánico. *Boletín del Museo Chileno de Arte Precolombino* 12(1): 9–41.
- Novellino P, Doro RA, Corvalan CP, Seldes V, Guichon R. 1997. Actualización de los hallazgos de puntas de proyectil en restos humanos de Argentina. *Actas del IV Congreso Nacional de Paleopatología, España*.
- Nystrom KC, Verano JW. 2003. Warriors of the clouds? Inference and interpretation of trauma from Chachapoya, Peru. Paper presented at the 73rd American Association of Physical Anthropology Meetings, Tempe, Arizona.
- Ortner D, Putschar W. 1981. *Identification of Pathological Conditions in Human Skeletal Remains*. Smithsonian Institution Press: Washington.
- Otonello MM, Lorandi AM. 1987. Introducción a la arqueología y etnología. *Diez mil años de Historia Argentina*. EUDEBA, 1ª ed., Buenos Aires.
- Sauer N. 1998. The timing of injuries and manner of death. Distinguishing among antemortem, perimortem and post-mortem Trauma. In *Forensic Osteology. Advances in the identification of human remains*, K Reichs (ed.). CC Thomas: Springfield; 321–332.
- Schiappacasse V, Castro V, Niemeyer H. 1989. Los Desarrollos Regionales en el Norte Grande (1000–1400 d.C.). In *Culturas de Chile: Prehistoria*, J Hidalgo, V Schiappacasse, H Niemeyer (eds.). Andrés Bello: Santiago de Chile; 181–220.
- Shimada I, Schaaf CB, Thompson LG, Mosley-Thompson E. 1991. Cultural Impacts of Severe Droughts in the Prehistoric Andes: Application of a 1500-Year Ice Core Precipitation Record. *World Archaeology* 22(3): 247–270.
- Standen V, Arriaza B. 1999. Traumas en las poblaciones Chinchorro (Costa Norte de Chile): ¿violencia o situaciones accidentales? *Chungará* 29: 133–150.
- Tarragó M. 1978. Paleocology of the Calchaqui Valley, Argentina. In *Advances in Andean archaeology.*, D Browman (ed.). Mouton: The Hague; 485–512.
- Tarragó M. 2000. Chacras y pukara. Desarrollos sociales tardíos. In *Nueva Historia Argentina*. Sudamericana: Barcelona; 257–300.
- Tarragó M, Díaz PP. 1972. Sitios arqueológicos del Valle Calchaquí. *Estudios de Arqueología* 1: 49–61.
- Thompson LG, Mosley-Thompson E, Bolzan JF, Koci BR. 1985. A 1500-Year Record of Tropical Precipitation in Ice Cores from the Quelcaya Ice Cap, Peru. *Science* 229: 971–973. DOI: 10.1126/science.229.4717.971
- Torres- Rouff C, Costa Junqueira MA. 2006. Interpersonal violence in prehistoric San Pedro de Atacama, Chile: behavioral implications of environmental stress. *American Journal of Physical Anthropology* 130: 60–70. DOI: 10.1002/ajpa.20315
- Tung T. 2007. Trauma and Violence in the Waru Empire of the Peruvian Andes: Warfare, Raids, and Ritual Fights. *American Journal of Physical Anthropology* 133: 941–956. DOI: 10.1002/ajpa.20565
- Ubelaker D. 1989. *Human skeletal remains*. Taraxacum Press: Washington DC.
- de la Vega ME, Frye KL, Chávez J. 2002. La cueva funeraria de Molino-Chilacachi (Acora), Puno. *Gaceta Arqueológica Andina* 26: 121–137.
- Verano JW. 2003. Trepanation in prehistoric South America: geographical and temporal trends over 2,000 years. In *Trepanation: discovery, history, theory*, R Arnott, S Finger, C Smith (eds.). Swets and Zeitlinger: Lisse; 223–236.
- Vitry C, Soria S, Pizzú G, Esparrica R, López F. 2007. Incahuasi, “el de la silla del Inca”, recientes investigaciones y nuevos aportes. *Revista de la Escuela de Historia* 6(1): 303–323.
- Wakeley J. 1997. Identification and analysis of violent and non-violent head injuries in osteo- archaeological material. In *Material Harm: archaeological studies of war and violence*, J Carman (ed.). Cruithne Press: Glasgow; 24–46.
- Walker PL. 1989. Cranial Injuries as Evidence for the Evolution of Prehistoric Warfare in Southern Carolina. *American Journal of Physical Anthropology* 80(3): 313–323. DOI: 10.1002/ajpa.1330800305
- Walker PL. 2001. A bioarchaeological perspective on the history of violence. *Annual Review of Anthropology* 30: 573–596. DOI: 0084-6570/01/1021-0573\$14.00

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- Webster D. 1977. Warfare and the Evolution of Maya Civilization. In *The Origins of Maya Civilization*, R Adams (ed.). University of New Mexico Press: Albuquerque; 335–372.
- Wheatley B. 2008. Perimortem or postmortem bone fractures? An experimental study of fracture patterns in deer femora. *Journal of Forensic Sciences* 53(1): 69–72. DOI: 10.1111/j.1556-4029.2008.00593.x
- Williams VI, Villegas MP, Arechaga L, Gheggi MS. 2010. Conflicto en el Calchaquí Medio durante el Periodo de Desarrollos Regionales. *Libro de Resúmenes Extendidos del XVII Congreso Nacional de Arqueología Argentina* 2: 619–624.