








# Nasal fracture and interpersonal violence in continental Southern Patagonia during the Late Holocene

## Fractura nasal y violencia interpersonal en la región continental de Patagonia Austral

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### Abstract

Nasal fracture is the most common type of facial fracture in modern populations, and is usually related to interpersonal violence. Nevertheless, this type of injury has been scarcely studied in bioanthropological field contexts. In this study, we characterized and discussed the oldest known Southern Patagonia individual presenting nasal fracture, among other lesions, most probably resulting from interpersonal violence. The nasal *fossae* and other skull bones from individual 2 from *Orejas de Burro 1* site, dated to the Late Holocene, were reanalysed in order to study nasal fractures using a recent method developed by Magalhães *et al.* (2020). *Orejas de Burro 1-2-* presented nine fractures, four of them in the nasal area and showing different timing: one *postmortem*, two *perimortem*, and one *antemortem*. The other facial lesions were four diastatic fractures and one in the fragile *septum*. The individual presented a high-energy injury resulting in intense bone disruption and displacement of nasal and facial bones produced by a lateral blow, which may be related to an episode of interpersonal violence. While some likely causes are regionally known, it is extremely difficult to assess the

cause of the injury and the blunt object associated with this episode, since this presents a situation of equifinality. This is one of the oldest cases in South America. It is also one of the first cases showing evidence of traumatic injury, possibly due to an episode of interpersonal violence. *Rev Arg Antrop Biol* 26(1), 077, 2024. <https://doi.org/10.24215/18536387e077>

Keywords: blunt-force trauma; facial fracture; hunter-gatherers; lateral impact force; skull

### Resumen

La fractura nasal es la lesión traumática facial más común en poblaciones modernas y se suele relacionar a violencia interpersonal. Sin embargo, este tipo de lesión ha sido poco estudiada en el ámbito de la antropología biológica. En este estudio, se caracteriza y discute la fractura nasal más antigua encontrada en Patagonia Austral, probablemente fruto de un evento de violencia interpersonal. Se ha reanalizado la cavidad nasal y otros huesos craneales mediante el método desarrollado por Magalhães *et al.* (2020) del individuo 2 del sitio *Orejas de Burro 1*, datado en el Holoceno tardío. Este sujeto presenta nueve fracturas, cuatro de ellas en el área nasal producidas en distintos momentos: una *postmortem*, dos *perimortem* y una *antemortem*. Las otras lesiones faciales observadas son cuatro fracturas diastásicas y una en el septum. El individuo presenta una lesión de alta energía dando lugar a una ruptura y desplazamiento de los huesos nasales y faciales producidos por un golpe lateral, el cual puede estar relacionado con un episodio de violencia interpersonal. Sin embargo, y a pesar del conocimiento que se tiene de la región, es inverosímil y pretencioso apuntar una causa u objeto específico causante de dicha lesión. El caso presentado es uno de los más antiguos de Sudamérica. Igualmente, es una de las primeras evidencias de lesión traumática causada por un posible evento de violencia interpersonal. *Rev Arg Antrop Biol* 26(1), 077, 2024. <https://doi.org/10.24215/18536387e077>

Palabras clave: golpe contundente; fractura facial; cazadores-recolectores; impacto lateral; cráneo

Nasal fracture is the most common type of facial fracture in modern populations (Chan & Most, 2008; Galloway & Wedel, 2014). Clinical studies indicate different causes such as falls, sports, work-related accidents, fist and foot blows, or blunt objects. A considerable relationship between nasal fracture and interpersonal violence has also been suggested (Galloway & Wedel, 2014; Magalhães *et al.*, 2020; Redfern, 2017). Although these injuries are relatively frequent, bioanthropological studies are scarce (Brickley & Smith, 2006; Djurić *et al.*, 2006; Krakowka, 2017; Walker, 1997). In small-scale societies (*sensu* Silberbauer, 1991), situations of interpersonal violence are associated with raids or ambushes (Gordón, 2011; Kelly, 2000). These events are usually extremely violent, i.e. attacks that occur at night and destroy, steal and/or burn victims' belongings, sometimes resulting in murder and slave labor exploitations. Conflictive events also occur within groups, i.e., intra-group interpersonal violence (Keeley, 1996; Redfern, 2017). While conflicts are frequent in small-scale societies, a large percentage of them are not lethal. This can be associated with various types of violence such as domestic violence or disputes. In this sense, it is common to observe *antemortem* le-

sions in the facial bones in bioarchaeological records (Sauer, 1998), particularly nasal fractures (Walker, 1997). The general pattern of conflict that characterizes these societies tends to distribute these lesions among all age groups and both sexes (Keeley, 1996; Otero *et al.*, 2023). Therefore, the analysis of nasal lesions together with other archaeological and bioarchaeological evidence can provide useful insights to discuss patterns of interpersonal violence in small-scale societies. There are several clinical approaches to recording nasal fractures (Han *et al.*, 2011; Murray *et al.*, 1986; Stranc & Robertson, 1979), but only one was recently developed to record this particular lesion in skeletonized individuals (Magalhães *et al.*, 2020).

Southern Patagonia (SP) comprises the continental and insular territories below latitude 50° South and, it is characterized by the scarcity of skeletal evidence, particularly before the Late Holocene (Borrero, 2001; Guichón *et al.*, 2001; Pérez *et al.*, 2016). Currently, in SP only one individual has been documented from the Early Holocene (previous to 8,200 years BP), seven from the Middle Holocene (8,200-4,200 years BP), and 337 from the Late Holocene (4,200 years BP – present; periods *sensu* Walker *et al.*, 2012), whilst for the remaining individuals there is no precise chronology (D'Angelo del Campo *et al.*, 2020). The low number of individuals from the Early and Middle Holocene makes it difficult to study the regional human settlement and the biology of these human groups. Also, SP is characterized by dispersed burials over a wide area, usually appearing as isolated inhumations (Guichón *et al.*, 2001; Suby *et al.*, 2008).

A recent bibliographic review on traumatic injuries in SP carried out by Flensburg & Suby (2020) indicates a low prevalence of traumatic lesions in SP with a higher frequency among terrestrial male hunter-gatherers. The oldest evidence observed in the region dates from the Middle Holocene and corresponds to *Punta Santa Ana 1* (6,290 ± 50 BP), an archaeological site occupied by maritime hunter-gatherers (Morello *et al.*, 2012; Ortiz Troncoso, 1975) where one individual presented a Colles fracture at the distal epiphysis of right radius and ulna, and the collapse of the C2, C3, C4, T12, L3 and L4 (Constantinescu, 2001).

The aims of the current work are (1) to characterize and discuss the lesions of the oldest known individual from the SP region presenting nasal fracture and, building on this (2) to consider the implications that this discovery entails to the archaeological knowledge of the region.

## MATERIALS AND METHODS

*Orejas de Burro 1* is located on the northern coast of Magellan Strait. This archaeological site is in the *Pali Aike* volcanic field, Argentina (Fig. 1), on the interior slope of a volcanic cone presenting discontinuous human activity for the last 4000 years. A simultaneous burial with five individuals was found under volcanic rocks in the site's central area at a depth of 70-75 to 90 cm. The individual examined in the present study (individual 2 from *Orejas de Burro 1*, OB1-2-) is a male adult (45-50 years old) with very good preservation and completeness, whilst individual 1 from the same burial was the only directly radiocarbon dated 3,565 years BP (L'Heureux & Barberena, 2008). Bioarchaeological and paleopathological investigations have indicated a relevant number of traumatic and degenerative lesions in OB1-2- such as bilateral rib fractures with calluses, some of them with displacement; vertebral body height reduction; and eburnation, porosity, lipping, and osteophytes in several cervical and lumbar vertebral bodies and articular facets. Regarding dental health, neither caries nor hypoplasia have been

observed in the twelve teeth preserved. However, a high level of dental wearing and six apical and complex abscesses (four in the maxilla and two in the mandible) were identified, possibly resulting from pulpal infection due to exposure to the advanced degree of wear (L'Heureux & Barberena, 2008). A paleoparasitological study has also been carried out showing evidence of *Trichuris* sp. and *Capillaria* sp. parasites in the abdominal cavity sediments (Fugassa & Barberena, 2006).

Despite these findings, no previous reference was made to the presence of a nasal fracture in this individual. In addition, the recent method developed by Magalhães *et al.* (2020) provides a new tool to re-examine the OB1-2- skull. This methodology consi-



**FIGURE 1.** *Orejas de Burro 1* archaeological site is in the *Pali Aike* volcanic field, Argentina, north of the Magellan Strait (L'Heureux & Barberena, 2008).

ders nasal fracture as the fracture of the nasal bones, frontal processes of the maxillae, and/or any of the internal osseous structures of the nasal cavity as well as the analysis of five morphological characteristics: 1) side of fracture: right, left, or bilateral; 2) side of deviation: side to where the nasal bones are deflected – right, left, or undetermined; 3) type of fracture: transverse, longitudinal, oblique, comminute, and doubtful; 4) other facial fractures, useful to differentiate energy impacts: high to low; 5) bone remodeling, to elucidate fracture timing: healed, remodeling, or not remodeled. Furthermore, this method improves the biocultural interpretation of facial fractures since nasal fracture may be an important criterion to differentiate interpersonal violence from other aetiologies (Magalhães *et al.*, 2020, 2023).

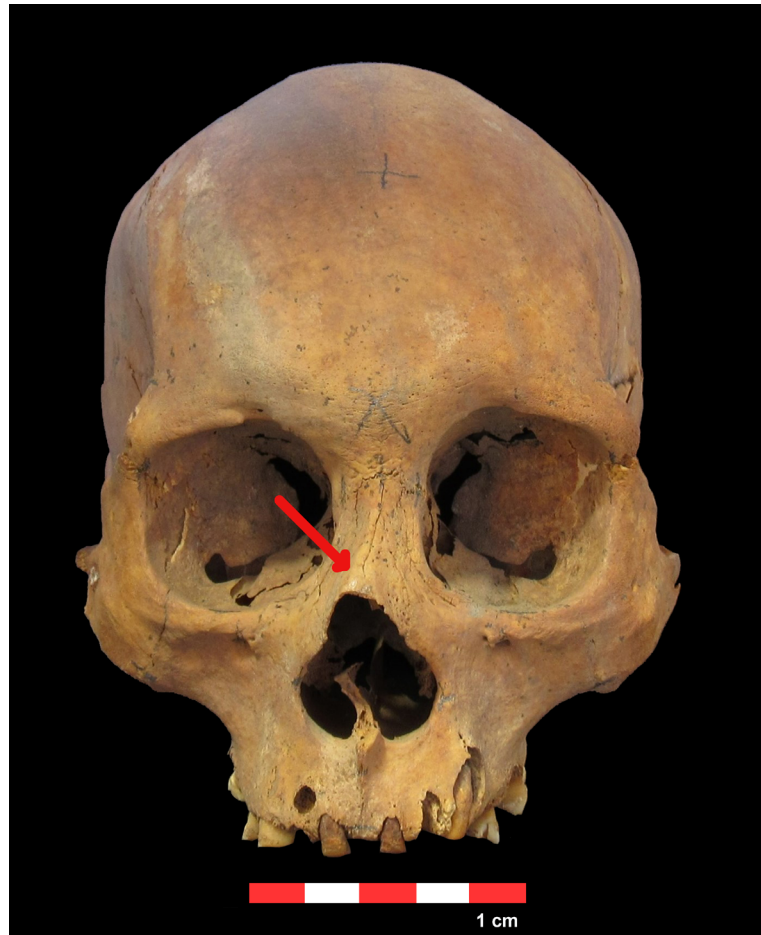
On the other hand, the detailed investigation of the timing of several other cranial injuries is fundamental in the present study. Thereby, the *antemortem* alterations refer to injuries produced prior to death and display evidence of osteogenic reaction. These alterations are characterized by evidence of healing, remodeling signs, osteophytes, and callus formation. The *perimortem* definition that we follow is used in forensic anthropology and osteoarchaeology considering that the bone still has viscoelastic properties before entering the “dry” state without healing evidence and lack of diagnostic taphonomic evidence. Also, *postmortem* damage may be the result of taphonomic alterations, possibly including scavenging on skeletal remains (Kranioti, 2015;

**TABLE 1:** Lesion timing: *perimortem* and *postmortem* characteristics.

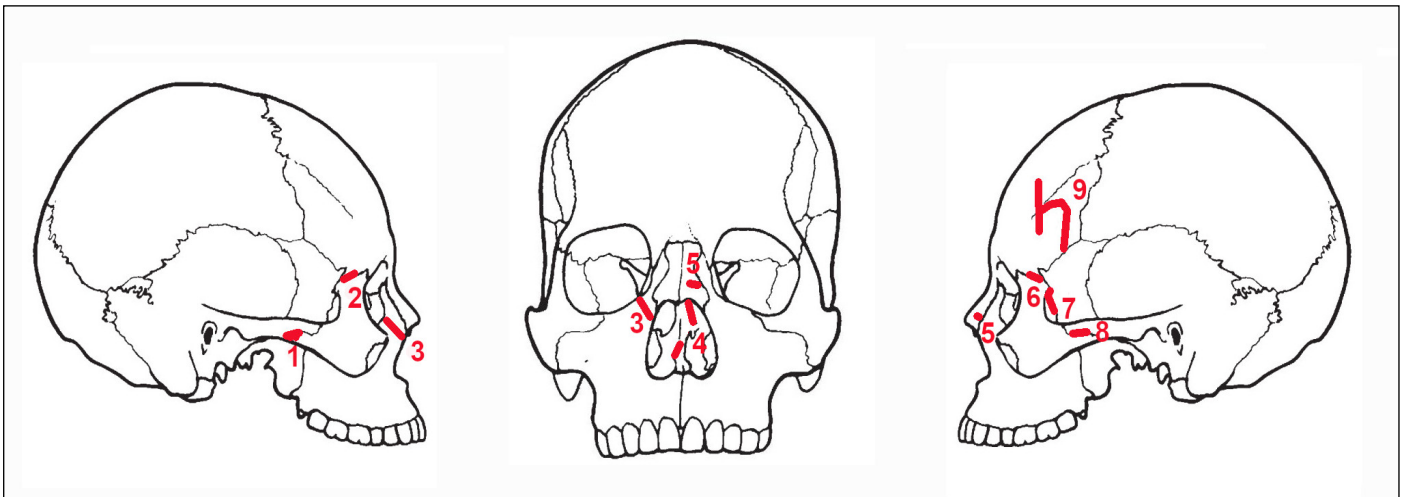
	Feature	Description	<i>Perimortem</i>	<i>Postmortem</i>	References
1	Colour	Skeletons exposed to the elements sustain progressive staining and color alteration over their exposed surface	Uniform coloration	<i>Bone broken prior to recovery</i> , color contrast between exposed internal bone surface and the unbroken external bone surface  <i>Bone broken during this period</i> , broken surfaces may not display diagnostic coloration contrast	Ubelaker, 2015
2	Signs of plastic response	Permanent deformation of the bone after exceeding the elastic response limit	Present	Absent	Kranioti, 2015
3	Bone flakes	Small bone fragments attached to the impact site	Present	Absent	1. Kranioti, 2015 / 2. Ribeiro <i>et al.</i> , 2020
4	Edge morphology	The relative sharpness of the fracture margin	Sharp, incomplete or bend-edges	Squared edges at right angle to the bone surface-no bending	Kranioti, 2015
5	Fracture angle	Angle between the cortical table and the direction of the fracture	Acute or obtuse	Right	Kranioti, 2015
6	Fracture texture	Morphology of the broken bone surface	Smooth	Rough	1. Kranioti, 2015 / 2. Ribeiro <i>et al.</i> , 2020
7	Preponderant outline	-	Regular	Irregular	Kranioti, 2015
8	Cortical delamination or beveling	Cleavege between the diploe and the inner/outer table	Present	Absent <sup>1</sup> / Present <sup>2</sup>	1. Kranioti, 2015 / 2. Ribeiro <i>et al.</i> , 2020
9	Bone remodeling	Bony bridges between the fragments	Absent <sup>1</sup> / Present <sup>2</sup>	Absent	1. Kranioti, 2015 / 2. Ribeiro <i>et al.</i> , 2020
10	Peels	Laminar overhangs of cortical bone on the edge of the fracture, inner and/or outer table	Present	Absent	Ribeiro <i>et al.</i> , 2020
11	Peel defect	Comprises a larger surface since a peel is thicker than a flake and still attached to the fracture	Present	Present	Ribeiro <i>et al.</i> , 2020
12	Fissure	Thin cortical crack, an incomplete fracture, can be curved or irregular, parallel or perpendicular to the fracture margins, outer and/or inner table	Present	Absent	Ribeiro <i>et al.</i> , 2020
13	Crushed margins	Damaged cortical edges. It occurs on the margin of the fracture and can be identified by a thin discoloured line along the margins	Present	Absent	Ribeiro <i>et al.</i> , 2020
14	Bone scales	Pieces of cortical bone still attached to the main fragment. They can appear in groups or individually	Present	Absent	Ribeiro <i>et al.</i> , 2020

## RESULTS

Individual 2 from OB1 (Fig. 2) presents a fracture of both nasal bones, both frontal processes of the maxilla, and the septum (Fig. 3 and 4). The nasal bones are deflected to the right side (Fig. 4) and the right frontal process of the maxilla presents a longitudinal fracture. The left frontal process of the maxilla and left nasal bone shows an oblique fracture (Fig. 4B, 4C, 4D), whilst seven fractures are observed in the splanchno- and neurocranium (Fig. 4A, 4E, 4F). Finally,



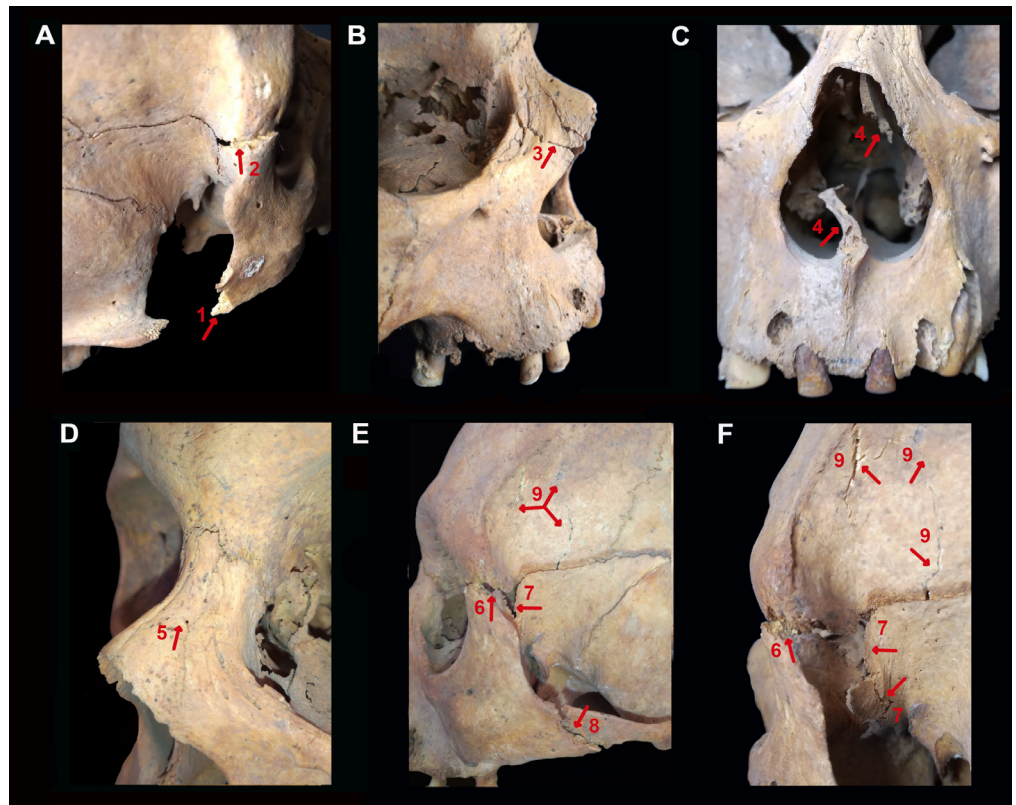
**FIGURE 2.** Skull of OB1-2- frontal view, where it is possible to observe the nasal fracture.



**FIGURE 3.** Nasal and facial fractures (1 - 9) observed in OB1-2- in frontal and lateral skull views.

bone remodeling is observed on the left nasal bone, presenting an advanced healing process with high vascularization and fracture line blurring (Fig. 4D).

Nasal and other facial fractures were summarized in Table 2, showing the different timing of injuries and doubts about diastatic fractures and nasal septum fractures. Of the nine cranial fractures analyzed, one was categorized as *postmortem*, two as *perimortem*, one as *antemortem* and the other five were diastatic fractures in fragile bone and were therefore classified as doubtful.



**FIGURE 4.** Nasal and facial fractures: A) Fractures 1 and 2; B) Fracture 3; C) Fracture 4; D) Fracture 5; E) Fractures 6, 7, 8 and 9; F) Fractures 6, 7 and 9.

**TABLE 2.** Fractures characteristics of each injury and timing.

Fractures	Features														Timing of injuries
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
1	color contrast	ab.	ab.	squared edge	right	rough	irregular	ab.	ab.	ab.	ab.	ab.	ab.	ab.	<i>postmortem</i>
2*	color contrast	ab.	ab.	NA	NA	NA	regular	NA	ab.	ab.	ab.	ab.	ab.	ab.	NA
3	uniform color	ab.	flakes	Sharp, incomplete or bend-edges	acute or obtuse	smooth	regular	NA	ab.	ab.	ab.	present	ab.	ab.	<i>perimortem</i>
4+	uniform color	pr.	ab.	Sharp, incomplete or bend-edges	acute or obtuse	rough	regular	NA	ab.	ab.	ab.	ab.	present	ab.	NA
5	uniform color	ab.	ab.	NA	NA	NA	regular	NA	**	ab.	ab.	ab.	ab.	ab.	<i>antemortem</i>
6*	color contrast	ab.	ab.	NA	NA	NA	regular	NA	ab.	ab.	ab.	ab.	ab.	ab.	NA
7*	color contrast	ab.	ab.	NA	NA	NA	regular	NA	ab.	ab.	ab.	ab.	ab.	ab.	NA
8*	uniform color	ab.	ab.	NA	NA	NA	regular	NA	ab.	ab.	ab.	ab.	ab.	ab.	NA
9	uniform color	ab.	flakes	Sharp, incomplete or bend-edges	acute or obtuse	smooth	regular	present	present	present	ab.	present	ab.	ab.	<i>perimortem</i>

Referenceses. \*= Suture fracture; + = Fragile bone fracture; ab. = absent; pr. = present; NA = Not Available; \*\* = Advanced healing process with highly vascularization and fracture line

## DISCUSSION

The most common type of traumatic injury in SP affects the skull, long bones, and ribs with higher frequency in males. These lesions are usually *antemortem* and possibly caused by accidents. However, some lesions were categorized as *perimortem* and provide information that could be associated with episodes of interpersonal violence that may have led to the individual's death, probably due to the use of *boleadoras* -stone spheres bound with rope used as throwing weapons-, axe, or blunt objects (Flensburg & Suby, 2020). Evidence of human skeletal remains in the region is scarce and dispersed, probably

due to the low population density, during the Early and Middle Holocene (D'Angelo del Campo *et al.*, 2020; Guichón *et al.*, 2001; Suby *et al.*, 2008).

In a broader regional context (i.e., continental Patagonia), it is worth mentioning the presence of numerous cases of interpersonal violence. Although systematic population studies are scarce (Gordón, 2011), previous palaeopathological literature mostly refers to the conflict among hunter-gatherers in Northern Patagonia -NP- (Barrientos & Gordón, 2004; Flensburg, 2011; Gordón, 2009, 2011, 2015; Mendonça *et al.*, 2010; Otero *et al.*, 2023; Scabuzzo, 2010; Vignati, 1947). Likewise, osteological evidence of interpersonal violence was registered on the central coast of Patagonia (Gómez-Otero & Dahinten, 1997-98; Vignati, 1947), and in SP (Alfonso-Durruty *et al.*, 2021; Constantinescu, 2003; Flensburg & Suby, 2020; García Guraieb *et al.*, 2007; L'Heureux & Amorosi, 2009). Especially in SP, the most common causes are related to conflicts in daily life. However, it must be considered that the regional record shows an increase in the radiocarbon signal from archaeological contexts starting at *ca.* 3,800 cal. years BP, accompanied by the first systematic presence of multiple burials, such as OB1, *Río Bote 1*, *Cerro Sota*, and *Cañadón Leona* (Franco *et al.*, 2017; L'Heureux & Barberena, 2008). Consequently, the defense of territories with critical resources is a distinct possibility that needs to be considered in the context of interpersonal relationships and violence (L'Heureux & Amorosi, 2009, 2010). In general, an increase in defense of highly ranked territories can be expected during the effective occupation of Patagonia, when all the geographical areas were occupied (Borrero, 1994-95). Considering that the population increase in the Late Holocene may have exerted some pressure on the resources, it is likely that levels of violence were underestimated in this period for several reasons. Firstly, due to the scarcity of bioarchaeological evidence from Late Holocene contexts. Secondly, the survey of multicausal fractures, such as nasal fractures, may have been omitted in bioarchaeological analyses, possibly due to a lack of attention to this type of injury. Thirdly, skeletal studies tend to bias the interpretation of disease that an individual may have suffered, since a percentage of lesions will only affect soft tissue, not leaving any skeletal traces (Gordón & Bosio, 2012; Otero & Beguelin, 2019). Finally, taphonomic alterations may also obliterate the osteological signatures of violence (Rascón *et al.*, 2011; Waldron, 1991).

It is also important to acknowledge that the discrimination between accidental and intentional fractures in human remains is complex (Redfern, 2017; Walker, 2001). On the one hand, the deviation to the right side of the nasal bones observed in OB1-2- may indicate an episode of interpersonal violence, considering that most humans are right-handed (Faurie & Raymond, 2004; Kranioti, 2015) and that an opponent's blow to the face with the fist or a blunt element would likely result in such a lesion (Magalhães *et al.*, 2020). Additionally, it is important to note that "*clinical literature indicating predominance of lateral force in facial injuries due to interpersonal violence, suggested that laterally displaced nasal fracture may characterize injury of the nasal bone due to violence*" (Magalhães *et al.*, 2023: 2). On the other hand, the injuries analyzed in OB1-2- are located fundamentally on the anterior part of the skull; some authors (Scaffidi & Tung, 2020; Tung, 2007; Walker, 1997) pointed out that anterior skull trauma may suggest face-to-face fighting.

The study of OB1-2- is complex since the individual has several other facial, cranial, and postcranial fractures, which may be related to different impact forces and different episodes in the individual's life resulting in fracture (Magalhães *et al.*, 2020). OB1-2- showed multiple skull fractures (maxillary, frontal, temporal, parietal, and sphenoid bones). Some fractures are diastatic, making it difficult to establish their timing. Fracture 5 is the only one identified as *antemortem*. In the SP context, *antemortem* injuries could be linked to



events of daily life characterized by low lethality. This could correspond to the same event that generated the rib trauma with fractured *callus* described by L'Heureux & Barberena (2008). However, there are two fractures that are probably *perimortem* (3 and 9). In both cases, a blow with a blunt force of high impact would have been involved (Fraïoli *et al.*, 2008; Magalhães *et al.*, 2020, 2023; Otero *et al.*, 2023). Currently, blunt forces that can create this kind of fractures are associated with falls and motor vehicle accidents (Fraïoli *et al.*, 2008), which is why they are less frequent in archaeological samples (Magalhães *et al.*, 2020). OB1-2- presents a high-energy injury resulting in intense bone disruption and displacement of nasal and facial bones (Fraïoli *et al.*, 2008; Galloway & Wedel, 2014; Magalhães *et al.*, 2020, 2023; Stranc & Robertson, 1979).

Nasal fractures *stricto sensu* have not been noted in SP, but Aspillaga *et al.* (1999) and Alfonso-Durruty *et al.* (2021) identified the nasal deviation and presence of fractures in maxillae in individuals from SP, which may also be related to nasal trauma. Nevertheless, to the north of SP, in *Lago Salitroso* locality, SAC 1-1-B, a female adult dated in  $622 \pm 27$  years BP, presented a high-energy nasal fracture (García Guraieb, 2010). Finally, it is important to note that OB1-2- is the oldest known record case reported of a nasal fracture in SP and the third one in South America (Standen & Arriaza, 2000).

Ethnography, archaeology, and bioarchaeology indicate that traumatic injuries produced by interpersonal violence happened between hunter-gatherers on both sides of the Magellan Strait (Flensburg & Suby, 2020). On the one hand, ethnographic information from SP indicates the existence of varied sources of conflict, such as territoriality, kidnapping of women from other groups for marital purposes, and the existence of skirmishes and ambushes (Chapman, 1989; Gusinde, 1951, 1982 [1939], 1951; Prieto & Cárdenas, 2007; Vidal, 2011). On the other hand, the archaeological record shows the presence of *boleadoras*, *cores*, *rompecráneos*, manuports, and sticks (Franco, 2004; González, 1953; Moreno *et al.*, 2000; Torres & Morello, 2011). In certain cases, the shape and size of a blunt object are associated with the resulting fracture pattern (Kranioti, 2015). However, it is extremely difficult to understand which intention and blunt object are associated with the fractures recorded for OB1-2-. Experimental work by Otero *et al.* (2023) suggests that massive damages with lethal consequences are generated by elements manufactured for such purposes. Stones and wooden sticks may have a lower capacity for killing and the interpersonal violence hypothesis may also be related to the use of a *bola*, stick, or a similar blunt tool. Nevertheless, the multitraumatic evidence of OB1-2- leads us to consider hypotheses such as falls or hunting accidents. This remains as an alternative the evidence at hand is not conclusive for OB1-2-. More studies of trauma dynamics need to be developed to clarify these questions, while some degree of equifinality will likely remain.

## CONCLUSIONS

Nasal fractures observed in the individual OB1-2- are probably compatible with the existence of an episode of interpersonal violence in SP. Following the methodology recently proposed by Magalhães *et al.* (2020), we have analyzed the nasal fractures in the individual OB1-2-. The location of the injuries, their direction, and the multiple facial fractures observed would indicate they were produced by a high-energy lateral blow, probably related to an episode of interpersonal violence. However, the presence of one healed nasal trauma suggests the existence of more than one traumatic episode. The tool applied cannot be confidently identified, since there is a situation of equifinality. Our case study also indicated that the methodological approach employed is useful for the systematic record of variables that

can be used to build a comparative bioarchaeological framework. Our results contribute to the database of individuals with early traumatic injuries in Patagonia and South America.

## AUTHOR CONTRIBUTIONS

Manuel Domingo D'Angelo del Campo: Conceptualisation (principal); Writing -preparation of the original draft- (principal); Writing- review and edition- (equal); Research (principal); Financing acquisition (principal); Supervision (principal). Florencia Gordón: Writing -preparation of the original draft- (equal); Writing -review and edition- (equal); Research (principal); Supervision (principal). Bruno Magalhães: Writing -preparation of the original draft- (equal); Writing -review and edition- (equal); Research (principal); Supervision (principal). G. Lorena L'Heureux: Writing -preparation of the original draft- (equal); Writing -review and edition- (equal); Research (principal); Supervision (principal). Nora V. Franco: Writing -preparation of the original draft- (equal); Writing -review and edition- (equal); Research (principal); Supervision (principal). Ramiro Barberena: Writing -preparation of the original draft- (equal); Writing -review and edition- (equal); Research (principal); Supervision (principal). Luis Borrero: Writing -preparation of the original draft- (equal); Writing -review and edition- (equal); Research (principal); Supervision (principal).

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## LITERATURE CITED

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