

SHORT REPORT

First evidence of elongated styloid process in two female archaeological individuals from Córdoba hills, Argentina (late Holocene)

Soledad Salega  | Mariana Fabra 

Instituto de Antropología de Córdoba-Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Museo de Antropología, Facultad de Filosofía y Humanidades, Universidad Nacional de Córdoba, Córdoba, Argentina

Correspondence

Dr. Soledad Salega, Avenida Hipólito Yrigoyen 174, Córdoba, CP 5000, Argentina.
Email: soledadsalega@gmail.com

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Abstract

The elongation of the styloid process is rarely reported in archaeological contexts. Thus, the aim of this work is to present 2 individuals dated by AMS in late Holocene from the hills region of Córdoba province (Argentina). Two female adults from Loteo 5 and Loma Bola sites presented elongated styloid processes, as well as a lack of development of one of them. This is the first time the condition is detected in archaeological individuals in Argentina.

KEYWORDS

Eagle syndrome, paleopathology, Reichert's cartilage, stylohyoid ligament ossification

1 | INTRODUCTION

The styloid process is a thin projection of the temporal bone that extends anteroinferiorly and that originates from the Reichert's cartilage—second branchial arch—(Barnes, 1994; Šikanjić & Vlák, 2010). Its average length varies between 25 and 30 mm (Mann & Hunt, 2005). In medical literature, the elongation of the styloid process is usually related to Eagle syndrome when it causes clinical symptoms such as chronic facial, cervical and ear pain, sensation of a foreign body in the throat, dysphagia, and even cerebral ischemia (Constantinides, Vidoni, Bodin, & Di Lenarda, 2013; Eagle, 1948; Gokce, Sisman, & Sipahioglu, 2008; Kyriakou et al., 2012; Orhan, Güldiken, Ural, & Cakmak, 2005; Rath & Anand, 1991), depending on the underlying pathogenetic process (Piagkou, Anagnostopoulou, Kouladouros, & Piagkos, 2009).

This pathology has been rarely reported in archaeological contexts. Usually, it is referred to in case or site reports or analyses of museum collections. Within the first group, we can mention Ozdemir et al. (2013), who found this pathology in an adult female individual of 2,000 years ago in Turkey, and Šikanjić and Vlák (2010), who reported the condition for three male individuals in a late medieval cemetery in Croatia. Within the second group, Ginesta Armengol et al. (2003) have reported six (five males and one female) out of 1,331 individuals of Catalan collections but without chronology. In South America, Gerszten, Gerszten, and Allison

(1998) analysed 703 skulls from southern Peru and northern Chile, dating back 8,000 years and detected this pathology in several individuals, although they mentioned no specific amount.

In this context, the aim of this work is to present two female individuals that show an elongation of the styloid process from two archaeological sites in the hills region of Córdoba province (Argentina). This is the first time the pathology is detected in archaeological individuals in Argentina.

2 | MATERIALS AND METHODS

2.1 | Study area and archaeological sites

The study area is located in the southern region of Pampean hills region between 30° and 35°S, and 62° and 66°W, encompassing the mountain ranges in the provinces of Córdoba and San Luis, and the eastern and western plains nearby, which correspond to the northwest sector of the Pampean region. Both archaeological sites from which the analysed individuals come were excavated during rescue activities between 2007 and 2011 by the Public Archaeology Program (Zabala, Fabra, Aichino, & De Carli, 2015) in the hills area (Figure 1). According to radiocarbon datings, the human remains can be related to small-scale societies from the end of late Holocene. Groups were sedentary, and they

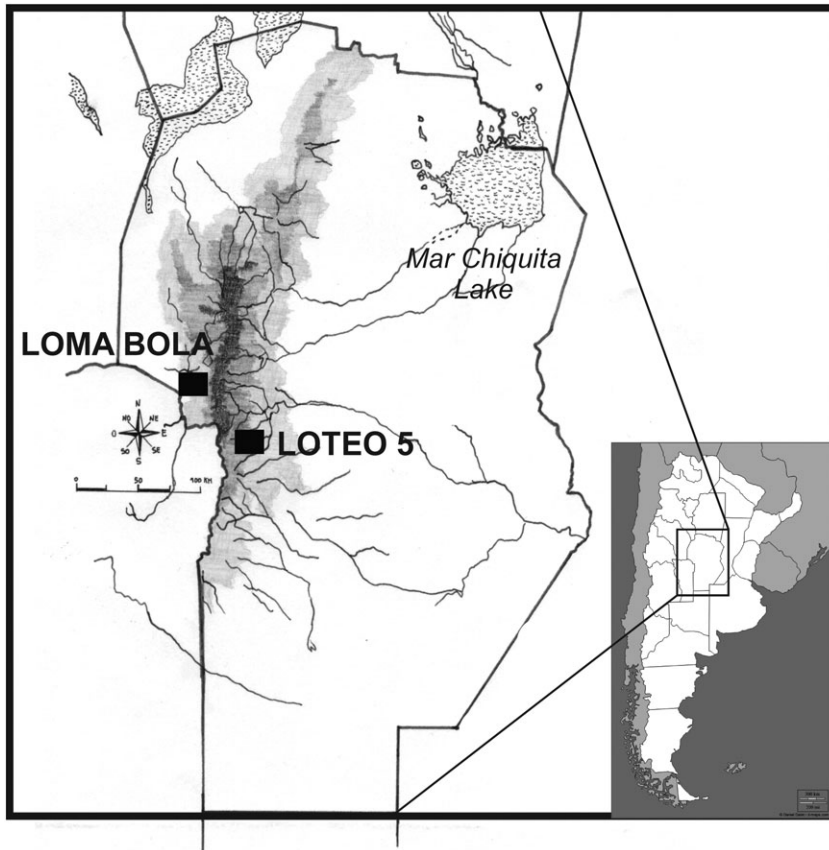


FIGURE 1 Location of the archaeological sites from which the analysed individuals come

developed a mixed economy based on hunting, gathering, and agriculture (Fabra, González, & Salega, 2012).

2.1.1 | Loteo 5 site

This is an open-air site (32° 05'S, 64° 32'O) located in a private property in the city of Santa Rosa (Calamuchita district) where a double primary burial of adult individuals was registered, as well as pottery fragments, and eggshells. Individual 1 was hiperflexed, lying on its right side, in decubitus position. During the excavation the elongation of the styloid process was noticed. Individual 2 was found 50 cm away from the first skeleton, toward the northwest. It was buried in decubitus position, lying on its right side and with semiflexed upper and lower limbs. The radiocarbon dating on Individual 1 resulted in 533 ± 42 years ^{14}C BP (AA102659).

2.1.2 | Loma Bola site

It is an outdoor site (32° 13'S, 65° 01'O) located south from Los Talas stream, near the city of La Paz (San Javier district). Some bone elements were exhumed by police officers, and the remaining ones were excavated by rescue archaeology activities, but the original position of the skeletons could not be recorded. Three burials were identified, with no structures or grave goods. They belonged to two adults and an infant of unknown age and sex, due to the absence of diagnostic parts. In the removed sediment, some pottery fragments were recovered. Radiocarbon dating on "1A" individual resulted in 954 ± 85 years ^{14}C BP (MTC-12806).

2.2 | Methodology

Sex determination was performed following the procedures compiled by Buikstra and Ubelaker (1994), thus considering the characteristics of the pelvis (subpubic region, sciatic notch, and preauricular sulcus), and the cranial morphology (development of the nuchal crest, size of the mastoid process, prominence of the glabella, and projection of the mental eminence). For age estimation, the changes in the pubic symphysis (Brooks & Suchey, 1990) and auricular surface of the ilium (Lovejoy, Meindl, Pryzbeck, & Mensforth, 1985) were taken into account. To describe intentional modifications in the cranial vault, the classification of Dembo and Imbelloni (1938) was used. For paleopathological analyses, macroscopic observation of bone elements was performed, the location and distribution of the abnormality were identified, and the morphology of the affected items was briefly described (Ortner, 2003, 2012). The length of the styloid processes was measured with a digital sliding caliper.

3 | RESULTS

3.1 | Loteo 5 site, Individual 1

This is an adult female between 33 and 42 years of age. The skull shows an artificial deformation, with a flattening of the occipital and frontal bones (tabular erect type). The right styloid process is 35 mm long, it is angulated anteromedially, and it has one thickened area of compact bone (Figure 2a). The left styloid process is not present, but



FIGURE 2 Loteo 5 site, Individual 1, adult female, showing a flattening of the occipital and frontal bones. (a) Right styloid process. (b) Absence of left styloid process [Colour figure can be viewed at wileyonlinelibrary.com]

the morphology of the bone suggests a lack of development or aplasia (Figure 2b): The base surface is homogeneous and flat, with no signs of pre-mortem or perimortem breakage. In the sacrum, there is an incomplete fusion of S1, and a variation in the normal number of segments, possibly due to the presence of an extra vertebral segment, or to a caudal shift at the sacrocaudal border.

3.2 | Loma Bola site, Individual 1B

Skeleton “1B” corresponds to a female adult aged between 35 and 50 years. The skull shows an artificial deformation in the occipital, slightly flattened towards the left side. The same is also observed in the right parietal, adjacent to coronal and sagittal sutures. Both styloid processes were broken post mortem, but it was possible to reconstruct their original position. The right one is 37.9 mm long (Figure 3 a,b), and the left one is 30.9 mm long (Figure 3c,d), both with a slight inclination towards the sagittal plane and an irregular surface with a thickened area of compact bone.

4 | DISCUSSION

According to clinical studies, the elongated styloid process occurs in a low percentage of the general population (2%–4%) and can remain asymptomatic or originate clinical symptoms such as chronic facial and cervical pain, sensation of a foreign body in the throat, and dysphagia (Constantinides et al., 2013; Gokce et al., 2008; Kyriakou et al., 2012; Orhan et al., 2005). In the medical literature, the latter is known as Eagle syndrome.

In our study, we cannot conclude that the analysed individuals suffered from Eagle syndrome throughout their lives. However, when the inferior end of the elongated process is angulated, the tip could reach the oropharyngeal wall and produce dysphagia and the sensation of a foreign body (Rodríguez-Vázquez, Mérida-Velasco, Verdugo-López, Sánchez-Montesinos, & Mérida-Velasco, 2006). According to Baena-Caldas, Rojas-Zuluaga, and Peckham (2017), the direction and angulation of the styloid process could explain the presence or absence of symptoms. Thus, it cannot be discarded

that the angulation recorded for both individuals here could have produced some of them.

Regarding the prevalence of the elongated styloid process according to sex, there is no consensus in the literature. Although some authors registered a higher prevalence among female individuals (Balcioglu, Kilic, Akyol, Ozan, & Kokten, 2009; Montalbetti, Ferrandi, Pergami, & Savoldi, 1995; Prasad, Kamath, Reddy, Raju, & Agarwal, 2002), some others found the same for male individuals among contemporary populations (Camarda, Deschamps, & Forest, 1989; Cawich, Gardner, Shetty, & Harding, 2008), as well as in archaeological samples (Ginesta Armengol et al., 2003; Šikanjić & Vlak, 2010). The variation can be related to the sample selection and evaluation criteria (Skrzat, Mróz, Walocha, Zawiliński, & Jaworek, 2007), whereas in ancient contexts, it is also necessary to consider post mortem loss, taphonomic processes, and biases derived from the very conformation of the archaeological collections, in particular, those derived from rescue works.

When considering laterality, bilateral elongation is more commonly reported (Prasad et al., 2002; Rizzatti-Barbosa, Ribeiro, Silva-Concilio, Di Hipolito, & Ambrosano, 2005; Cawich et al., 2009), although others point that unilateral occurrence, especially on the right side, is the norm (Rath & Anand, 1991). When finding the latter in archaeological contexts, the loss of an elongated styloid process due to post mortem breakage or an unhealed ante mortem fracture is a possibility to be considered (Judd, 2017). However, the morphology of the base surface of the left styloid process in Loteo 5 Individual 1 does not match that of a pre-mortem or post mortem fracture, which suggests another explanation for its absence (see below).

Several causes have been suggested for the elongation of the styloid process. Trauma in the pharyngeal region may lead to the hyperplastic or metaplastic reaction of certain sections of the stylohyoid ligament, thus resulting in ossification (Steinman, 1968, in Camarda et al., 1989). This is similar to what Skrzat et al. (2007) describe as an ossification of the stylohyoid ligament—related to the retention of embryonic cartilage—that results in an irregular and bulky appearance. They keep the term elongated styloid process only when the bony projection is involved, showing a smooth pointed appearance. The latter is

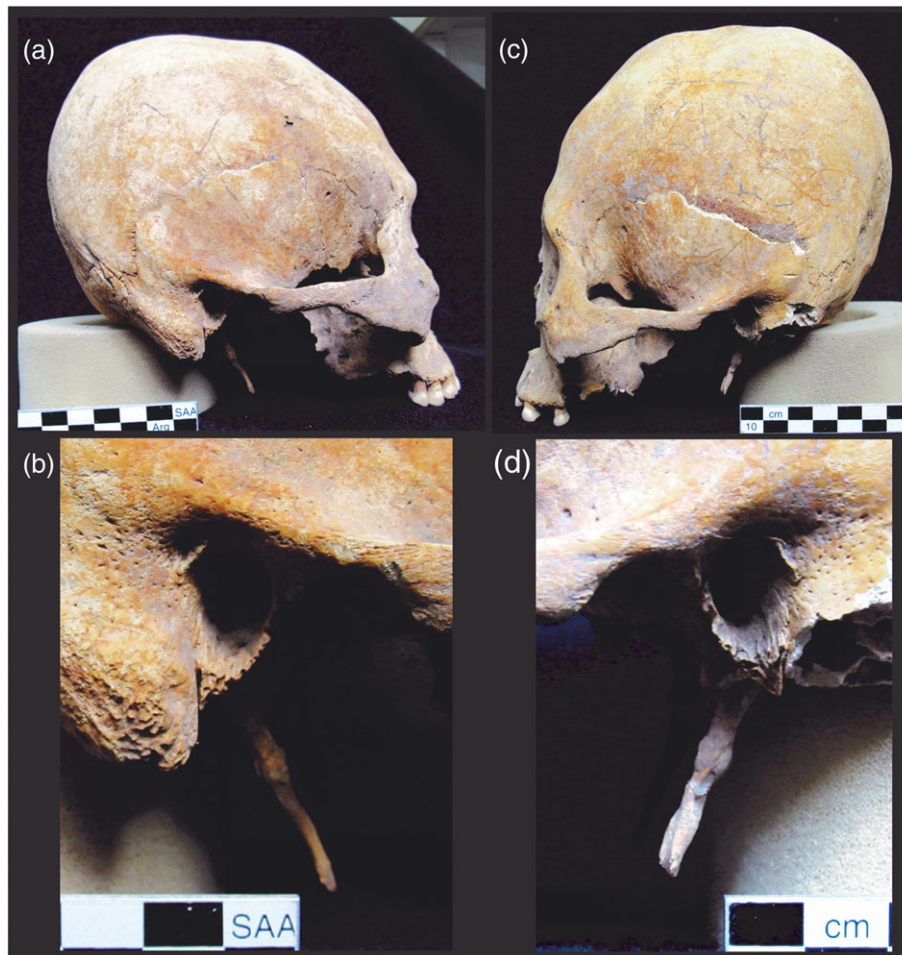


FIGURE 3 Loma Bola site, Individual 1B, adult female, showing a slight flattening of the occipital bone. (a)–(b) Right styloid process. (c)–(d) Left styloid process [Colour figure can be viewed at wileyonlinelibrary.com]

considered as a normal biological variation. The irregular surface and the angulation of the three styloid processes that were recorded in our study suggest that they can be classified within the former. This has been also registered in other archaeological (Šikanjić & Vlák, 2010) and contemporary populations (Cawich et al., 2008).

Age has also been proposed as a possible cause, because there is a decrease of the elasticity of soft tissue and a greater ligament resistance to joint movement (Montalbetti et al., 1995). The length of the styloid process in clinical studies was greater among individuals of 30–50 (Prasad et al., 2002) or 60–79 years old (Rizzatti-Barbosa et al., 2005). However, the condition was also found among individuals of 2–21 (Camarda et al., 1989) and 20–39 years of age, which also points out that there is a large variation among individuals (Rizzatti-Barbosa et al., 2005).

Finally, other authors suggest that the condition originates from a developmental anomaly. The stylohyoid ligament fails to differentiate during the embryonic period, thus retaining its cartilaginous potential, which results in its ossification (Barnes, 1994, 2012). It has been suggested that it may be inherited by an autosomal dominant gene (Morrison, Morrison, & McKinstry, 2012), more specifically on chromosome 6p (Sperber, Sperber, & Guttmann, 2010). On the same trend, the relative high frequency found by Šikanjić and Vlák (2010) in a medieval population is highlighted by the authors as a possible familiar inheritance origin.

Although we cannot relate the elongated styloid processes of the individuals analysed here solely to this hypothesis, the absence of the left styloid process in the Individual 1 from Loteo 5 site could be explained by a development anomaly (Sperber et al., 2010), due to the failure of the tympanohyal segment to develop (Barnes, 1994). If we follow this line, the identification of congenital defects in archaeological settings contributes to population studies, given that their genetic origin can be related to the degree of homogeneity of human groups (Brasili, Bonfigliani, & Ventrella, 2002), as well as to cultural practices related to consanguinity (Bittles & Black, 2010; Ritter, Liascovich, López-Camelo, & Castilla, 2001; Tayebi, Yazdani, & Naghshin, 2010), particularly in small-scale societies such as those from which the analysed individuals come (Fabra & Salega, 2016; Salega & Fabra, 2016).

5 | CONCLUSION

In this work, we presented two adult female individuals with an elongation of the styloid process from two archaeological sites of Córdoba province (Argentina). The surface appearance of the processes suggests an ossification of the stylohyoid ligament, whereas their angulation could be related to the presence of symptoms during the life of these individuals. The absence of the left styloid process in one

individual would be related to a development anomaly. Finally, although the sex and age of the individuals could be linked to this condition, there is no consensus as previous results on prevalences are variable.

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ORCID

Soledad Salega  <http://orcid.org/0000-0003-4798-0897>

Mariana Fabra  <http://orcid.org/0000-0002-7269-6639>

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