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Suprascapular ligament ossification and nerve entrapment in a modern skeleton from the central coast of Patagonia, Southern South America

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SUMMARY

Modification of the suprascapular notch into a foramen as a consequence of the ossification of the suprascapular transverse ligament is a well-known anatomical change. However, it was rarely considered by research in skeletal and cadaveric remains as a possible cause of Suprascapular Nerve Entrapment, a neuropathy that usually produces pain and weakness of the affected shoulder. This paper has the aim to present and to discuss a case of ossification of the suprascapular transverse ligament in a modern-era, possible archaeological male skeleton of 30-45 years old from the central coast of Patagonia, and a possible development of suprascapular nerve entrapment. Complete bilateral ossification of the superior transverse scapular ligament was identified. As no other morphological, traumatic or neoplastic lesions were found in the scapulae, physical activity is suggested as the cause of the ligament ossification in the skeleton, although epigenetic origin cannot be completely rejected.

Key words: Suprascapular notch – Foramen – Suprascapular nerve entrapment – Skeletal remains – Patagonia – Anatomical change

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INTRODUCTION

Suprascapular nerve entrapment (SNE) is a neuropathy in which the suprascapular nerve is compressed (Zehetgruber et al., 2002), first described by Thomas in 1936 and later better detailed by Thompson and Kopell in 1959 (Cummins et al., 2000; Pecina, 2001). The most common location of SNE is the suprascapular notch, in the superior aspect of the scapulae (Boykin et al., 2010), although entrapment at the spinoglenoid notch has also been described (Aiello et al., 1982). Pressure on the suprascapular nerve is usually produced by the ossification of the superior transverse scapular ligament, a fibrous band that connects the borders of the suprascapular notch, which is then converted into a foramen (Cummins et al., 2000; Jacob et al., 2011; Zehetgruber et al., 2002). The possible causes are ganglion cysts closing the suprascapular notch, trauma, physical activity and malignant tumors (Antoniadis et al., 1996; Edeland and Zachrisson, 1975; Fritz et al., 1992; Rengachary et al., 1979a; Rochwerger et al., 1996; Romeo et al., 1999).

The incidence and prevalence of SNE in living populations are unknown (Sahu et al., 2012). It was considered a rare condition (Laulund et al., 1984), but Boykin et al. (2010) suggested that SNE could be more common than it was suspected in the past, based on the great amount of reports

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produced in the last decade. Toneva and Nikolova (2014) recently presented a review of the frequencies of the suprascapular foramen, which ranged between 1.5% and 30.8% in the studied sample, but most frequently ranged between 3-7%. Coincidently, Tubbs et al. (2013) reported a SNE prevalence of 5% in a cadaveric sample of 100 scapulae.

Although the suprascapular foramen has been recognized in skeletal samples since Hrdlicka (1942a, b) studied the anatomy of adult scapulae, its possible neurological consequences were rarely considered in skeletal samples. Only Toneva and Nikolova (2014) mentioned three cases of the suprascapular foramen among 102 skeletons in a morphological study of the suprascapular notch in a medieval skeletal sample from Bulgaria as the possible cause of SNE. Nagar and Sonntar (2008) analyzed the prevalence of the suprascapular foramen in a sample from Bizantine Negev population, showing 30.8% (44 out of 143) of individuals affected. However, they treated the suprascapular foramen as an epigenetic trait and not as a possible cause of suprascapular neuropathy. Finally, only a few cases in non-archaeological samples were described (Khan, 2006; Soni et al., 2010). In consequence, the aim of this paper is to present a case of the bilateral suprascapular foramen as a possible cause of SNE in a skeleton of a male of <200 years BP found in Puerto Madryn city (the central coast of Patagonia) and to discuss its recognition and diagnosis in skeletal samples.

BACKGROUND

According to the archaeological record the central-northern coast of Patagonia was occupied since at least the middle Holocene (7400 AP) to Modern times (200 AP) by hunter-gatherer societies with a mixed terrestrial-maritime economy, including guanaco meat, plants, small mammals, mollusks, pinnipeds, fish and birds as part of its diet (Gómez Otero, 2006; Gómez Otero and Dahinten, 1997-1998; Gómez Otero and Novellino, 2011). The ethnohistorical data confirm that these populations, known as “Patagones” or “Tehuelches” in the historical period, supported this kind of life until the mid-1880s, when they were defeated and taken prisoner by the Argentine military forces (Walther, 1948).

Numerous human archaeological remains (approximately 150 individuals), whose chronology extends from 2640 AP to 200 AP, were recovered in the last 25 years in this coastal sector and the near Chubut river low valley. The skeletal sample of adult individuals is distinguished by its bone strength and high stature: male stature ranges from 160 to 187 cm; female stature from 160 a 171 cm (Millán et al., 2013).

MATERIALS AND METHODS

The skeleton here described appeared on the ground surface of an abandoned lot in a neighborhood of Puerto Madryn city (Chubut, Argentina – Fig. 1) in 1997, mingled with garbage and sediments. It was found by two children that reported the finding to the Centro Nacional Patagónico of the National Council for Science and Technology Research of Argentina (CONICET). When the archaeologist Julieta Gómez Otero went to verify this information, the bone specimens had just been extracted. Unfortunately no lithic artifacts or other cultural evidence were found in association with the sediment matrix or the human remains.

According to some neighbors that were present during the archaeological recovery, this skeleton and associated sediment had been carried out from the surroundings of Loma Blanca hill in the decade of the 1960s. This hill is in the urban center of Puerto Madryn, two hundred meters far from the old rail station. After the installation of the maritime port and the railway at the end of XIX century, the town began to grow around the hill and it was necessary to remove sediments, which in several cases produced the appearance of human remains (Gavirati et al., 2006). The frequency of these unpredictable findings increased after the explosive growing of Puerto Madryn city in the decade of the 1970s.

The skeleton, partially recovered and well preserved, was curated by Silvia Dahinten, bioanthropologist. Bones of the right arm, both hands and feet were not found during the excavation and part of the parietals and facial bones are taphonomically lost (Fig. 2). A previous non-calibrated radiocarbon date (LP-1117) resulted in a < 200 years BP or “Modern” (Millán et al. 2013). This age, the fact that the bone remains were not in situ, and the

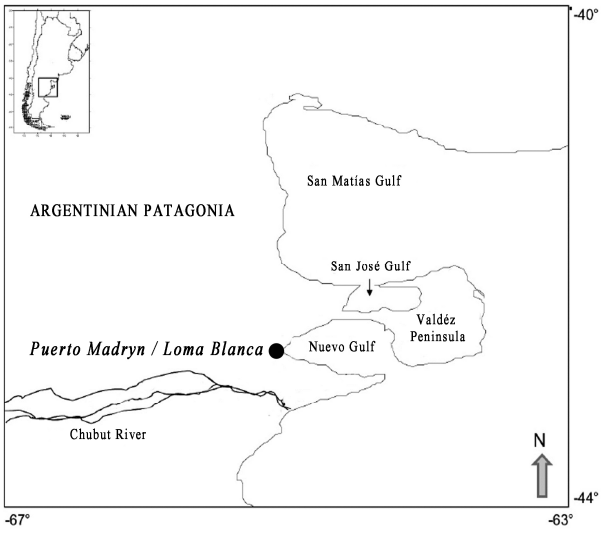

Fig. 1. Location of the archaeological site Loma Blanca in Puerto Madryn City, Chubut Province, Argentina.

Fig. 2. Skeleton recovered in the archaeological site Loma Blanca. Scale is in cm.

Fig. 3. Scapulae of the skeleton from Loma Blanca, showing bilateral ossification of suprascapular ligament.

Fig. 4. Left scapula with complete ossification of the suprascapular transverse ligament.

lack of any material evidence in association with the skeleton do not allow us to be sure about the cultural origin of the individual.

Age at death was estimated by the epiphyseal fusion pattern (Buiktra and Ubelaker, 1994) and the analyses of the morphology of the pubic symphyses (Brooks and Suchey, 1990; Todd, 1921) and the auricular surfaces (Lovejoy et al., 1985). Sex was determined following the methods described by Buikstra and Ubelaker (1994) for the dimorphic structures of the skull and hip bones. All bones were examined macroscopically and with the aid of a 10X magnification hand glass. Any indication of pathological bone alteration was recorded, describing its anatomical location and severity following Aufderheide and Rodríguez-Martín (1998), Campillo (2001) and Ortner (2003). Osteoarthritis was diagnosed following the criteria proposed by Rogers and Waldron (1995) and Waldron (2009).

RESULTS

The studied skeleton was sexed as a male. The age at dead was estimated at 30 to 45 years, with all its epiphyses fused. Complete bilateral ossification of the superior transverse scapular ligament was identified during the inspection of the skeleton (Figs. 3 and 4). The right suprascapular foramen presented a maximum length of 11.6 mm and a minimum of 6.2 mm, while the foramen of the left scapula showed a maximum and minimum length of 10.5 mm and 5.5 mm respectively. Both are completely closed, forming an elongated foramen (Fig. 4).

Marginal new bone and porosity of the marginal surface was identified in both glenoid cavities of the scapulae suggesting osteoarthritis. Beside these changes, the morphology of both scapulae is normal, with no evidence of traumatic or neoplastic injuries.

Moreover, other several osteoarthritic lesions were identified. New bone formation of joint margins and modification of the contour of the coronoid process of the right ulna was observed. Also, segments C3-C6; T10-T12 and L1-L3 and S1 of the spine and sacroiliac joint show slight to moderate osteophytes, new bone formation on joint sur-

faces and porosity.

DISCUSSION AND CONCLUSIONS

Suprascapular Nerve Entrapment is a clinically well-described neuropathy. It received much attention during the last two decades because it is the cause of posterolateral shoulder pain, which may radiate to the neck, arm, or upper chest wall (Rizzello et al., 2013), weakness, a selective paresis in external rotation and abduction of the arm, and atrophy of supraspinatus and infraspinatus muscles, limiting the shoulder movements (Laulund, 1984; Zehetgruber et al., 2002; Jacob et al., 2012; Tubb et al., 2013). As no specific bone lesions were described until now as caused by SNE (Tubbs et al., 2013), there cannot be any certainty of it being diagnosed in skeletal remains. However, despite a potential epigenetic component or secondary pathological/trauma origin (Finnegan, 1978; Kaur et al., 2012), the complete ossification of the suprascapular notch and high physical activity are considered high risk factors for this neuropathy (Albino et al., 2013; Alon et al., 1988; Bayramoglu et al., 2003; Boykin et al., 2010; Cummins et al., 2000; Gosk et al., 2007; Polguj et al., 2013; Rengachary et al., 1979b; Ticker et al., 1998). Recently, Tubbs et al. (2013) reported that histologic and immunohistochemistry analyses on a cadaveric sample revealed signs of neural degeneration and suprascapular nerve grossly compressed in all cases with the suprascapular foramen, which confirms its high influence on SNE.

In this sense, although it cannot be directly confirmed, the complete ossification of suprascapular transverse ligament, as identified in the skeleton from Loma Blanca, could be suggested as a possible case of SNE. No other traumatic or neoplastic lesions were found in the scapulae of this particular skeleton that oriented the causes of the ossification, and for that reason, the suprascapular notch cannot be completely rejected as epigenetic trait or anatomic variation in this particular case. However, as SNE was also related with sports such as tennis, gymnastics, volleyball and baseball, in which repetitive traction, microtrauma and overhead motion contributes to ossification of the suprascapular ligament (Boykin et al., 2010; Ferretti et al., 1987; Tubbs et al., 2013), physical activity could be related with the ossification identified in the skeleton from Loma Blanca. The osteoarthritic lesions observed in the right arm and the spine suggested a high physical demand, which could support the hypothesis of mechanical stress as a possible cause of the suprascapular ligament ossification (Waldron, 2012). However, this hypotheses has to be considered with caution because osteoarthritis is not always related to physical activity since joint could be also differently affected by age, body size and genetics (e.g. Weiss and Jurmain, 2007; Jurmain et al., 2012).

No morphological alterations of the scapulae were identified, which suggests that if SNE had been present, the atrophy of supraspinatus and infraspinatus muscles was unlikely to be produced, and consequently no evidence for alteration of the normal movement of the shoulder could be sustained. Tubbs et al. (2013) found that no muscle atrophy affected the individuals with SNE. Additionally, bilateral SNE is considered extremely rare, reported only in few occasions (Alon et al., 1988; Asami et al., 2000; Aydin et al., 2004). Thus, the bilateral ossification of suprascapular ligaments identified in the skeleton from Loma Blanca gains relevance.

Considering the numerous reports of ossification of the suprascapular transverse ligament and SNE in clinical literature and the near absence in skeletal research, it is highly probable that its presence was overlooked in ancient and current skeletal samples. The high influence of complete ossification of the suprascapular transverse ligament in the etiopathogenesis of SNE suggests that morphological changes of this anatomical structure need more attention in the future, including their recognition, classification and possible diagnosis in archaeological and documented skeletal samples, offering a wider view of their consequences on the normal use of the shoulder. Several studies could be useful for this task, since anatomical variations of suprascapular notch, including the complete ossification of suprascapular transverse ligament, were described since the beginning of 20th Century (Boykin et al., 2012; Cummins et al., 2000). In skeletal remains, Hrdlicka (1942a) described the variable suprascapular notch in his studies of the scapulae, proposing five visual types, from the absence of a suprascapular notch to the presence of a complete foramen. Later, Rengachary (1979b) divided the suprascascapular notches in six types, including V-shaped and U-shaped notches. In this classification, complete foramen is the sixth and last type. Natsis et al. (2007) introduced a quantitative method to classify the suprascapular notch, including measurements of the maximal vertical diameter, the transverse diameter and the imaginary line that joins the superior corners of the notch. In this study, five stages were proposed, in which complete foramen of the suprascapular notch is the fourth type. Finally, Polguj et al. (2011) offered a new quantitative method based on geometrical parameters, including five types. Although these methods are not conclusive of SNE, more frequent recognition of anatomical variants of suprascapular notch will offer new evidence of the presence of this neuropathy in skeletal samples.

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