



Glenoid retroversion: The palaeopathological perspective



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ABSTRACT

Retroversion of the glenoid articular plane has not received sufficient attention in palaeopathological studies. Occasionally mentioned in severe forms of osteoarthritis, exceptionally studied in extreme congenital forms isolated or in the context of malformation syndromes and overlooked in cases of minor dysplasia, it is nonetheless a valuable marker for identifying debilitating pathological conditions, abnormal shoulder laxity or sequelae of obstetric palsy. It is sometimes associated with other anomalies of the shoulder, the acromion or the coracoid processes of the scapula or the proximal end of the humerus. In this contribution, we first define a new method for measuring glenoid retroversion based on recent embryological and anatomical findings. This new method is particularly well adapted to archaeological remains for its simplicity and the possibility of using it with very fragmentary scapulae. We then applied it to eight pathological cases of various origins, dysplasias or acquired forms of glenoid retroversion; semiological analysis enabled the definition of diagnostic criteria for the main aetiologies. Several new diagnostic features are described, in particular for sequelae of obstetric palsy in adults.

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1. Introduction

Excessive glenoid retroversion is an element of bone semiology found in various pathological conditions: congenital dysplasia (Owen, 1953; Wirth et al., 1993; Currarino et al., 1998), sequelae of brachial plexus palsy (Waters et al., 1998), posterior instability of the shoulder (Brewer et al., 1986; Trout and Resnick, 1996) and scapulohumeral osteoarthritis when it causes posterior glenoid wear (Walch et al., 1999; Habermeyer et al., 2006). The advent of prosthetic surgery of the shoulder has stimulated anatomical research on variations in the glenoid mass, thanks to progress in imaging (CT and MRI) and basic embryology.

Posterior glenoid failure had long been suspected in cases of an unusual skin fold behind the shoulder in abduction. This can be seen in photographs, as in Ombrédanne's treatise (1944, p. 700) where the author defends a nosological significance for "congenital shoulder dystrophy", as well as in the article by Brewer et al. (1986) (p. 725). The incomplete ossification of the inferior glenoid was first mentioned by Giongo in 1927 (Giongo, 1927) in a case associated with a bilateral coracoclavicular joint. Asplund (1943) was the first to link radiological aspects of dysplasia, flattening and hollowing of

the posteroinferior part of the glenoid, with posterior displacement of the humeral head in cases of voluntary posterior dislocation.

Palaeopathological examples of glenoid retroversion include isolated congenital bilateral dysplasia, the rarest case, but characterised by major retroversion. We have identified three such cases, all from the Middle Ages: one reported by Bennike et al. (1987) and two by Mays (2009). Nevertheless, minor dysplastic lesions are not usually reported. Similarly, in cases of osteoarthritis with glenoid retroversion, there is no mention of the role of underlying dysplasia. To the best of our knowledge, no specific palaeopathological article focuses on the sequelae of obstetric brachial plexus palsy, in which glenoid retroversion is a significant element. They are only discussed as a differential diagnosis of other pathological conditions of the scapulohumeral joint, as in Mays (2009) for cases of probable primary dysplasia. In contexts of thalassemia, infection or trauma, attention usually focuses on humeral lesions, while glenoid lesions are seen only as secondary osteoarthritis (Hershkovitz et al., 1991; Pálfi, 1997, p. 40; Molto, 2000; Kacki et al., 2013). Similarly, in rotator cuff disease (Roberts et al., 2007), there is no reference to glenoid version, although it probably has a predisposing role in the distribution of muscle stress, with retroversion related more often to anterior cuff tears (Tétreault et al., 2004). However, this topic is beyond the scope of our study.

In our experience, since excessive glenoid retroversion is not rare, it deserves special attention. Although we found visual

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assessment of glenoid retroversion to be effective in identifying it, it should be possible to find an objective and reproducible measurement of it. The methods used in anatomy laboratories and in medical practice are not applicable to often incomplete archaeological scapulae. This is why we propose a new method adapted to such situations, selecting markers very often present on the portions of bone available. We apply it to eight cases of different origins in order to highlight the potential of systematic assessment of this bone sign in palaeopathology.

2. Material

We selected eight cases of excessive scapular glenoid retroversion, obvious to the eye, all from archaeological sites in France. We excluded cases of retroversion corresponding only to advanced scapulohumeral osteoarthritis (stage B, [Walch et al., 1999](#)).

2.1. Angers (Maine-et-Loire)

Subject S.22, an adult male, was buried in the Saint-Lazare Chapel in Angers. He was laid to rest in a shroud fastened with pins, with a sheet of schist under his cranium to hold it in place. His tomb was near the altar. He belonged to a group interred in the Modern period (late 17th–18th century). Located in a peripheral part of the city, the chapel, a former leper house which became a secondary parish, was then reserved for the population of the Saint-Lazare district and the surrounding countryside. The written sources, confirmed by palaeopathological study of the sample exhumed, indicate that this population was made up, for the most part, of craftsmen, shopkeepers and peasants. Humerus, scapula and clavicle are present bilaterally.

2.2. Buchères (Aube)

Subject D37F0006/1, an adult of undetermined sex, was in poor condition (major deterioration and fragmentation of the bone) in a shaft grave, dating from the end of the Early La Tène period (4th–3rd century BC, Tène B1–B2). Skeletal remains are poorly preserved. As regards shoulders, only the right scapula is sufficiently complete for study.

2.3. Esclavolles-Lurey (Marne)

Subject S.179, a relatively elderly adult of undetermined sex, from a burial ground with some 60 graves, dates from the mid-7th to the late 9th century. The two scapulae are present, but the humeral heads are damaged.

2.4. Mâcon (Saône-et-Loire)

Subject S.156, from the 14th–16th centuries, is from the former Church of Saint Clement in Mâcon. This is an adult male lying on his back, with his hands on his pubis. The left scapula is not preserved, but the humeri are present.

2.5. Poitiers (Vienne)

This female subject is from the Modern chapter house of the nunnery of Sainte Croix in Poitiers (16th–18th centuries). Her partially preserved body was found with the remains of another woman in inhumation fill from grave 36 in the middle of the structure. In Modern times, the Benedictine nuns were essentially of local high social standing: gentry or, more rarely, provincial nobility. The left scapula and the two humeri were found in the backfill.

2.6. Pont-sur-Seine (Aube)

Subject S.298, a young adult male, is from the exhaustive excavation of an early mediaeval necropolis which yielded at least 730 individuals. This necropolis, which stretches along the ancient Roman road between Troyes and Paris, is dated between the late 5th century to the Mediaeval period (possibly to the 10th–12th centuries), concomitantly with the occupation site located a few hundred metres to the north. Almost all the bones are present.

2.7. Toulon (Var)

Subject S.20 US 1101 is from a primary double burial excavated on the site of the Red Cross in the cemetery of Saint Roch in Toulon, used between 1752 and 1828. The population buried in this zone was mainly from a penal colony. The subject, a young adult male, was buried in a tightly wound shroud. The skeleton is incomplete, but the two humeri and the right scapula are present. The left scapula is poorly preserved.

2.8. Vienne (Isère)

Subject S.338 is from the excavations of the church of Saint Georges of Vienne and dates from the Middle Ages: a young woman bearing a foetus, whose skeleton is very fragmentary. Only the lateral part of the right scapula could be studied.

3. Methods

3.1. Glenoid analysis

3.1.1. Position of the glenoid on the scapula

The scapula is the bone with the greatest variability between its two components, the body and the glenoid, the developments of which are independent of one another ([Landau and Hoenecke, 2009](#)). Recent genetic and embryological evidence shows that the body and glenoid derive from two completely different tissues controlled by independent genes. An avian model reveals that the scapula has a dual origin: the glenoid and acromion are derived from the somatopleure of the lateral plate mesoderm, while the body is derived from somites 17 to 24 ([Huang et al., 2000](#)). As a result, the body seems to be less a skeletal element proper than the ossification of muscle attachments whose development depends on the surrounding muscle sleeve. Its profile is thus linked to the shape of the thorax rather than genetic determination. As regards its articular face, the glenoid is compared to a vault ([Kwon et al., 2005](#); [Codsi et al., 2008](#)). It can be positioned with respect to the body with major variations in translation and in version in a transverse plan, or tilt in a frontal plane. To analyse various shoulder stability disorders, whether congenital or secondary to direct (osteoarthritis) or indirect (obstetric palsy) pathological conditions, it is necessary to measure glenoid surface version compared with the medial part of the glenoid vault, and not with the blade.

3.1.2. Measuring glenoid retroversion

All series of measurements of glenoid retroversion, both *in vivo* or on dry bone, confirm variability on the order of 10° regardless of reference axis ([Saha, 1971](#); [Brewer et al., 1986](#); [Randelli and Gambrioli, 1986](#); [Friedman et al., 1992](#); [Churchill et al., 2001](#); [Kwon et al., 2005](#)). Such variability supports the idea that shoulder stability depends not only on bone architecture, but also on biomechanical equilibrium among the soft tissues of the region. Furthermore, in cases of excessive retroversion, relative compensation develops through localised hypertrophy of articular cartilage and the labrum, revealed by MRI ([Harper et al., 2005](#)). In addition to a study of shoulder instability, shoulder replacement requires

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