

Terminology

Entheses in medical literature and physical anthropology: a brief review

Terminological background

In 1959, G. La Cava used the term "enthesis", derived from ancient Greek and which means insertion, for creating the word "enthesitis" to designate inflammation of tendon attachments into bone. Subsequently, J. Ball (1971) and G. A. Niepel and S. Sit'Aj (1979) suggested to use the words "enthesis" to designate the area where a tendon, a capsule or a ligament attaches to bone and "enthesopathy" to indicate any pathological changes of this structure.

Anatomical considerations

Two types of entheses have been defined by Benjamin and colleagues: fibrocartilaginous and fibrous (Benjamin and Ralphs 1998; Benjamin and McGonagle 2001; Benjamin *et al.* 2002).

In the limbs, fibrous entheses are characteristic of attachments to diaphyses (Benjamin and Ralphs 1998; Benjamin and McGonagle 2001) but they also can be found on the skull and vertebrae (François *et al.* 2001). These entheses attach soft tissues (tendon and muscle) to bone directly or via the periosteum (Benjamin *et al.* 2002). In these entheses, intra tendinous vessels can merge with bony ones (Dörfl 1969). Fibrous entheses have been subdivided by Benjamin and colleagues (2002) into two categories: periosteal and bony.

Fibrocartilaginous entheses occur at the epiphysis of the bones, but also on short bones and some parts of vertebrae. In the adult four histological zones are distinguished in a fibrocartilaginous entheses (Benjamin *et al.*, 1986; Cooper and Misol, 1970): 1) tendon or ligament, 2) uncalcified fibrocartilage, 3) calcified fibrocartilage and 4) subchondral bone. Zones 2 and 3 are avascular and separated from each other by a regular calcification front called the "tidemark". The tidemark is the region at which soft tissues are removed during maceration (Benjamin *et al.*, 1986), and the zone of calcified fibrocartilage has been found to be preserved in some archaeological skeletal remains (Henderson and Gallant, 2005).

The distinction between fibrous and fibrocartilaginous entheses is now recognized in clinical and anatomical literature (e.g. François *et al.* 2001; de Pinieu and Forest 2003; Fournié 2004; Huber *et al.* 2007) as well as in physical anthropology (Villotte 2006). However, as François and colleagues (2001, 256) noted, "descriptions of the histologic structure of entheses are too often restricted to the fibrocartilaginous entheses as if there were no other type of insertion".

Terminology used in physical anthropology

Over the last few decades clinical researchers have referred to most enthesal changes affecting calcified tissues as “enthesopathies”. As anthropologically trained osteologists began to more intensively study these types of morphological features, a variety of terms have been used: Enthesopathies (Dutour 1986), muscle markings (Robb 1998), muscle crests (Angel et al. 1987), but the most well known and widely used terminology dates to Hawkey and Merbs’ influential publication of 1995 in which they proposed Musculoskeletal Stress Markers (MSM).

This particular usage has some immediate predecessors within human osteological studies:

Merbs 1983 “Activity-Induced Pathology”

Kelley and Angel 1987 “Evidence for Occupation”

Kennedy 1989 “Skeletal Markers of Occupational Stress”

Hawkey and Street 1992 “Activity-Induced Stress Markers”

As noted, this trend in terminology culminated in 1995 with publication of the article by Hawkey and Merbs in the *International Journal of Osteoarchaeology* and gained wider recognition with publication of a special issue of this same journal in 1998. In the last 15 years use of the terminological referent, “MSM,” has increased in popularity, although it is inherently imprecise and in some ways misleading. Its rather instantaneous popularity and superficial acceptance relate to a variety of factors.

However, the most inappropriate aspect of the MSM terminology is that it presupposes the primary etiological agent involved. In biomedical science it is wise (and typical) to use terminology to label morphological/pathological changes that is more neutral and descriptive and not inherently biased. It is now obvious to a majority of researchers that the etiology of enthesal changes is multifactorial in nature. Indeed, for many scholars, this has been obvious for over a decade.

Thus, it is suggested that, while simple, popular, and easily remembered, that “MSM” terminology be replaced with something that is both less biased and more accurately descriptive.

Proposal

A research search of several terms was carried out using ScienceDirect (from September 25, 2009).

- "Enthesopathy" OR "Enthesopathies": 976 hits
- "Enteseal changes": 46 hits
- "Enthesial changes": 2 hits
- "Entesal changes" : 2 hits
- "Enteseal remodelling": 0 hit
- "Entesal remodelling": 0 hit
- "Enthesial remodelling": 0 hit

As entheses are primarily studied by clinical researchers, almost all of these authors used the term "enthesopathy" and it is tempting to designate all enteseal changes seen on skeletal material as "enthesopathies". However, in our opinion there are two main limitations for this terminology: 1) As it was noted previously, we know little about fibrous entheses. These attachment sites appear very rarely involved in abnormal conditions associated with pain or discomfort. Moreover, osseous irregularity in the area of fibrous attachments (e.g. the insertion of deltoid to the humerus) is common in human skeletal remains (and are also seen in the first decades of adulthood, for which degenerative changes cannot be invoked). Since the term enthesopathies implies a pathological condition, it is not appropriate to designate all of these very common and probably asymptomatic changes.

2) Before adulthood, skeletal changes in the area of tendon or ligament metaphyseal attachment appear (at least for a great part of these changes) to be associated with the process of attachment migration during skeletal growth (Hoyte et Enlow 1966; Dörfl 1980), and so also should not be referred to as pathological conditions.

If we look for a term which could be used for both pathological and non-pathological cases, "enteseal change" or "enteseal changes" appear to be the most neutral, i.e. not implying a causal agent (stress, for instance), a specific nature (e.g. degenerative) or a specific aspect (enteseal new bone formation).

Enteseal changes can be divided into two types - 1) bone remodeling changes (which may occur in both fibrous and fibrocartilaginous entheses) and 2) other calcified tissue changes

(mainly, perhaps uniquely, for fibrocartilaginous entheses). In the near future, we will propose terms to designate changes according to the nature of the enthesis and aspect of the changes (foramina, erosion, cysts ...).

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