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FIFTH TOE DISTAL INTER-PHALANGEOS SYNOSTOSIS: PALEOPATHOLOGICAL DESCRIPTION AND POSSIBLE EVOLUTIONARY SIGNIFICANCE

ABSTRACT: *The authors examine the gross pathology and the radiographic aspect of a distal inter-phalangeous synostosis of the fifth toe from archaeological excavation of an early Middle Age cemetery in Central Italy (Teramo-Sant'Anna, Abruzzo, VIIIth century A.D.). The authors suggest that this type of congenital synostosis might be of evolutionary significance. In fact, human toes might be considered as vestigial organs, because they have undergone a remarkable reduction in length during the evolution of our species, perhaps in connection with the acquisition of the erect posture and, more recently, with the regular use of footwear.*

KEY WORDS: *Congenital synostosis – Fifth toe – Vestigial organs – Effects of the shoes*

INTRODUCTION

Congenital synostosis consists in the absence of all the anatomical structures of a joint; and results in ankylosis. Congenital synostosis occurs more frequently in the vertebral column, where it leads to total fusion of two contiguous vertebrae. In the limb bones the joints most frequently affected are the radio-ulnar and the tibio-fibular. Familiarity has been indicated as a factor possibly contributing to radio-ulnar synostosis (Berant, Berant, 1973). In the small joints of the extremities congenital synostosis involves particularly the wrist and ankle joints (in particular the talo-calcaneal); the interphalangeous joints are of minor clinical significance (Dastugue, Gervais 1992). Distal inter-phalangeous congenital synostosis (DIPCS) may involve only the last three toes, while the first and second toes are generally unaffected. In the present European population, DIPCS of the fifth toe is very frequent. Although statistical data are very scanty, we think that the 36% frequency calculated by Pfitzner (Testut 1921) is likely to be correct.

In archaeological material congenital synostosis has frequently been described, but the majority of the cases reported involve the radio-ulnar joint (Grant 1978, Ortner, Putschar 1981, Morse 1969, Vyhnanek *et al.* 1965, Capasso 1985).

In contrast with the high frequency in modern human populations, no paleopathological examples of fifth toe DIPCS are described in the literature. This lack of data is probably related to the scarce attention of archaeologists to the *minor* bones, as foot phalanges. Only an animal paleopathological case of phalangeal fusion has been published by Baker and Brothwell (1980), but in this case the inter-phalangeous joint was not affected, because the fusion involved the distal phalanges of two contiguous toes of an Osborne House pig.

CASE REPORT

The material consists in the second and third phalanges of the fifth toes collected in the burial No. 51 (subject A: adult,

female) of the Medieval necropolis of Teramo-Sant'Anna (Central Italy), dated with the radiocarbon method to 600 to 685 A.D. The samples consist in two osseous segments, left and right, each derived from the coalescence of the second and third phalanges (Figure 1 A, B). The gross pathology consists in a bone fusion between the second and the third phalanges of the fifth toe. The cortical bone of the region near the joint involved appears normal, without reactive new bone formation. Furthermore, there is no evidence of ligament ossification. Radiographically, the articular cavity and the joint rims are not visible (Figure 1 C, D): this confirms that the joint was congenitally absent (synostosis). The differential diagnosis includes osteoarthritis, rheumatoid arthritis, post-traumatic ankylosis, and infectious processes. Nevertheless, in our case, the absence of new bone formation and the total absence of the articular rim, are signs in favour of a congenital absence of the anatomical structure of the joint.

DISCUSSION

DIPCS of the fifth toe has traditionally been considered as an *anatomic variant* by many anatomists (Testut 1921). In fact, this synostosis is not a true pathological condition, because it is not associated with clinical signs of disease, or with anatomical signs of infection. Moreover, the condition is present in fetuses and newborns with the same frequency as in adults (Testut 1921).

DIPCS may be compared to other congenital synostoses of the foot, such as those involving the tarsal bones, that were also described in infants, newborns and fetuses (Testut 1921). According to Leboucq (Testut 1921), they are due to alterations of the processes leading to the formation of the joint in the embryo. As DIPCS, the synostoses of the posterior foot can be interpreted as "eversive anomalies" (Testut 1921). They would correspond to morphological arrangements that develop following functional

modifications of the foot related to the acquisition of the erect bipedal posture. Such processes of progressive modification that would tend to the evolution of a foot containing a reduced number of articulations, might be accentuated in more civilized human communities, following the regular use of footwear. In fact, tight footwear might compress the bones of the foot leading to the immobilization (and loss of functions) of the joints (Testut 1921). This could be considered as a tentative phylogenetic account of the frequent occurrence of fifth toe DIPCS.

In addition, it is possible that fifth toe DIPCS has a characteristic and independent evolutionary significance, as suggested by early authors (e.g., the famous French anatomist Testut). In fact, human toes might be considered

as *vestigial* organs, because, in the course of human evolution, they have been remarkably reduced in length. In fact, the toes of our species are the shortest when compared to the toes of all extant primates (Figure 2).

It is probable that the toe DIPCS is related to an evolutionary tendency to the reduction of the fifth two phalanges. Pfizner (Testut 1921) went even further, suggesting that the process of joint reduction will involve also the first phalanx of the fifth toe. Considering that phalangeal fusion has consistently been reported in the last three toes and not in the first and second ones, Pfizner suggests that the human foot might progress towards a two-digit structure, composed of a principal digit, the *first* toe, and an accessory digit, the second toe.

Only quantitative analysis of data from ancient populations and an exhaustive study of paleopathological material will provide evidence for this possible trend.

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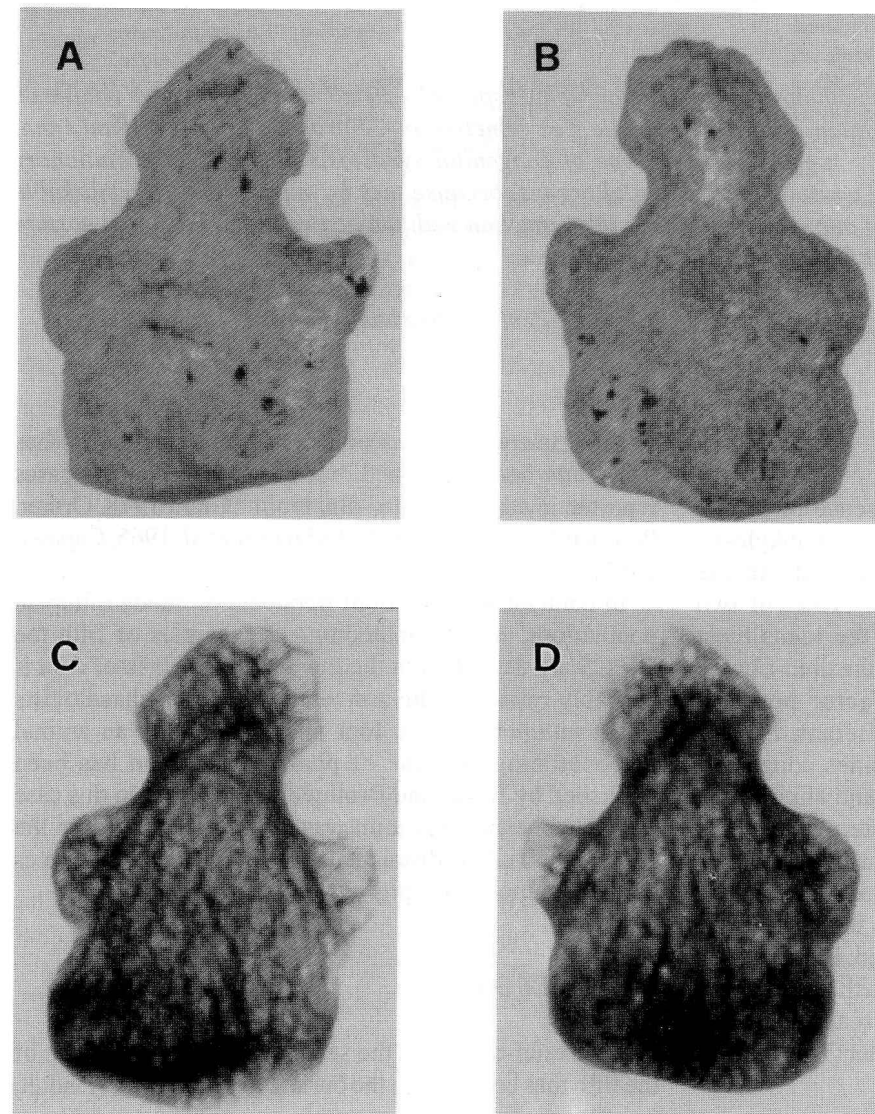


FIGURE 1. Macroscopic aspect of the ventral (A) and dorsal (B) surface of the fused distal phalanges of the fifth toe with corresponding radiographic aspect (C and D).

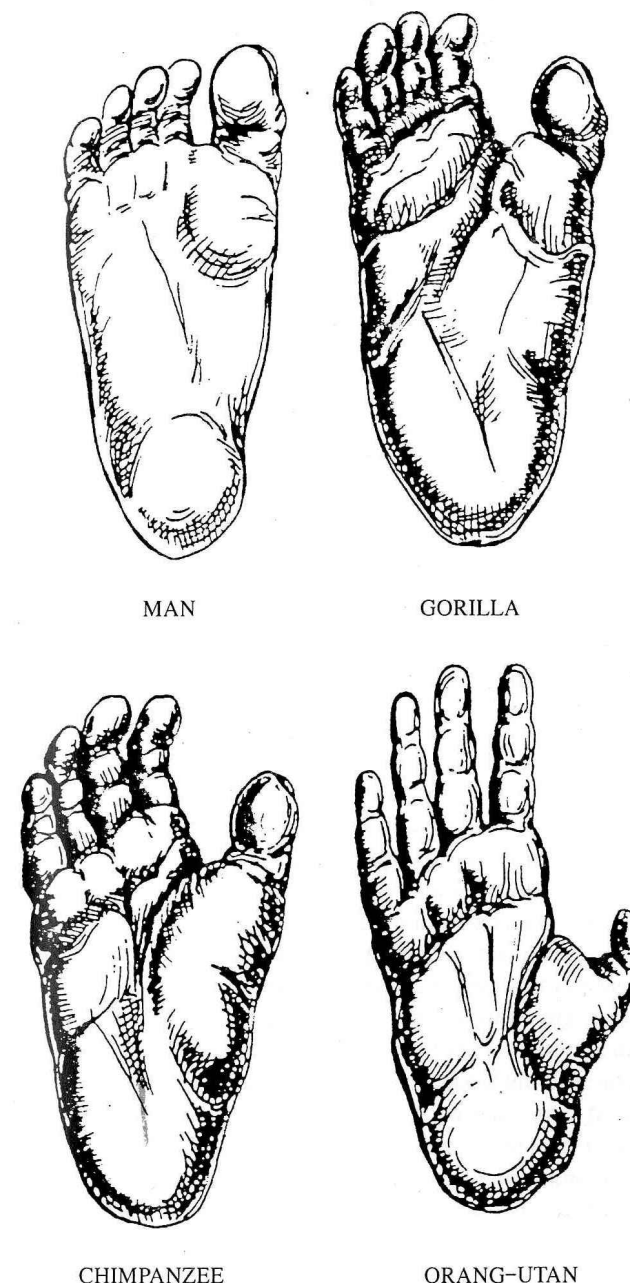


FIGURE 2. Comparison of the foot plant of various extant primates.