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Pathological Skeletal Changes in a Specimen of *Pan troglodytes* from the Primate Collection of the Museum of Anthropology and Ethnography, University of Turin

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Introduction

The non-human primate osteological collection of the Museum of Anthropology and Ethnography (Department of Life Sciences and Systems Biology, University of Turin) was collected at the beginning of the 20th century by the museum's first director, Professor Giovanni Marro (1875-1952), a medical doctor and anthropologist. It comprises 52 virtually complete skeletons, most of them referring to Cercopithecoidea (*Papio* and *Macaca*), with only two great ape specimens (*Pan* and *Pongo*). The assemblage was recently re-arranged in long-term storage in order to assess the preservation condition, to monitor the status of biological samples and to devise a conservation plan. All biological data that can improve our understanding of the origin and evolution of some diseases have also been recorded.
During the scientific investigation, several gross pathological skeletal changes, visible by naked eye, were described in a specimen of *Pan troglodytes* (n. 10342 DBAU).
The lesions suggest a severe hematological disorder.
This paper presents some of the results of the ongoing paleopathological research.

Materials and Methods

The skeleton of *Pan troglodytes* belongs to a young individual about 10-12 years old (Nissen and Reisen, 1964; Smith *et al.*, 1994). It was not possible to determine the sex from macroscopic observations.
In the study of the specimen, our approach included a physical examination of the bones by direct observation, also with a magnifying lens. Direct inspection of the endocranial surface of the skull was possible through the coronal section of the calvaria.

Case Report

The subject is affected by extensive porotic hyperostosis, symmetrically distributed.
The calvaria and oro-maxillo-facial components are considerably remodeled. The overall size of the skull is bigger than non-pathological individuals approximately of the same age. Cranial lesions involve the frontal and parietal bones, the occipital squama and zygomatic processes of the temporal, the palatine and the alveolar processes of the maxillary bone. Deep symmetrical depressed areas in the outer table of the parietals are observed. The parietal and nuchal crests are heavily developed and show evident radial bony spicules on the top.

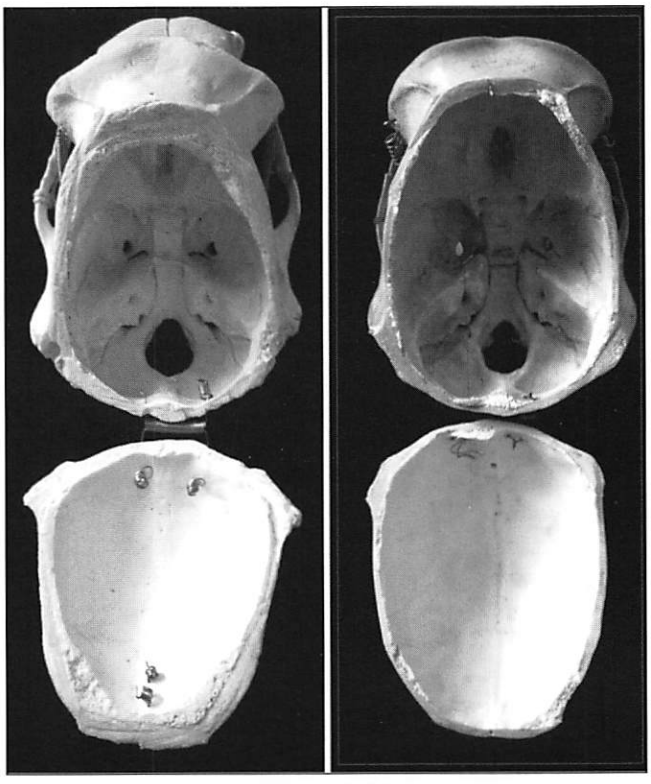

Fig. 1. *Left: Pan troglodytes (10342DBAU): general thickening of the bones and widened diploë. Right: non-pathological individual.*

All sutures are prematurely fused (craniosynostosis). Direct inspection through the coronal section of the calvaria revealed a general thickening of the bones and widened diploë, with hair-on-end appearance of the outer table (Fig. 1). There is also involvement of the facial skeleton resulting in prominence of the malar bone, with severe maxillary hypertrophy, spacing and displacement of teeth, malocclusion, enamel hypoplasia and porosity of the palate (Fig. 2). The swelling of the facial bones, maxillary overbite,

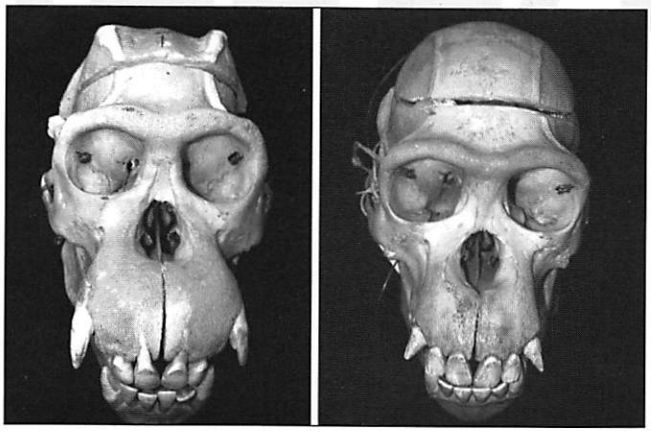

Fig. 2. *Left: Pan troglodytes (10342DBAU): severe maxillary hypertrophy. Right: non-pathological individual.*

ocular hypertelorism and the upper incisors displaced forward give rise to peculiar features of the face that the specific literature identifies by the term "rodent facies", characteristic of thalassemia major. No signs of cribra orbitalia were detected. This sort of skeletal pathology has never been described in non-human Primates except by Schultz (1956, p. 971).

On macroscopic examination, the post-cranial skeleton is less affected than the skull. Localized porosity is present on the proximal metaphysis of the upper limbs and on the coxal bones, and slight bone deposition is clearly visible in areas of tendon attachments along the limb diaphyses.

Discussion

The osteological evidence suggests a diagnosis of a hematological disorder, in particular an iron deficiency or hereditary anemia (hemolytic anemia) (Mann and Hunt, 2005; Fornaciari and Giuffra, 2009). A variety of factors, including the age of the subject, the severe manifestations of marrow hyperplasia and the distribution of the lesions, might indicate a disorder related to hemolytic anemias, such as thalassemia; in human pathology, facial bone involvement is seen in Cooley's anemia and is an important diagnostic finding (Angel, 1964; Moseley, 1974; Resnick and Niwayama, 1988; Hes *et al.*, 1990; Hershkovitz *et al.*, 1997; Hollar, 2001; Hazza and Al-Jamal, 2006, Lagia *et al.*, 2007). As differential diagnosis, a hematological disorder related to an infectious disease caused by parasites, which is surprisingly common in wild monkeys and apes.

The next step of the research will be the molecular detection of possible genetic mutations (for example β-thalassemia). A complete radiological examination of the skeleton is also planned.

In the same time, in order to detect for possible genetic mutations (β-thalassemia), DNA extraction and sequencing of the coding region of β-globin gene are implementing in collaboration with the Genetic Service "IRCCS Burlo Garofolo" of Trieste.

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