



D21 Virtual Autopsy of a Natural Mummified Fetus: About One Case

*Fabrice Dedouit, MD**, Service de Médecine légale, Hôpital de Rangueil, 1 Avenue du Professeur Jean Poulhès, TSA 50032, Toulouse Cedex 9, 31059, France; *Céline Guilbeau Frugier, MD*, Service d'Anatomie Pathologique, Hôpital de Rangueil, 1 Avenue du Professeur Jean Poulhès, TSA 50032, Toulouse Cedex 9, 31059, France; *Florence Loubes Lacroix, MD*, Service de Neuroradiologie, 1 Avenue du Professeur Jean Poulhès, TSA 50032, Toulouse Cedex 9, 31059, France; *Francis Joffre, PhD*, Service de Radiologie Générale, Hôpital de Rangueil, 1 Avenue du Professeur Jean Poulhès, TSA 50032, Toulouse Cedex 9, 31059, France; and *Daniel Rouge, PhD*, and *Norbert Telmon, PhD*, Service de Médecine légale, Hôpital de Rangueil, 1 Avenue du Professeur Jean Poulhès, TSA 50032, Toulouse Cedex 9, 31059, France

The goal of this presentation is to illustrate the potentialities of the multi-slice computed tomography (MSCT) for the study of a natural

fetal mummy in term of skeletal evaluation (to research abnormalities), but also in term of gestational age assessment using methods not directly accessible during autopsy.

This presentation will impact the forensic community and/or humanity by providing an example of forensic application of the MSCT. **Background:** Multi-slice computed tomography (MSCT) is uncommonly used in forensic pathology. The authors present a case of MSCT examination of a natural mummified fetus. This exploration was performed in order to determine gestational age and make an exhaustive skeletal study of the fetus.

Purpose: This case report illustrates the potentialities of the MSCT concerning one natural fetal mummy in terms of skeletal evaluation to research abnormalities, but also in term of gestational age assessment using methods not directly accessible during autopsy.

Introduction: A jar containing the body of a fetus was found in a bush near a building. The body was mummified. The body was unidentified. A medico legal autopsy was ordered. Multi-slice computed tomographies (MSCT) examination of the fetus was performed in order to determinate gestational age and make an exhaustive skeletal study of the fetus. It was followed by an autopsy and an anatomico-pathological study to evaluate gestational age and detect potential malformations. Results of the different studies were finally compared.

Material and Methods: *Imaging study:* a full body MSCT exploration was performed with a 16 x 0.75 mm collimation on a Sensation 16 unit (Siemens, Germany). Based on results of obstetrical osteometrical criteria by measurement of different parts of the fetus, an assessment of the gestational age was made. Age estimation based on temporal bones analysis was also performed. Two- (2D) and three dimensional (3D) reconstructions were obtained on a Leonardo workstation (Siemens, Germany). Images interpretations were performed by board-certified radiologists.

Autoptical and anatomo-pathologic studies were performed by board-certified forensic pathologists. All three body cavities (cranium, thorax, and abdomen) were examined. The lengths of the tibia and the foot were measured. Anatomopathology was performed after a fixation in 10% formalin and decalcification with nitric acid.

Results: *MSCT imaging:* the MSCT exploration found no traumatic bone fractures. Air between the skull and the cerebral hemispheres and the prominence of the ventricles were clearly visualized; both were caused by volume loss. The cerebral hemispheres, cerebellum, pons, medulla oblongata, and the spinal cord could also be seen. In the thorax, the lungs appeared tiny, non-aerated. The trachea and both major bronchi were visible, with lumen air-filled. The esophagus was visible from its proximal to distal extremity, filled with air. The heart was seen, but characterization of the four cardiac chambers was not possible. The liver was visible. The stomach contained air. Other internal organs were not identifiable because of an insufficient spontaneous contrast. The length of tibias was 40 millimeters, what corresponds to a gestational age of 23 weeks. Concerning external ear, both external auditory canals were well defined, normally aerated. Concerning middle ear, the malleus, stapes, and incus were present with a non-disrupted ossicular chain. The footplate of the stapes is visualized within the oval window. Concerning internal ear, MSCT scan shows that cochlea and vestibule had reached full adult size. The lateral, posterior, and superior semicircular canals were visible. The labyrinthine segment of the facial nerve canal was well developed. Internal auditory canal was also well defined. Both vestibular aqueducts were visible but not cochlear aqueducts. The labyrinthine segment of the facial canal and the pyramidal process were well defined. All this image's findings were in favor of a gestational age ranged between 22 and 24 weeks.

Autopsy and anatomo-pathology: the body was a male fetus completely mummified. The distal extremity of the navel string was present but the placenta was absent. The fetus was curled oneself up. No malformation was noted. The examination of the body revealed no evidence of trauma. The autopsy



was difficult because of the dried consistence of the corpse. It was very fragile and it was not possible to free the anterior part of the body without breaking the upper and lower members. The length of tibias was 40 millimeters, which corresponds to a gestational age of 23 weeks. The length of the foot was 35 millimeters, which represents an estimated gestational age ranging from 21 and 22 weeks. The tibia presented an endochondral ossification. The periosteum was ossified. The striated muscle comported well defined striations. The skin had a keratinised epidermis. Dermal papilla and sebaceous glands and papilla of hair were visible. An endochondral ossification was noted in the temporal bone. Ossicular chain was visible, surrounded by mesenchyma. The facial nerve was also visible. The three semicircular canals were present. Ossification had started in the cochlea. Histological analysis confirms that the fetal growth (osseous, vestibulocochlear, cutaneomuscular) was at least 20 weeks.

Discussion: Gestational age is determined by estimation of the fetus's development age concluded from the skeletal growth. With the development of prenatal ultrasonography, several abacuses became available for complete fetuses or ossified parts of developing bones. In forensic practice, abacuses can be useful in real anatomical conditions; however, radiographic methodology has to be applied when skeletal preparation is impossible or undesirable. MSCT give an isotropic image, with no deformation of the anatomical reality. This is important because measuring lengths of long bones on 2D reconstructions gives directly the anatomical length, without using corrective factors. In cases of particular position, as in this case, radiographic evaluation of the long bones' lengths with plain X-Rays seems to be difficult or impossible because of the superposition of the bones caused by the particular position of the body. MSCT permits with one single scanning to determine all or most of the long bones' lengths. Furthermore, it allows a skeletal and visceral exploration to determine if major abnormalities are present or not. A supplementary element to assess gestational age was used in this case: the analysis of the structures of the temporal bones. Although this exploration is not accessible to autopsy, study of the temporal bone is important for detection of congenital disorders and may bring elements to assess the gestational age. Furthermore, autopsy of mummified corpses is technically difficult because of the lack of elasticity of the different parts of the body, which break easily. Measures of long bones performed on MSCT images and on histological samples were identical and consequently gestational age assessment too. Study of temporal bones on MSCT images and histological samples were precise. Of course, accurate dating through histogenesis is imprecise because of the maternofetal factors which may interfere with the fetal development (drug addiction, metabolic disorders). However, it may give elements for estimate the range of gestational weeks.

Conclusion: MSCT is a non-destructive method available for mummy investigation. This case report illustrates the potentialities of the MSCT concerning one natural fetal mummy in term of skeletal evaluation to research abnormalities, but also in term of gestational age assessment using methods not accessible to autopsy.

Computed Tomography, Mummy, Fetus