OSTEOLOGICAL EVALUATION

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Product No. SC-183

Modern Human, Child (5 years old) Skeleton

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Modern Human, Child (5 years)

PRODUCT NUMBER: SC-183

SPECIMEN EVALUATED: Bone Clones® replica

SKELETAL INVENTORY: 1 Cranium with 10 maxillary deciduous teeth
1 Mandible with 10 deciduous teeth

1 Complete postcranial skeleton including major growth centers. (All primary centers of ossification and all morphologically-recognizable secondary centers are included.)

COMMENTS:

SC-183 is produced from the skeleton of a normal, average 5-year-old. Age is confirmed by the pattern of tooth eruption and the developmental age of individual bones.

This group of casts includes all of the primary and secondary centers of ossification which demonstrate sufficient morphological detail to be isolated, recognized, and identified out of anatomical context. A few additional secondary centers of ossification can be visualized on radiographs, but are too amorphous for inclusion here. This includes some of the carpal bones.

OSTEOLOGIC OBSERVATIONS:

The general shape and configuration of the individual bones is within normal limits. There is no evidence of acute/recent or remote trauma or disease.

Skull:

The general shape and configuration of the skull and the individual skull bones are within normal limits for a 5-year-old child. The sutural patterns are of normal configuration. Bossing is palpable in the central areas where primary ossification commenced on the parietals and frontal.

Dentition:

All twenty deciduous teeth are present. The cusps of the mandibular 1st permanent molars can be seen in the dental crypts distal to the 2nd deciduous molars. The crowns of the maxillary permanent 1st molars are beginning to erupt into the oral cavity. The crypts of the 2nd permanent molars are slightly open, but the growing teeth within the crypts are years from time of eruption.

The dentition is atraumatic and without restorations. Slight attrition is present on the anterior teeth. There is a mild diastema between the maxillary central incisors. This is normal in children approaching the transition from deciduous to permanent dentition.

RACE DETERMINATION:

Indeterminate. The very nature of the concept of human race creates problems for analysis and definition, and the problems are compounded in sub-adult material. Well-researched statistically-based methods for racial estimation are based on the adult form and are not applicable to children.

SEX DETERMINATION:

Indeterminate. Sex determination from skeletal material is based on the skeletal changes that take place in the pelvis and skull at the time of puberty. Sex-specific characteristics have not yet begun to appear in the 5-year-old skeleton.

AGE DETERMINATION:

Skull:

The fontanelles (soft spots) are closed, and the spheno-occipital synchondrosis is open (2.5mm). All cranial sutures are open and unfused, with the exception of the metopic (frontal) suture, which typically fuses within the first year of life. A small residual of the metopic suture can be seen immediately superior to the nasofrontal suture.

Dentition:

All teeth have deciduous morphology. The crowns of the first permanent teeth (1st molars) have formed and are nearing the time of eruption into the oral cavity. (Eruption of the first permanent molars typically takes place around the time of the 6th birthday.)

Epiphyseal Union:

Vertebrae: The anterior and posterior arches of C1 are complete. The dens of C2 is fused with the centrum, but the apical epiphysis (the *ossiculum terminale*) is absent. The arches of all vertebrae are fused to their corresponding vertebral bodies, but the line of fusion remains visible in most of the bodies. The sacral vertebral bodies are unfused, but the sacrum is cast as a unit with the growth cartilage indicated by dark yellow. The first two coccygeal segments are cast as a part of the sacral unit but would not have been fused to the sacrum during life. The terminal coccygeal units are not ossified at age 5.

Scapula and Clavicle: The coracoid epiphysis is unfused but present and recognizable. The glenoid epiphyses, acromion epiphysis, and inferior and lateral scapular epiphyses are not present at this age. The lateral and medial clavicular epiphyses are also not present.

Ribs and Sternum: The epiphyses of the rib heads are absent. The sternum is in three parts. The manubrium and the first segment of the body are separate. The second and third segments of the body are recently fused. (The line of fusion is partially visible.) The inferior-most segment of the body and xiphoid process are not present.

Arms: The centers of ossification for the head, greater tubercle, and lesser tubercle of the humerus are present and fused together. – Note the characteristic Y-shaped groove on the metaphyseal surface. – At the distal end of the humerus, the epiphysis of the capitulum is present and recognizable, but the centers for the trochlea, medial epicondyle, and lateral epicondyle are not sufficiently formed to be present. Only the distal epiphysis of the radius is present and morphologically recognizable. The epiphyses of the ulna are not present.

Hands: The capitate and hamate are present and distinguishable. The centers for the other carpals, with the exception of the pisiform, are commencing at this age, but are not morphologically recognizable. The distal epiphyses of metacarpals 2-5 are present in the form of small spheres (future knuckles). All diaphyses of the phalanges are present without proximal epiphyses.

Pelvis: The pubis, ischium and ilium are completely separate, but the ischiopubic ramus is nearing the time of fusion. (It should fuse between ages 5-8.) The epiphyses of the iliac crest and spines, the ischial tuberosity, and the acetabular area are not present.

Legs: The epiphyses of the femoral head, greater trochanter, and condyles are present and recognizable. The proximal and distal epiphyses of the tibia are present and recognizable. The distal epiphysis of the fibula is present, and the proximal is not present.

Feet: All seven tarsal bones can be identified by morphology. The diaphyses of all five metatarsals are present, but the distal epiphyses are not present. The proximal phalanges are present without epiphyses. The medial and distal phalanges were cast as one and the yellow color represents the connecting cartilage. This fusion is not evidence of trauma as it might be in an adult foot.

SUMMARY:

Skeleton: Typical of a normal 5-year-old human.

Sex: Undetermined. Evaluation is limited by the developmental youth of the individual at the time of death.

Age: Between 5 and 6 years old, as determined by dental eruption and epiphyseal development.

Race: Undetermined. Little comparative data exists for racial determination of juvenile skeletal remains.

Trauma: None.

EDUCATIONAL SUGGESTIONS:

This child was within the 6th year of post-natal development at the time of death. It can be used either as reference material or as a teaching resource. If it is used for teaching, the instructor might wish to utilize the following topics, questions, and notes, beginning with basic human anatomy and continuing to subjects of growth, development, social correlates, and comparative anatomy.

1. What does the 5-year-old skeleton look like? Traditionally, radiographs and articulated skeletons are used to demonstrate the growing skeleton. Centers of ossification are recognized by location rather than actual morphology, and it is difficult, if not impossible, to compare and contrast elements from different regions of the body. With a disarticulated skeleton such as SC-183-D, all elements can be viewed out of context and from all surfaces. It is possible to see, for example, the differences between the metaphyseal surfaces of the epiphyses of the humeral and femoral heads.

2. How does the child's skeleton compare with the adult skeleton? The 5-year-old can be compared with the adult in form, proportions, and absolute numbers of bony elements. In adults, long bones tend to be identified by the ends or the shapes of the articular surfaces. This is not possible when **epiphyses** and **diaphyses** are disassociated in juvenile skeletal material. It is useful to be able to compare the diaphyses of the immature bones with the fully-formed bones of the adult and focus on details of the shafts.

3. How does bone form? SC-183 provides an opportunity to explain and demonstrate the appearance and growth of bone in the body. Bone develops either between layers of early connective tissue (**intramembranous ossification**) or within a cartilaginous model (**endochondral ossification**). The bony plates of the skull grow by intramembranous ossification and long bones grow by endochondral ossification. Students tend to be surprised that long bone growth takes place in cartilage located between the diaphysis and the epiphyses of the long bones rather than at the actual ends of the bones.

4. How does bone achieve the adult form? SC-183 provides an opportunity to explain the differences between **primary** and **secondary centers of ossification** in the overall configuration of adult bone. The use of charts to estimate age can be demonstrated. (See References for suggested textbooks.) Age of **appearance** and **fusion** can be explained. The process of bone **remodeling** and **appositional growth** can be described to explain changes in shape with growth.

5. How does the human child compare with other primates? SC-183 can also be useful in classes on human evolution or primatology as a way to introduce the subject of **neoteny (**retention of juvenile features in adulthood). Immature apes and humans are more similar in form than adult apes and humans. Adult humans retain more juvenile traits whereas the adult ape undergoes greater change.

6. How do bones of human children compare with non-human animals of similar size? It is not unusual for children's bones to be confused with young animals found in

archaeological and forensic contexts. For example, animal bones from the many World Trade Center restaurants were commingled with human remains in the bony parts delivered to the NY medical examiner's office. A clear recognition of human vs. nonhuman was essential to the work.

7. What are the social correlates to developmental maturity? SC-183 may also be used to launch a discussion of stages of maturity. In many cultures, formal education begins during the 6th year of life. The instructor might want to ask why this age is significant for the human child. – Is it only mental development and language facility, or might there be skeletal factors as well? By this age, deciduous dentition is complete and adult dentition is beginning to erupt, the brain is well-encased, and the limbs are better-developed. Thus, a protein-rich diet is possible, adult protection is less necessary, and long-distance walking is achievable.

NOTES:

1. Sex cannot be reliably determined on subadult remains. Both the skull and the pelvis undergo sex-specific changes around the time of puberty, but prior to that time, the differences are slight. A number of researchers have published methods, but tests of the methods have been disappointing. (See Scheuer & Black, 2000, pp. 15-17.)

2. Age assessment in subadult skeletons is dependent on developmental changes, specifically the appearance, development, and fusion of centers of ossification. Extensive works have been published on various regions of the body (See Gruelich & Pyle, 1959). Developmental changes can be relied upon to occur more regularly than the degenerational changes used for age assessment in adult skeletons. However, age assessment in subadults is complicated by two facts: males and females mature at different rates, and sex is difficult to determine in subadult material. Dental development is less affected by sex and, therefore, is the more reliable indicator.

   When reporting age of an unknown individual, the investigator should offer the age range suggested by all of the available evidence. Age assessment is best done in the context of the entire skeleton and using methods based on samples from the same general population.

3. Racial identity is controversial in all human remains. It is even more difficult in subadult remains. The skull is the best indicator of racial identity in the adult, but the immature skull changes in proportions as it grows (e.g., the size of the face in relation to the size of the neurocranium). An enormous sample would be necessary for racial research on children, with examples at multiple age levels.

4. Some instructors might want to introduce students to the problems inherent in skeletal research on subadults. A major impediment to research is the lack of immature skeletons in research collections. Modern, well-documented skeletons are even rarer. Cultural biases are a major impediment to development of these extremely important collections.

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DISCLAIMERS:

This report is provided as a teaching tool for introductory level students of human anatomy, osteology, or physical anthropology. My opinions are based solely upon the material presented to me. Individual variation is to be expected.

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