

Growth and Development of the Gibbon

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PURPOSE: The production of gibbons from the gibbon breeding program has offered a unique opportunity to measure certain parameters of growth and development in animals where birthdates are known. The purpose of this study is to relate distinctive developmental features to the age of these young gibbons so that the age of animals with unknown birthdates may be accurately determined.

DESCRIPTION: Growth and development is measured in the following ways in young gibbons:

- a) body weights are taken regularly on each of the gibbons in the study;
- b) The time of eruption and notable characteristics of wear on the teeth are observed and recorded quarterly;
- c) Skeletal development is evaluated radiographically at quarterly intervals following birth. In measuring skeletal development, emphasis is placed on the development of the hands, wrists, ankles, and feet;
- d) The time that obvious signs of sexual development occur, such as descension of the testicles in the male and the onset of menstruation in the female are observed and recorded.

PROGRESS: Information that has been accumulated during the course of this study is presented Tables 1 and 2. The following developments characterize the growth and development of the gibbon at the ages indicated:

- 6 months. The proximal radial epiphysis and styloid process of the ulna become visible radiographically. Two juvenile incisors are present in both the upper and lower jaw.
- 9 months. Eight carpal bones are present and the distal epiphysis of the third metacarpal becomes equal in width to its diaphysis.
- 12 months. The proximal epiphysis of the proximal first phalanx and the first metacarpal appears. The proximal epiphysis of the proximal third phalanx, proximal radial epiphysis, and distal radial epiphysis become equal in width to their diaphyses. The upper central permanent incisors are present.
- 15 months. The radial styloid process appears and the distal ulnar epiphysis becomes equal in width to the ulnar diaphysis. Several changes in bone shape occur during this time that are distinctive. The carpal bones become modeled and tend to conform more to the shape of the bones they articulate with as in the adult carpus. The metacarpals as well become funnelized, or assume a more triangular shape. The proximal epiphysis of the proximal third phalanx of the hand is in transition between its earlier distal convex shape to a more flattened appearance.
- 18 months. The distal epiphysis of the third metacarpal of the hand becomes nearly square shaped instead of round. The proximal radial epiphysis is "capping" and becoming wider than the diaphysis. At least one patella, ossifying from two centers, appears during this period.

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21 months. The proximal epiphysis of the first metacarpal reaches a width equal to that of its diaphysis. Changes in shape include the proximal epiphysis of the proximal third phalanx of the foot becoming concave in shape, and the distal radial epiphysis becoming "capped"; the distal radial epiphyseal plate begins to assume a sigmoid shape. The second lower incisor has appeared by this time.

24 months. The distal epiphysis of the third metacarpal is square.

Due to the influenza epizootic that passed through the gibbon colony in August that is described elsewhere in this report, two of the three infant gibbons died. It is hoped that further pregnancies in the breeding colony will result in the additional young gibbons that are necessary to complete this study. As of the present time the remaining female gibbon has shown no signs of sexual development.

Table 1. Growth in Infant Gibbons
(in grams)

Age	PC 1	PC 2	PC 3
3 mos.			447
6 mos.		838	1,150
9 mos.	1,190	980	1,610
12 mos.	1,210	1,200	2,050
15 mos.	1,350	1,240	
18 mos.	1,800	1,560	
21 mos.	2,120		
24 mos.	2,400		

Table 2. Gibbon Skeletal and Dental Development

Age (Mos)	Proximal Epiphysis 1st Phalanx, hand	Proximal Epiphysis 3rd Phalanx, hand	Ossification of Sesamoid Process, metacarpophalangeal joint	Distal Epiphysis 3rd metacarpal, hand	Proximal Epiphysis 1st Metacarpal	Number of Carpal bones	Proximal Epiphysis 3rd phalanx, foot	Fusion, of Distal Radial Epiphysis	Proximal Radial Epiphysis	Fusion of Distal Ulnar epiphysis	Ulnar Epiphysis	Remarks	Dental Formula
	Abs.	Unk	Abs.	Unk	Abs.	7	Unk.	Unfused present $\frac{2^{**}}{3}$	Abs.	Unfused Present $\frac{1}{3}$	Styleoid Process Present		$\frac{i}{i} \frac{c}{c} \frac{p}{p} \frac{m}{m}$
3 (1)*	Abs.	Unk	Abs.	Unk	Abs.	7	Unk.	Unfused present $\frac{2^{**}}{3}$	Abs.	Unfused Present $\frac{1}{3}$	Abs.		$\frac{i}{i} \frac{c}{c} \frac{p}{p} \frac{m}{m}$
6 (2)	Abs.	Unfused present $\frac{2}{3}$	Abs.	Unfused present round $\frac{3}{4}$	Abs.	7	Unk.	Unfused $\frac{3}{4}$	$\frac{3}{4}$	Unfused $\frac{1}{2}$	present indistinct		$\frac{ii}{ii} \frac{c}{c} \frac{p}{p} \frac{m}{m}$
9 (3)	Abs.	Unfused $\frac{3}{4}$	Abs.	Unfused $\frac{1}{1}$	Abs.	7-8	Unk.	Unfused $\frac{3}{4}$	$\frac{3}{4}$	Unfused $\frac{1}{2}$	present distinct $\frac{1}{2}$		$\frac{ii}{ii} \frac{c}{c} \frac{p}{p} \frac{m}{m}$
12 (3)	Unfused Present $\frac{1}{3}$	Unfused Convex distally $\frac{1}{1}$		Unfused Not round $\frac{1}{1}$	Unfused present $\frac{1}{2}$	8	Unfused present $\frac{1}{1}$	Unfused $\frac{3}{4}$	$\frac{1}{1}$	Unfused $\frac{3}{4}$	present		$\frac{ii}{ii} \frac{c}{c} \frac{p}{p} \frac{m}{m}$
15 (3)	Unfused $\frac{1}{2}$	Unfused tends to flatten $\frac{1}{1}$		Unfused $\frac{1}{1}$	Unfused	8	Unfused flatter $\frac{1}{1}$	Unfused Radial Styleoid present $\frac{1}{1}$	$\frac{1}{1}$	Unfused $\frac{1}{1}$	present	Metacarpal functionalization begins	$\frac{ii}{ii} \frac{c}{c} \frac{p}{p} \frac{m}{m}$

Table 2. (Continued)

Age (Mos)	Proximal Epiphysis 1st Phalanx, hand	Proximal Epiphysis 3rd Phalanx, hand	Ossification of Sesamoid Process, metacarpo- phalangeal joint	Distal Epiphysis 3rd Metacarpal, hand	Proximal Epiphysis 1st Metacarpal	Number of Carpal bones	Proximal Epiphysis 3rd Phalanx, foot	Fusion, of Distal Radial Epiphysis	Proximal Radial Epiphysis	Ulnar Epiphysis		Remarks	Dental Formula
										Fusion of Distal Ulnar epiphysis	Styloid Process Present		
18 (1)	Unfused 1 2	Unfused 1 1	Abs.	Unfused Nearly Square 1 1	Unfused 3 4	8	Unfused 1 1	Unfused 1 1	Unfused Capped 7 6	Unfused 1 1	Patella present	Patella present	II $\frac{c}{c}$ $\frac{p}{p}$ $\frac{m}{m}$ II $\frac{c}{c}$ $\frac{p}{p}$ $\frac{m}{m}$
21 (1)	Unfused 1 2	Unfused flat 1 1	Abs.	Unfused 1 1	Unfused 1 1	8	Unfused convave 1 1	Unfused sigmoid capped 1 1	Unfused 8 7	Unfused 1 1		Meta- carp. well funneli- zed	I $\frac{c}{c}$ $\frac{p}{p}$ $\frac{m}{m}$ I $\frac{c}{c}$ $\frac{p}{p}$ $\frac{m}{m}$
24 (1)	Unfused 2 3	Unfused 1 1	Abs.	Unfused Square 1 1	Unfused 1 1	8	Unfused concave 1 1	Unfused 1 1	Unfused 8 7	Unfused 1 1			II $\frac{c}{c}$ $\frac{p}{p}$ $\frac{m}{m}$ II $\frac{c}{c}$ $\frac{p}{p}$ $\frac{m}{m}$

* Indicates number of observations

** Indicates epiphysis to diaphysis width ratio