Supplementary Materials for

A biomechanical perspective on molar emergence and primate life history

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Other Supplementary Material for this manuscript includes the following:

Data S1 to S7
**Constrained Lever Model Description and Predictions for Molar Position**

Forces applied to the mandible by the masticatory adductor muscles are resisted at three points: the bite point, the working-side TMJ, and the balancing-side TMJ (24, 57-61). These three points make up the corners of the triangle of support (TOS), a theoretical area through which the masticatory adductor muscle resultant vector (AMRV) must pass to ensure TMJ stability (Fig. S1a; 24-26, 62). The key parameter for rendering an intact CLM is the position of the AMRV, in both the AP and ML dimensions relative to the three principal resistance points of the TOS.

When the working-side and balancing-side adductor muscles are equally active, the resultant lies in the midsagittal plane (Fig. S1a). During anterior biting, when the TOS is large and can easily encompass the AMRV, the working-side and balancing-side TMJs can resist most of the load. As the bite point moves posteriolry along the postcanine row, however, the TOS gets increasingly smaller and, ultimately, a midline AMRV will fall outside of the TOS (Fig. S1b; 30, 61), loading the TMJ in tension and causing TMJ distraction. To avoid loading the TMJ in tension during posterior molar biting, the AMRV migrates laterally, away from the midline and towards the working side, a movement enabled by reducing balancing-side muscle force (Fig. S1b). Based on the AP position at which the AMRV crosses the TOS and its ML movements, the mandible has been divided into three regions (Fig. S1c). Region I contains bite points at which the AMRV can stay in the midline. Region II contains bite points that cause the AMRV to shift laterally in order to stay within the TOS. Regions I and II contain teeth because biting in these regions will not result in TMJ distraction. On the other hand, biting in Region III, in which the AMRV fails to pass within the TOS, would distract the TMJ. Thus, teeth should only be positioned anterior to the AMRV and within Regions I and II. Importantly, the boundary between Region II and Region III is determined by the AP position of the AMRV. This boundary represents the most posterior possible position of bite points that will not cause distractive forces to the TMJ.

An AMRV moving freely during chewing would often come close to, or potentially drop outside of, the boundaries of the TOS (31). During bite force production, the AMRV should therefore avoid the edges of the TOS. A buffer zone, first proposed by Greaves (24), but refined by Spencer (31), is hypothesized to exist along the edges of the triangle where the AMRV can migrate during submaximum force production (Fig. S1d). The AMRV should stay within the inner portion of the TOS, an area referred to as the sweet spot (Fig. S1d; 31), during maximum force production as this represents the most stable loading scenario.

The CLM was developed using the artiodactyl masticatory system (24), with the assumption that the TMJ is positioned at the level of the occlusal plane. This general configuration results in the AMRV being aligned perpendicular to the occlusal plane (24). A TMJ positioned at the level of the occlusal plane produces a TOS that falls along the occlusal plane. Recall that the distal boundary of Region II occurs where the AMRV crosses the TOS. In artiodactyls and many other mammals that have TMJs at the level of the occlusal plane (e.g., many carnivores, rodents, strepsirrhines), the point at which the AMRV crosses the TOS is the same as the point at which the AMRV crosses the occlusal plane (i.e., points 1 and 2 in Fig. S2a are coincident in space). In anthropoid primates, however, the TMJ is raised above the occlusal plane, which yields a TOS that is inclined to the occlusal plane (Fig. S2b). In such a configuration, unless the AMRV is perpendicular to the occlusal plane, the AP position at which the vector crosses the TOS will differ from the position that it crosses the occlusal plane (i.e., points 1 and 2 in Fig. S2b are not coincident in space). This affects the distribution of Region II.
Primates tend to have anteriorly inclined AMRVs (62). An anteriorly inclined AMRV will cross the TOS at a more anterior location (point 2 in Fig. S2b) than the point at which it crosses the occlusal plane (point 1 in Fig. S2b), resulting in a more anteriorly positioned boundary between Region II and Region III.

To estimate AMRV position, information on the position, orientation, and magnitude of the three mandibular adductor muscles (the temporalis, masseter (deep and superficial components combined), and medial pterygoid muscles) is combined. In the absence of data on physiological cross-sectional area, which are necessary to determine force magnitude but are scant across primates and essentially absent for non-adults, the position and orientation of the muscle lines of action can be used to reconstruct the position of the AMRV. This is the approach taken here with the assumption that all three adductor muscles contribute equally to bite force.

**Data Collection**

**Landmarks**
To collect landmark data, primate crania were positioned on a ring, secured with dental wax. The ring was supported by a ring stand. The crania were inverted, with the basicranium positioned superior to the neurocranium. Landmarks are listed in Table S8 and illustrated in Figure 1a. Landmarks were first collected from the inferior and lateral aspects of the cranium (landmarks 1-12) and the occlusal portions of maxillary teeth (landmarks 13-22). Mandibular landmarks (landmarks 23-38) were collected after the mandible was articulated with the cranium so that maxillary and mandibular teeth were in occlusion. Some of the mandibular landmarks were collected along the labial/buccal aspect of the alveolar bone, distal to each tooth position (landmarks 29-38). The distances between these mandibular landmarks were summed and added to the distance between the last molar and the AMRV to equal the variable *mandibular arch length* (i.e., MAL: the distance from the point between the two central mandibular incisors (infradental) to the intersection of the AMRV with the TOS, projected onto the occlusal plane, see Fig. 2b). Because infant and juvenile primates do not possess a full complement of adult teeth, the number of landmarks varied depending on the dental emergence category (see below) of each skull.

**Masticatory System Measurements**
The coordinate data were used to calculate how the following two parameters: (1) the distance between the TMJ and the point at which the adductor muscle’s lines of action (MLAs) intersect the TOS, projected onto the occlusal plane ($d_{TMJ, MLA, Occlusal}$), and (2) the distance between the TMJ and the last molar, projected onto the occlusal plane ($d_{TMJ, Molar, Occlusal}$). All landmark data were analyzed using customized code written in R 3.6.3 (48) by HG.

Because the TMJ is raised above the occlusal plane in many primate species, the TOS is inclined to the occlusal plane (Fig. S2b). This, along with an anteriorly inclined AMRV, which is found in most primates (63), yields an intersection point between the AMRV and the TOS that is more anterior than the intersection between the AMRV and the occlusal plane. To accommodate the influence of having a raised TMJ on the intersection of the AMRV and the TOS, this study investigated the antero-posterior position at which the AMRV crosses the TOS, which was projected onto the occlusal plane and compared to the position of the last molar. Landmark data were used to determine the points at which MLAs of the masseter m., anterior temporalis m., and medial pterygoid m. cross the TOS.
Two planes were defined for the purposes of data collection. The plane of the TOS (from here on referred to as the TOS plane, Fig. S2) was defined using three points: two points for the right and left TMJ articular surfaces and the trigon basin of the last molar (Table S9). The occlusal plane (Fig. S2b) was defined using the trigon basin of the right and left last two molars and the P3/dp3 (Table S9). A plane is defined by any three points that are in the plane. For a hypothetical plane that contains the points $P_1(x_1,y_1,z_1), P_2(x_2,y_2,z_2)$, and $P_3(x_3,y_3,z_3)$, two vectors can be defined as:

$$\overrightarrow{P_1P_2} = (x_2, y_2, z_2) - (x_1, y_1, z_1) = Ax, Ay, Az$$ (1)

$$\overrightarrow{P_1P_3} = (x_3, y_3, z_3) - (x_1, y_1, z_1) = Bx, By, Bz$$ (2)

The cross product of these two vectors will be a vector that is orthogonal to the hypothetical plane:

$$\overrightarrow{P_1P_2} \times \overrightarrow{P_1P_3} = \begin{vmatrix} i & j & k \\ Ax & Ay & Az \\ Bx & By & Bz \end{vmatrix} = i(AyBz - AzBy) + j(AzBx - AxBz) + k(AxBx - AyBx)$$ (3)

If $(AyBz - AzBy)$ is represented by $E$, if $(AzBx - AxBz)$ is represented by $G$, if $(AxBx - AyBx)$ is represented by $H$,

then, 

$$\overrightarrow{P_1P_2} \times \overrightarrow{P_1P_3} = Ei + Gj + Hk$$ (4)

The scalar equation of the plane is therefore:

$$Ex + Gy + Hz + D = 0$$ (5)

Where D is a constant, found by plugging a point into the equation that is in the plane ($P_1[x_1,x_2,x_3]$):

$$E(x - x_1) + G(y - y_1) + H(z - z_1) + D = 0$$ (6)

Once the planes were established, the points of intersection between each of the MLAs and the TOS plane were determined. To do this, the equation of the plane (equation 5) and the equation of the lines are needed. The equation of a line in the form:

$$r = r_0 + vt$$ (7)

can be decomposed into

$$x = x_0 + v_xt$$ (8)
\[ y = y_0 + v_y t \]  
\[ z = z_0 + v_z t \]  

Equations 8, 9, and 10 were used in the TOS plane equation to solve for \( t \). The values of \( t \) were then plugged back into equations 8, 9, and 10 to determine the x-, y-, and z-coordinates of the intersection of an MLA and the TOS plane (Point\(_{\text{MLA_Tri}}\)). Point\(_{\text{MLA_Tri}}\) was determined for each of the three adductor muscle MLAs. Next, the distance from Point\(_{\text{MLA_Tri}}\) and the occlusal plane (\( d_{\text{MLA_Occlusal}} \), Fig. S4) was measured using the equation:

\[
d_{\text{MLA_Occlusal}} = \frac{|E x_{\text{MLA_Tri}} + G y_{\text{MLA_Tri}} + H z_{\text{MLA_Tri}} + D|}{\sqrt{E^2 + G^2 + H^2}}
\]  

Where, E, F, G, and D are components from equation 5, in this case for the occlusal plane.

Similarly, the distance from the TMJ to the occlusal plane (\( d_{\text{TMJ_Occlusal}} \), Fig. S4) was measured using the equation:

\[
d_{\text{TMJ_Occlusal}} = \frac{|E x_{\text{TMJ}} + G y_{\text{TMJ}} + H z_{\text{TMJ}} + D|}{\sqrt{E^2 + G^2 + H^2}}
\]  

The Euclidean distance between the TMJ and Point\(_{\text{MLA_Tri}}\) (\( d_{\text{TMJ_MLA}} \), Fig. S4) was then measured using the equation:

\[
d_{\text{TMJ_MLA}} = \sqrt{(x_{\text{MLA_Tri}} - x_{\text{TMJ}})^2 + (y_{\text{MLA_Tri}} - y_{\text{TMJ}})^2 + (z_{\text{MLA_Tri}} - z_{\text{TMJ}})^2}
\]  

Where \( d_{\text{TMJ_MLA}} \) represents the hypotenuse of a right triangle (Fig. S4), the opposite distance of which was determined using the equation:

\[
d_{\text{Opposite_TMJ}} = d_{\text{TMJ_Occlusal}} - d_{\text{MLA_Occlusal}}
\]  

The distance from the TMJ to the intersection of the MLA with the TOS plane, projected onto the occlusal plane (\( d_{\text{TMJ_MLA_Occlusal}} \), Fig. S4) is therefore defined as:

\[
d_{\text{TMJ_MLA_Occlusal}} = \sqrt{|d_{\text{Opposite_TMJ}}^2 - d_{\text{TMJ_MLA}}^2|}
\]

The above measurement (\( d_{\text{TMJ_MLA_Occlusal}} \)) was calculated for each of the three MLAs separately and then averaged to yield the overall \( d_{\text{TMJ_MLA_Occlusal}} \) value.
Finally, it was necessary to determine the distance from the TMJ to the last erupted molar, projected onto the occlusal plane. The point on the alveolar margin, just distal to the last mandibular molar was projected onto the occlusal plane using the equation:

\[ d_{\text{Molar\_Occlusal}} = \frac{|Ex_{\text{Molar}} + Gy_{\text{Molar}} + Hz_{\text{Molar}} + D|}{\sqrt{E^2 + G^2 + H^2}} \] (16)

The distance from the TMJ to the occlusal plane \(d_{\text{TMJ\_Occlusal}}\) was previously determined. The Euclidean distance between the TMJ and the point distal to the last molar \(d_{\text{TMJ\_Molar}}\), Fig. S5) was measured using the equation:

\[ d_{\text{TMJ\_Molar}} = \sqrt{(x_{\text{TMJ}} + x_{\text{Molar}})^2 + (y_{\text{TMJ}} + y_{\text{Molar}})^2 + (z_{\text{TMJ}} + z_{\text{Molar}})^2} \] (17)

The sum of the distances \(d_{\text{TMJ\_Occlusal}}\) and \(d_{\text{Molar\_Occlusal}}\) formed the hypotenuse of a right triangle (Fig. S5). The opposite of this right triangle was equal to \(d_{\text{TMJ\_Occlusal}}\) (Fig. S5) and so the distance from the TMJ to the last erupted molar, projected onto the occlusal plane \(d_{\text{TMJ\_Molar\_Occlusal}}\), Fig. S5), is calculated using the equation:

\[ d_{\text{TMJ\_Molar\_Occlusal}} = \sqrt{d_{\text{TMJ\_Occlusal}}^2 - d_{\text{TMJ\_Molar}}^2} \] (18)

Finally, the variable Resultant-Molar (Fig. S6) was calculated. This variable represents the distance between the AMRV and the last molar, along the occlusal plane. Resultant-Molar was calculated by taking the difference between \(d_{\text{TMJ\_Molar\_Occlusal}}\) and \(d_{\text{TMJ\_MLA\_Occlusal}}\), using the formula:

\[ \text{Resultant} - \text{Molar} = d_{\text{TMJ\_Molar\_Occlusal}} - d_{\text{TMJ\_MLA\_Occlusal}} \] (19)

Several landmarks were used for the attachment points of the temporalis and masseter muscles. Two landmarks were used to estimate masseter origin (landmarks 2 and 3 on the left side and landmarks 10 and 11 on the right side, Table S8) and one to estimate masseter insertion (landmark 24 on the left side and 27 on the right side, Table S8). The anterior temporalis muscle fibers run vertically and act in jaw adduction. This portion of the temporalis muscle is continuous with the posterior temporalis, which has muscle fibers that are positioned more horizontally and act in retrusion of the mandible. The anterior temporalis was defined here as that portion of the temporalis muscle that originates lateral and distal to the orbit and in the pterion region. Two landmarks were used to estimate anterior temporalis origin (landmarks 4 and 5 on the left side and landmarks 8 and 9 on the right side, Table S8) and one landmark for its insertion (landmark 23 on the left side and landmark 28 on the right side, Table S8). These multiple landmarks were used to capture variation in the attachment sites of these muscles. Only one landmark was used to represent the origin (landmark 6 on the left side and landmark 7 on the right side, Table S8)
and insertion (landmark 25 on the left side and landmark 26 on the right side, Table S8) of the medial pterygoid muscle.

The position of the AMRV was estimated using skeletal landmarks. This was done by calculating the average $d_{TMJ\_MLA\_Occlusal}$ value for each of the three adductor muscles’ MLAs using all combinations of landmarks as described above, and then calculating the average $d_{TMJ\_MLA\_Occlusal}$ of these three to yield an overall mean $d_{TMJ\_MLA\_Occlusal}$ value. This assumes that each muscle contributes equal force during isometric maximum bite force production. This method was used to determine the variable Resultant-Molar, which represents the distance between the AMRV and the last molar.

**Known-Age Skeletal Sample Provenance**

A list of all species examined for the study is available in Table S1. These include specimens of known-age, the information for which can be found below and are listed in Table S2.

The modern human skeletal sample (n=94; Table S2a) was a combination of two skeletal collections. The majority of subadults were from the Atkinson Collection, a collection of human skulls from Mexico, India, Europe, Peru, Asia, and Australia/New Zealand amassed in the 1930s and housed at the Arthur A. Dugoni School of Dentistry at the University of the Pacific. These skulls were aged based on dental radiographs using standard dental ageing methods (64). The Robert J. Terry Anatomical Skeletal Collection of modern human skeletons was also used in this study. This cadaveric collection is housed at the National Museum of Natural History and consists of known-age individuals. Individuals with craniofacial malformations, missing teeth with bone resorption, or tooth agenesis were excluded for the purposes of this study.

The mountain gorilla (G. beringei beringei) sample (n=21; Table S2b) is a cross-sectional ontogenetic series of known-age wild individuals whose skeletons were recovered from Volcanoes National Park, Rwanda. These mountain gorilla skeletons are part of a growing collection curated by the Mountain Gorilla Skeletal Project (MGSP), under the authority of the Rwanda Development Board’s Department of Tourism and Conservation and in partnership with Dian Fossey Gorilla Fund International, Mountain Gorilla Veterinary Project, The George Washington University, Institute of National Museums of Rwanda, New York University College of Dentistry, and other institutions (see 65, 66). Age determination and attribution for the skeletons is described in further detail in McFarlin et al. (66), Galbany et al. (67), and Kralick et al. (39).

The chimpanzee sample (n=36; Table S2c) consisted of two skeletal populations. The first is of Taï chimpanzees (P. troglodytes verus) housed at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. Behavioral data have been collected continuously on this community since 1989 and skeletal remains have been recovered since 1995 (68). The second, smaller addition to the chimpanzee sample was that of western chimpanzees (P. t. schweinfurthii) from Gombe Stream National Park, Tanzania. Remains of deceased individuals have been collected, skeletonized, and curated at Gombe since the late 1970s (69). While most of the skeletal collection from Gombe are in Tanzania, some of the collection, including the individuals used in this study, is currently housed at the University of Minnesota, in the Evolutionary Anthropology Laboratory. Despite belonging to separate subspecies, the data from these two populations were combined to yield one chimpanzee sample in order to boost sample size.
The skeletal sample of yellow baboon (*P. cynocephalus*) individuals (n=17; Table S2d) is curated by the National Museums of Kenya. The sample represents individuals of known life history that were monitored in life by the Amboseli Baboon Research Project (ABRP), and whose skeletons were curated in collaboration with Kenya Wildlife Service, National Museums of Kenya, The George Washington University, and other partners (see Acknowledgments).

The final skeletal collection examined in this study was of rhesus macaques (*M. mulatta*) from the Cayo Santiago colony (n=104; Table S2e), established in 1938 and now part of the Caribbean Primate Research Center. Individuals here are provisioned and monitored on a daily basis. Deceased individuals are macerated and included in an extensive skeletal collection of known-age individuals. Details of the skeletal collection, including how it is amassed and curated, can be found in Rothschild et al. (70).

**Analyses**

**Position of Emergence**

Due to the high number of t-tests performed, a Bonferroni correction was used to ensure that any significant results were not due to chance. A total of 66 t-tests were performed, resulting in an adjusted alpha value of 0.000758.

**Growth Rate**

Two-sided t-tests were used to determine whether there are significant differences between adult male and female MALs. These tests were performed on a larger sample of adult individuals than the remainder of the analyses, regardless of whether age information was available or not. It was determined that in all species except *H. sapiens*, there are significant sex differences in MAL (Table S3). Despite this, data for males and females were combined in the analyses below because data on sex attribution were not available for some of the subadult specimens and separating the sexes resulted in very small sample sizes for most of the species.

Pairwise comparisons of MAL growth trajectories between taxa differing in MAL and/or molar emergence timing were performed. MAL growth rate was determined using segmented (i.e., piecewise) regressions, which described species-specific MAL growth curves (49) with age as the independent variable and MAL as the dependent variable. Segmented regressions were fit to the data using the *segmented* package (50) (version 0.5.1.4) in R. This package uses maximum likelihood to iteratively fit curves to the data and find breakpoints (50). Growth data should be defined by two curves separated by one breakpoint; the first curve representing growth rate, the breakpoint representing the age at growth cessation, and the second curve representing the asymptotic phase (i.e., the adult phase). The segmented regressions fit to the data were compared to ordinary least-squares (OLS) regressions using Akaike’s Information Criterion (AIC). If segmented regression is a better fit to the data then it should possess lower AIC scores.

Segmented regression is widely used to study growth and has been used to study growth rate and growth cessation in body mass in both captive and wild primates (71, 72) and the ontogeny of primate brain mass (66). Identified breakpoints were extracted as the variable *MAL growth cessation*. After breakpoints were identified, data points from the first part of the growth curve were extracted. These data were then used in an OLS regression with age as the predictor variable and MAL as the response variable, and the resulting slopes (extracted as the variable *MAL growth rate*) were compared between sets of taxa using an analysis of covariance (ANCOVA) to determine if the interaction between species and age is significantly different
from zero, in other words, if the slopes of the two species are significantly different from one another. This was done to test the predictions outlined in Figure S3 and Table S4.

**PGLS**
The PGLS analyses outlined in the main text estimated lambda by maximum likelihood. Due to our low sample size (n=5 species) we also performed PGLS analyses that bracketed lambda between a value of zero and one (i.e., the possible range of lambda). This allowed us to evaluate the range of possible results, depending on the influence of phylogeny on the error structure of the model.

**T-test Results**
Results of t-tests comparing Resultant-Molar to zero are listed in Table S5.

**Segmented Regression Results**
Segmented regression models all identified one breakpoint in each model, separating each MAL curve into a growth component and an adult component. The estimated breakpoint (i.e., MAL growth cessation) values for each species are listed in Table 1 and are illustrated in Figure 2. In the segmented models, a large amount of variation in MAL was explained by age ($R^2=0.52-0.90$; Table S11).

**MAL Growth Rate Results**
OLS regression results using growth data (i.e., individuals that were younger than the breakpoints identified in the above analysis) are reported in Table S12. In all models, slopes for MAL were positive, the 95% slope confidence intervals did not include zero, and the slopes were significantly different from zero (Table S12). In these models, age explained a large portion of the variation in MAL ($R^2=0.75-0.94$; Table S12). Slopes from the above analyses were extracted for future analysis and renamed as the variable: MAL growth rate.

**Phylogenetic PCA and PGLS Results**
The phylogenetic PCA model was based on data indicated in Table S10. The data yielded a lambda value of zero indicating that there was no phylogenetic signal in the error structure of the model (Table S14A). The first component explained 80.29% of variance in the data, and yielded an eigenvalue >3, while the remaining three components together explained less than 20% of variance and yielded eigenvalues <1 (Table S14b, c). PC1 was therefore used as a variable in the analyses below to represent the cumulative effect of brain size and life history variables. Eigenvector loadings for PC1 were all positive and all contributed substantially to the component, with brain size and age at first reproduction having the greatest contributions (Table S14C). Loadings for PC1-4 are listed in Table S14d. PGLS results when lambda was estimated using maximum likelihood are indicated in Table S7 and are described in the main text. PGLS results when lambda was set to zero and to one are indicated in Table S15.

**Gorilla-Chimpanzee Comparison**
The comparison between mountain gorillas and chimpanzees did not conform to the predictions of the model. Based on inferred molar emergence ages and adult MAL estimates in these two species, it was predicted that mountain gorilla mandibular arches would grow at a faster rate and
for a similar duration compared to chimpanzee mandibular arches (Table S4b). Results indicate that the rate of MAL growth in mountain gorillas is statistically indistinguishable from that of chimpanzees. Gorillas complete molar emergence just over halfway (~63%) through orofacial development, as marked by the cessation of mandibular growth relative to emergence of the M3 (Table 1). This completion schedule is accelerated compared to all other primates sampled, in which molar emergence schedules are spread across ~80-90% of the time allotted to facial growth. Accelerated dental emergence schedules are associated with folivory (73) and thus consistent with extreme folivory in mountain gorillas (74, 75). These growth cessation estimates are also consistent with data on somatic growth rates for the same population. Although adult body proportions in most Virunga mountain gorillas are reached between 11-16 years of age, head proportions are the last to reach adult values, especially in males where adult head size is not reached until 16.7-18.1 years (76). The late age of attainment of adult head proportions is related to masticatory system maturation and late attainment of secondary sexual characteristics, including the late emergence of permanent canines, growth of the sagittal crest, and related size increases of the masticatory muscles (77). Male dispersal occurs at the same time as when adult size is reached (78-80) and should coincide with these final stages of growth.
Fig. S1. Parameters of Constrained Lever Model. Occlusal view of mandible showing (A) the triangle of support (TOS; grey triangle outlined in red) with the adductor muscle resultant vector (AMRV; red square) falling within it. The TOS is bounded by the working-side and balancing-side TMJs and the bite point (red diamond). When biting on anterior bite points, the AMRV falls within the midline (black dashed line) because both balancing- and working-side adductor muscles are used with equal force. (B) As the bite point moves posteriorly, the TOS gets smaller and the AMRV must shift laterally towards the working side from its midline position in order to stay within the TOS. This lateral movement is achieved by reducing the balancing-side adductor force. (C) The spatial relationship among the AMRV and working-side TMJ in conjunction with the midline sagittal plane are used to define three regions of the mandible: Regions I and II are separated by an oblique line passing through the working-side TMJ and the AMRV’s intersection with the TOS; Regions II and III are separated by a transverse (dashed) line passing through the AMRV. See text for the biomechanical definitions of Regions I, II, and III. Bite points are only located in Regions I and II (i.e., anterior to the AMRV), but never in Region III as they would distract the TMJ at the working-side TMJ. (D) TOS for a posterior bite point on the M3. Image indicates a buffer zone around the periphery of the TOS and a sweet spot, where the AMRV should be located during maximum biting, as described by Spencer (31). The distance between the last molar (red diamond) and the AMRV (red square) represents the theoretical anterior portion of the buffer zone and is captured by the measurement “Resultant-Molar” in this study. Photo credit: Halszka Glowacka, University of Arizona.
Fig. S2. Effects of raising TMJ above occlusal plane. Lateral views of a lemur (A) and a macaque (B) skull illustrating the effects of moving the TMJ above the occlusal plane and inclining the adductor muscle resultant vector (AMRV). A TMJ at the occlusal plane (as in A) produces a TOS that falls along the occlusal plane. In this scenario, the point at which the AMRV crosses the occlusal plane (Point 1) will coincide with the point at which that vector crosses the plane of the TOS (Point 2), even if the vector is inclined anteriorly. When the TMJ is raised above the occlusal plane (B) the TOS plane becomes inclined to the occlusal plane. If the AMRV is inclined anteriorly, then at any bite point, the vector will cross the occlusal plane more posteriorly (Point 1) than it does the TOS plane (Point 2). Skulls not to scale. Figure adapted from Spencer (37). Photo credit: Halszka Glowacka, University of Arizona.
Fig. S3. Effects of varying mandibular arch length growth rate and duration on molar emergence ages. Schematic of mandibular arch length growth curves comparing taxa with longer (blue) and shorter (red) adult mandibles. Boxes along the y-axis indicate the mandibular arch length at which enough space has been vacated anterior to the adductor muscle resultant vector (AMRV) for a molar to emerge and dashed lines indicate the ages at which molars emerge. Relatively early molar emergence is attained either through a shorter mandibular arch that grows at the same (red line in a), faster (red line in b), or slower rate (red line in c), but for a shorter duration or through a longer mandibular arch that grows at a faster rate for a shorter duration (blue line in d). Relatively later molar emergence is attained either through a longer mandibular arch that grows at the same (blue line in a), faster (blue line in c), or slower rate (blue line in b), but for a longer duration or by a shorter mandibular arch that grows at a slower rate and for a longer duration (red line in d). Similar ages at molar emergence are attained through a longer mandibular arch that grows at a faster rate but for the same duration (blue line in e), through a shorter mandibular arch that grows at a slower rate and for the same duration (red line in e), or through similar mandibular arch lengths that grow at similar rates and for similar durations (not shown).
Fig. S4. Measurements used to determine $d_{\text{TMJ-MLA Occlusal}}$. Lateral view of an adult female macaque skull showing the occlusal plane (short-dashed black line), the TOS plane (long-dashed black line), and an MLA (thick solid black line). Red line represents the distance between the MLA’s intersection with the TOS plane and the occlusal plane ($d_{\text{MLA Occlusal}}$). Blue line represents the distance between the TMJ and the occlusal plane ($d_{\text{TMJ Occlusal}}$). Image illustrates variables that were measured to determine the distance between the TMJ and the MLA, projected onto the occlusal plane ($d_{\text{TMJ-MLA Occlusal}}$). See text for details. Photo credit: Halszka Glowacka, University of Arizona.
Fig. S5. **Measurements used to determine $d_{TMJ\_Molar\_Occlusal}$**. Lateral view of an adult female macaque skull showing the occlusal plane (short-dashed black line), the TOS plane (long-dashed black line), and an MLA (thick solid black line). Red line represents the distance between the point just distal to the last molar and the occlusal plane ($d_{Molar\_Occlusal}$). Blue line as in Fig S4. Image illustrates variables that were measured to determine the distance between the TMJ and the last molar, projected onto the occlusal plane ($d_{TMJ\_Molar\_Occlusal}$). See text for details. Photo credit: Halszka Glowacka, University of Arizona.
Fig. S6. Measurements used to determine Resultant-Molar. Lateral view of an adult female macaque skull showing the occlusal plane (short-dashed black line), the TOS plane (long-dashed black line), and an MLA (thick solid black line). Red and blue lines as in Figs. S4 and S5. Image illustrates variables used to measure the distance between the AMRV and the last molar (Resultant-Molar). See text for details. Photo credit: Halszka Glowacka, University of Arizona.
Table S1. List of species examined, including sample sizes, listed according to dental emergence category and institution of collection.

| Taxon                          | Sample size for dental emergence category | Institution |
|-------------------------------|------------------------------------------|--------------|
|                               | dp4    | M1    | M2    | M3    |              |
| Strepsirrhini                 |        |       |       |       |              |
| Eulemur mongoz                | -      | 2     | -     | 13    | 1,2,4        |
| Lemur catta                   | 3      | -     | 5     | 18    | 1,2,3,4      |
| Perodicticus potto            | 2      | 8     | 8     | 20    | 1,2,3,4      |
| Otolemur monteiri             | 3      | 3     | -     | 31    | 2,5          |
| Platyrhini                    |        |       |       |       |              |
| Alouatta palliata             | 10     | 10    | 10    | 20    | 1            |
| Ateles geoffroyi              | 7      | 10    | 10    | 20    | 1,2,3        |
| Cebus (Sapajus) apella        | 10     | 10    | 6     | 30    | 1,4          |
| Saimiri sciureus              | 4      | 9     | 10    | 19    | 1,4          |
| Cercopithecidae               |        |       |       |       |              |
| Colobus angolensis            | 10     | 9     | 10    | 19    | 2,5          |
| Colobus polykomos             | 3      | 5     | 8     | 20    | 1,3,4        |
| Procolobus verus              | -      | 6     | 7     | 19    | 5            |
| Macaca mulatta                | 28     | 33    | 31    | 58    | 1,6          |
| Macaca fascicularis           | 10     | 10    | 8     | 16    | 1,2,3,4      |
| Papio anubis                  | 10     | 10    | 10    | 28    | 5            |
| Papio cynocephalus            | 12     | 10    | 17    | 34    | 1,3,5,7      |
| Hominidae                     |        |       |       |       |              |
| Gorilla beringei              | 16     | 14    | 9     | 57    | 1,5,8        |
| Gorilla gorilla               | 7      | 10    | 5     | 29    | 1,2,3,4,5    |
| Homo sapiens                  | 25     | 22    | 31    | 50    | 1,9          |
| Pan paniscus                  | 10     | 10    | 12    | 21    | 5            |
| Pan troglodytes               | 16     | 21    | 21    | 69    | 1,5,10,11    |
| Pongo pygmaeus                | 9      | 11    | 12    | 19    | 1,2,3,4      |

(1) National Museum of Natural History, Washington, DC; (2) American Museum of Natural History, New York, NY; (3) Museum of Comparative Zoology, Harvard University, Cambridge, MA; (4) Vienna Museum of Natural History Museum, Vienna, Austria; (5) Royal Museum for Central Africa, Tervuren, Belgium; (6) Caribbean Primate Research Center, Laboratory of Primate Morphology and Genetics at the University of Puerto Rico, Puerto Rico; (7) Amboseli Baboon Research Project, Skeletal Collection, National Museums Kenya; Nairobi, Kenya; (8) Mountain Gorilla Skeletal Project, Musanze, Rwanda; (9) Spencer Atkinson Collection, University of the Pacific School of Dentistry, San Francisco, CA; (10) Max Planck Institute, Leipzig, Germany; (11) Department of Anthropology, University of Minnesota, Minneapolis, MN.
Table S2. List of known-age specimens examined.
A. Specimen list for *Homo sapiens*

| Species     | Specimen # | Sex | Age (yrs) | Mandibular arch length |
|-------------|------------|-----|-----------|------------------------|
| *H. sapiens* | AC A73     | -   | 2.3       | 58.04                  |
| *H. sapiens* | AC 64      | -   | 2.8       | 57.62                  |
| *H. sapiens* | AC A69     | -   | 2.8       | 55.17                  |
| *H. sapiens* | AC A75     | -   | 2.8       | 55.88                  |
| *H. sapiens* | AC A67     | -   | 2.9       | 55.07                  |
| *H. sapiens* | AC A76     | -   | 2.9       | 56.2                   |
| *H. sapiens* | AC D41     | -   | 3         | 59.09                  |
| *H. sapiens* | AC D51     | -   | 3         | 55.61                  |
| *H. sapiens* | AC A206    | -   | 3.2       | 57.89                  |
| *H. sapiens* | AC A68     | -   | 3.3       | 55.62                  |
| *H. sapiens* | AC D38     | -   | 3.3       | 59.29                  |
| *H. sapiens* | AC A65     | -   | 3.7       | 58.88                  |
| *H. sapiens* | AC D42     | -   | 4         | 58.48                  |
| *H. sapiens* | AC A62     | -   | 4.1       | 57.56                  |
| *H. sapiens* | AC D39     | -   | 4.1       | 58.12                  |
| *H. sapiens* | AC D47     | -   | 4.2       | 52.07                  |
| *H. sapiens* | AC D270    | -   | 4.3       | 55.16                  |
| *H. sapiens* | AC A105    | -   | 5         | 55.79                  |
| *H. sapiens* | AC A131    | -   | 5         | 57.39                  |
| *H. sapiens* | AC A140    | -   | 5.3       | 57.31                  |
| *H. sapiens* | AC D299    | -   | 6.4       | 62.57                  |
| *H. sapiens* | AC A145    | -   | 6.5       | 70.62                  |
| H. sapiens | AC  |   -  |   6.6 |   66.75 |
|------------|-----|------|-------|---------|
| H. sapiens | AC D263 | - | 6.6 | 67.72 |
| H. sapiens | AC D53 | - | 6.7 | 60.96 |
| H. sapiens | AC A147 | - | 6.8 | 65.69 |
| H. sapiens | AC A101 | - | 7 | 67.84 |
| H. sapiens | AC A181 | - | 7.1 | 67.18 |
| H. sapiens | AC A116 | - | 7.2 | 69.75 |
| H. sapiens | AC A115 | - | 7.5 | 69.38 |
| H. sapiens | AC A193 | - | 7.9 | 69.37 |
| H. sapiens | AC A55 | - | 8 | 61.98 |
| H. sapiens | AC 102 | - | 8.1 | 69.48 |
| H. sapiens | AC A183 | - | 8.3 | 66.13 |
| H. sapiens | AC A151 | - | 8.9 | 69.27 |
| H. sapiens | AC A191 | - | 8.9 | 67.89 |
| H. sapiens | AC A153 | - | 9.1 | 65.59 |
| H. sapiens | AC D294 | - | 9.5 | 62.67 |
| H. sapiens | AC D43 | - | 10 | 61.46 |
| H. sapiens | AC A152 | - | 10.2 | 66.62 |
| H. sapiens | AC A157 | - | 10.6 | 74.59 |
| H. sapiens | AC A158 | - | 10.8 | 68.53 |
| H. sapiens | AC C196 | - | 11.8 | 68.69 |
| H. sapiens | AC A228 | - | 13 | 68.16 |
| H. sapiens | AC B195 | - | 13 | 75.91 |
| H. sapiens | AC B219 | - | 13 | 69.29 |
| H. sapiens | AC B220 | - | 13 | 73.08 |
| Species | Accession | Age | Location | Score |
|---------|-----------|-----|----------|-------|
| H. sapiens | AC B221 | - | 13 | 72.21 |
| H. sapiens | AC B65  | - | 13 | 71.41 |
| H. sapiens | AC B66  | - | 13 | 70.53 |
| H. sapiens | AC C112 | - | 13 | 68.43 |
| H. sapiens | AC C134 | - | 13 | 67.16 |
| H. sapiens | AC C152 | - | 13 | 76.97 |
| H. sapiens | AC A215 | - | 13.5 | 74.19 |
| H. sapiens | NMNH 1363 | F | 14 | 72.02 |
| H. sapiens | AC 194 | - | 15 | 71.52 |
| H. sapiens | AC A192 | - | 15 | 71.72 |
| H. sapiens | AC D268 | - | 15 | 69.29 |
| H. sapiens | AC D275 | - | 15 | 64.87 |
| H. sapiens | AC D297 | - | 15 | 62.54 |
| H. sapiens | AC D56  | - | 15 | 66.69 |
| H. sapiens | NMNH 822 | F | 16 | 76.71 |
| H. sapiens | NMNH 306 | F | 17 | 61.86 |
| H. sapiens | NMNH 329 | M | 17 | 71.06 |
| H. sapiens | NMNH 562 | F | 17 | 80.85 |
| H. sapiens | AC D223 | - | 18 | 73.96 |
| H. sapiens | NMNH 800R | F | 18 | 75.29 |
| H. sapiens | NMNH 567 | F | 19 | 71.72 |
| H. sapiens | NMNH 129 | M | 19 | 83.43 |
| H. sapiens | NMNH 1434R | F | 19 | 77.8 |
| H. sapiens | NMNH 760 | M | 19 | 79.77 |
| H. sapiens | NMNH 1183 | M | 20 | 75.58 |
| Species         | NMNH  | Sex | Age | Value |
|-----------------|-------|-----|-----|-------|
| *H. sapiens*    | 210   | M   | 20  | 77.9  |
| *H. sapiens*    | 1187  | M   | 21  | 89.71 |
| *H. sapiens*    | 970   | F   | 21  | 77.29 |
| *H. sapiens*    | 1503  | M   | 22  | 79.39 |
| *H. sapiens*    | 39    | F   | 22  | 81.76 |
| *H. sapiens*    | 477   | M   | 22  | 86.01 |
| *H. sapiens*    | 594   | M   | 22  | 77.17 |
| *H. sapiens*    | 723   | F   | 22  | 81.49 |
| *H. sapiens*    | 1507  | F   | 23  | 77.71 |
| *H. sapiens*    | 1544  | F   | 23  | 75.64 |
| *H. sapiens*    | 1539  | M   | 23  | 88.34 |
| *H. sapiens*    | 850   | M   | 23  | 88.07 |
| *H. sapiens*    | 859   | M   | 23  | 77.77 |
| *H. sapiens*    | 886   | F   | 23  | 77.57 |
| *H. sapiens*    | 1206  | F   | 25  | 80.56 |
| *H. sapiens*    | 49R   | M   | 27  | 78.91 |
| *H. sapiens*    | 880   | F   | 27  | 70.56 |
| *H. sapiens*    | 645   | M   | 28  | 74.57 |
| *H. sapiens*    | 235   | M   | 30  | 85.36 |
| *H. sapiens*    | 125   | M   | 31  | 77.58 |
| *H. sapiens*    | 815   | F   | 32  | 68.23 |
| *H. sapiens*    | 920   | F   | 36  | 76.2  |

N=94

B. Specimen list for *Gorilla beringei beringei.*
| Species     | Specimen # | Sex | Age (yrs) | Mandibular arch length |
|-------------|------------|-----|-----------|------------------------|
| *G. b. beringei* | GP 012     | M   | 1.2\*    | 73.06                  |
| *G. b. beringei* | GP 171     | M   | 1.3\*    | 77.46                  |
| *G. b. beringei* | GP 182     | M   | 2        | 79.11                  |
| *G. b. beringei* | GP 151     | M   | 2.9\*    | 81.14                  |
| *G. b. beringei* | GP 169     | M   | 3.4\*    | 92                     |
| *G. b. beringei* | GP 183     | F   | 3.6\*    | 90.61                  |
| *G. b. beringei* | GP 165     | F   | 3.6\*    | 97.12                  |
| *G. b. beringei* | GP 147     | F   | 8.6\*    | 109.5                  |
| *G. b. beringei* | GP 196     | F   | 9.5\*    | 117.38                 |
| *G. b. beringei* | GP 167     | F   | 12.2\*   | 116.25                 |
| *G. b. beringei* | GP 161     | M   | 18.5\*   | 147.16                 |
| *G. b. beringei* | GP 148     | F   | 19.8\*   | 129.73                 |
| *G. b. beringei* | GP 176     | M   | 21.6\*   | 153.22                 |
| *G. b. beringei* | GP 150     | M   | 24.8\d   | 159.98                 |
| *G. b. beringei* | GP 153     | F   | 30.1\e   | 119.61                 |
| *G. b. beringei* | GP 149     | F   | 31.2\a   | 117.45                 |
| *G. b. beringei* | GP 143     | F   | 33.7\d   | 126.07                 |
| *G. b. beringei* | GP 065     | M   | 34.5\f   | 164.52                 |
| *G. b. beringei* | GP 117     | F   | 36.9\f   | 136.69                 |
| *G. b. beringei* | GP 131     | F   | 38.3\f   | 147.2                  |
| *G. b. beringei* | GP 134     | F   | 42.1\h   | 140.88                 |

N=21

Birth errors are adapted from McFarlin et al. (66):

\*Birth and death dates are known to the exact day or week (± 4 days for Karisoke monitored individuals, Williamson & Gerard-Steklis, 81);
C. Specimen list for *Pan troglodytes*

| Species          | Specimen # | Sex | Age (yrs) | Mandibular arch length |
|------------------|------------|-----|-----------|------------------------|
| *P. t. verus*    | MPI 06 55  | F   | 1         | 55.3                   |
| *P. t. verus*    | MPI 06 15  | M   | 2         | 64.81                  |
| *P. t. verus*    | MPI 06 45  | M   | 2         | 62.83                  |
| *P. t. schweinfurthii* | UM PT  | M   | 2.6       | 56.94                  |
| *P. t. verus*    | MPI 06 10  | M   | 6         | 78.3                   |
| *P. t. verus*    | MPI 06 57  | M   | 6         | 69.07                  |
| *P. t. verus*    | MPI 06 64  | M   | 7         | 75.77                  |
| *P. t. verus*    | MPI 06 46  | M   | 8         | 88.16                  |
| *P. t. schweinfurthii* | UM FT  | M   | 8.5       | 82.3                   |
| *P. t. verus*    | MPI 06 29  | F   | 9         | 90.64                  |
| *P. t. verus*    | MPI 08 64  | F   | 10        | 85.01                  |
| *P. t. verus*    | MPI 06 15  | F   | 11        | 91.44                  |
| *P. t. verus*    | MPI 06 50  | F   | 11        | 86.83                  |
| *P. t. verus*    | MPI 06 31  | F   | 12        | 101.69                 |
| *P. t. schweinfurthii* | UM MM  | M   | 13        | 98.62                  |
| *P. t. verus*    | MPI 06 18  | M   | 13        | 97.76                  |
| *P. t. schweinfurthii* | UM MCD | M   | 13.5      | 97.83                  |
| Species          | Specimen # (OM/ABRP) | Sex | Age (yrs) | Mandibular arch length |
|------------------|----------------------|-----|-----------|------------------------|
| P. t. verus      | MPI 06 14            | F   | 16        | 96.13                  |
| P. t. schweinfurthii | UM GK               | F   | 18.9      | 98.24                  |
| P. t. verus      | MPI 06 17            | F   | 19        | 98.4                   |
| P. t. verus      | MPI 06 65            | M   | 19        | 105.5                  |
| P. t. verus      | MPI 06 40            | M   | 20        | 99.34                  |
| P. t. verus      | MPI 06 52            | F   | 22        | 92.01                  |
| P. t. verus      | MPI 06 39            | F   | 23        | 91.39                  |
| P. t. verus      | MPI 06 19            | F   | 25        | 104.59                 |
| P. t. verus      | MPI 15 04            | M   | 25        | 105.28                 |
| P. t. schweinfurthii | UM CH              | M   | 25.9      | 104                    |
| P. t. verus      | MPI 06 47            | F   | 27        | 99.75                  |
| P. t. verus      | MPI 06 09            | F   | 28        | 95.9                   |
| P. t. schweinfurthii | UM PL              | F   | 29.2      | 94.14                  |
| P. t. schweinfurthii | UM MB              | F   | 30.2      | 94.15                  |
| P. t. schweinfurthii | UM PS              | F   | 30.6      | 92.78                  |
| P. t. schweinfurthii | UM MF              | F   | 30.9      | 96.22                  |
| P. t. schweinfurthii | UM ML              | F   | 36.3      | 94.82                  |
| P. t. verus      | MPI 06 25            | F   | 39        | 96.07                  |
| P. t. verus      | MPI 06 48            | M   | 40        | 110.54                 |

N=36

D. Specimen list for *Papio cynocephalus*

| Species          | Specimen # (OM/ABRP) | Sex | Age (yrs) | Mandibular arch length |
|------------------|----------------------|-----|-----------|------------------------|
| P. cynocephalus  | 8713/030             | M   | 1.6       | 57.13                  |
P. cynocephalus 8588/008  F  3.3  72.86
P. cynocephalus 8585/010  F  3.4  71.1
P. cynocephalus 8590/006  F  3.6  74.17
P. cynocephalus 8589/007  F  3.3  69.36
P. cynocephalus 8598/009  F  7.7  93.54
P. cynocephalus 8591/020  M  7.7  121.3
P. cynocephalus 8599/018  M  8.1  133.08
P. cynocephalus 8594/001  F  9.2  92.3
P. cynocephalus 8597/011  F  10.7  92.6
P. cynocephalus 8504/004  F  13.1  93.74
P. cynocephalus 8592/016  F  14.1  96.1
P. cynocephalus 8582/022  M  14.6  129.26
P. cynocephalus 8711/025  F  15.6  93.6
P. cynocephalus 8595/014  M  16.8  123.51
P. cynocephalus 8600/017  F  17.2  89.57
P. cynocephalus 8596/015  M  18.7  126.74

N=17

OM #: National Museums of Kenya catalogue number;
ABRP #: Amboseli Baboon Research Project catalogue number.

E. Specimen list for Macaca mulatta

| Species | Specimen #      | Sex | Age (yrs) | Mandibular arch length |
|---------|-----------------|-----|-----------|------------------------|
| M. mulatta | CPRCMUS-00484 | F   | 0.5       | 36.42                  |
| M. mulatta | CPRCMUS-00449 | F   | 0.6       | 39.55                  |
| M. mulatta | CPRCMUS-00474 | F   | 0.6       | 37.9                   |
| Species   | ID         | Sex | Age | Value |
|-----------|------------|-----|-----|-------|
| *M. mulatta* | CPRCMUS-00461 | F   | 0.6 | 39.59 |
| *M. mulatta* | CPRCMUS-00516 | F   | 0.6 | 38.28 |
| *M. mulatta* | CPRCMUS-00527 | F   | 0.7 | 39.7  |
| *M. mulatta* | CPRCMUS-00491 | M   | 0.7 | 38.92 |
| *M. mulatta* | CPRCMUS-00475 | M   | 0.8 | 41.21 |
| *M. mulatta* | CPRCMUS-00011 | F   | 0.9 | 42.31 |
| *M. mulatta* | CPRCMUS-00473 | M   | 0.9 | 42.12 |
| *M. mulatta* | CPRCMUS-00340 | M   | 0.9 | 41.48 |
| *M. mulatta* | CPRCMUS-00464 | M   | 1   | 43.18 |
| *M. mulatta* | CPRCMUS-00477 | F   | 1   | 39.94 |
| *M. mulatta* | CPRCMUS-00549 | M   | 1   | 44.16 |
| *M. mulatta* | CPRCMUS-00479 | M   | 1.1 | 40.05 |
| *M. mulatta* | CPRCMUS-00339 | M   | 1.1 | 43.51 |
| *M. mulatta* | CPRCMUS-00481 | F   | 1.1 | 41.85 |
| *M. mulatta* | CPRCMUS-00104 | M   | 1.2 | 46.23 |
| *M. mulatta* | CPRCMUS-00366 | F   | 1.2 | 42.73 |
| *M. mulatta* | CPRCMUS-00148 | M   | 1.5 | 47.54 |
| *M. mulatta* | CPRCMUS-00072 | F   | 1.6 | 48.05 |
| *M. mulatta* | CPRCMUS-00140 | F   | 1.6 | 49.4  |
| *M. mulatta* | CPRCMUS-00052 | F   | 1.6 | 46.62 |
| *M. mulatta* | CPRCMUS-00084 | F   | 1.7 | 46.73 |
| *M. mulatta* | CPRCMUS-00096 | F   | 1.7 | 50.04 |
| *M. mulatta* | CPRCMUS-00592 | M   | 1.7 | 49.23 |
| *M. mulatta* | CPRCMUS-00311 | F   | 1.9 | 47    |
| *M. mulatta* | CPRCMUS-03018 | M   | 1.9 | 48.35 |
| Species     | Catalog   | Gender | Age | Weight |
|-------------|-----------|--------|-----|--------|
| *M. mulatta*| CPRCMUS-00116 | M      | 2.2 | 51.19  |
| *M. mulatta*| CPRCMUS-00676 | M      | 2.5 | 55.04  |
| *M. mulatta*| CPRCMUS-00054 | F      | 2.5 | 51.89  |
| *M. mulatta*| CPRCMUS-00794 | M      | 2.5 | 48.93  |
| *M. mulatta*| CPRCMUS-00079 | F      | 2.8 | 48.23  |
| *M. mulatta*| CPRCMUS-00178 | F      | 2.8 | 54.13  |
| *M. mulatta*| CPRCMUS-00059 | M      | 2.9 | 53.08  |
| *M. mulatta*| CPRCMUS-00190 | M      | 3   | 55.68  |
| *M. mulatta*| CPRCMUS-00831 | M      | 3   | 57.16  |
| *M. mulatta*| CPRCMUS-00088 | F      | 3.1 | 58.27  |
| *M. mulatta*| CPRCMUS-00427 | M      | 3.1 | 57.15  |
| *M. mulatta*| CPRCMUS-00346 | F      | 3.1 | 53.15  |
| *M. mulatta*| CPRCMUS-00350 | F      | 3.3 | 57.84  |
| *M. mulatta*| CPRCMUS-00352 | F      | 3.4 | 50.2   |
| *M. mulatta*| CPRCMUS-00349 | F      | 3.4 | 54.26  |
| *M. mulatta*| CPRCMUS-00600 | M      | 3.7 | 58.53  |
| *M. mulatta*| CPRCMUS-00118 | M      | 3.8 | 70.09  |
| *M. mulatta*| CPRCMUS-00254 | M      | 3.9 | 62.51  |
| *M. mulatta*| CPRCMUS-00160 | F      | 4   | 56.64  |
| *M. mulatta*| CPRCMUS-00333 | M      | 4   | 65.04  |
| *M. mulatta*| CPRCMUS-00062 | F      | 4   | 58.45  |
| *M. mulatta*| CPRCMUS-00353 | F      | 4.1 | 60.43  |
| *M. mulatta*| CPRCMUS-00130 | F      | 4.2 | 62.06  |
| *M. mulatta*| CPRCMUS-00150 | M      | 4.7 | 70.8   |
| *M. mulatta*| CPRCMUS-00314 | M      | 4.7 | 65.66  |
| Species | Code          | Gender | Weight | Age  |
|---------|---------------|--------|--------|------|
| M. mulatta | CPRCMUS-00068 | M      | 4.9    | 67.35|
| M. mulatta | CPRCMUS-00044 | M      | 5.3    | 75.89|
| M. mulatta | CPRCMUS-00154 | M      | 5.7    | 74.35|
| M. mulatta | CPRCMUS-00060 | M      | 6.5    | 81.5 |
| M. mulatta | CPRCMUS-00032 | F      | 6.5    | 64.55|
| M. mulatta | CPRCMUS-00031 | M      | 7.9    | 77.92|
| M. mulatta | CPRCMUS-00163 | M      | 7.9    | 79.6 |
| M. mulatta | CPRCMUS-00361 | M      | 8.4    | 79.72|
| M. mulatta | CPRCMUS-00051 | F      | 8.6    | 66.43|
| Species     | Catalog   | Sex | Age | BMI   |
|-------------|-----------|-----|-----|-------|
| *M. mulatta*| CPRCMUS-00047 | F   | 8.6 | 65.92 |
| *M. mulatta*| CPRCMUS-00323 | M   | 8.6 | 83.09 |
| *M. mulatta*| CPRCMUS-00320 | M   | 8.8 | 83.45 |
| *M. mulatta*| CPRCMUS-00337 | M   | 9.4 | 79.13 |
| *M. mulatta*| CPRCMUS-00406 | F   | 9.5 | 70.99 |
| *M. mulatta*| CPRCMUS-00381 | M   | 9.6 | 80.62 |
| *M. mulatta*| CPRCMUS-00360 | M   | 9.7 | 85    |
| *M. mulatta*| CPRCMUS-00038 | F   | 10  | 70.64 |
| *M. mulatta*| CPRCMUS-00374 | F   | 10.4| 69.03 |
| *M. mulatta*| CPRCMUS-00383 | F   | 10.5| 68.51 |
| *M. mulatta*| CPRCMUS-00637 | F   | 10.6| 71.91 |
| *M. mulatta*| CPRCMUS-00596 | F   | 11  | 70.36 |
| *M. mulatta*| CPRCMUS-00597 | F   | 11.1| 73.71 |
| *M. mulatta*| CPRCMUS-00598 | F   | 11.4| 72.45 |
| *M. mulatta*| CPRCMUS-00382 | M   | 11.6| 83.09 |
| *M. mulatta*| CPRCMUS-00440 | F   | 12  | 71    |
| *M. mulatta*| CPRCMUS-00300 | M   | 12.2| 77.41 |
| *M. mulatta*| CPRCMUS-00326 | F   | 12.6| 70.16 |
| *M. mulatta*| CPRCMUS-00156 | M   | 12.7| 80.6  |
| *M. mulatta*| CPRCMUS-00672 | F   | 14.2| 73.8  |
| *M. mulatta*| CPRCMUS-00364 | M   | 14.5| 75.34 |
| *M. mulatta*| CPRCMUS-00620 | F   | 16.9| 78.12 |
| *M. mulatta*| CPRCMUS-00617 | F   | 17  | 69.47 |

\(N=104\)
Table S3. Summary statistics for adult male and female MAL values, and $t$-tests comparing sexes.

| Species       | Adult male | Adult female | Adult average |
|---------------|------------|--------------|---------------|
|               | n  | Mean (mm) | SD  | n  | Mean (mm) | SD  | $t$  | $p$-value | Mean (mm) |
| $G. beringei$ | 23 | 154.68    | 9.83 | 34 | 126.85    | 10.44 | 10.23 | $0.00$     | 140.77    |
| $H. sapiens$  | 14 | 81.71     | 4.95 | 12 | 77.31     | 4.81  | 2.30  | 0.05       | 79.51     |
| $P. troglodytes$ | 29 | 102.40    | 5.05 | 38 | 97.78     | 3.80  | 4.12  | $0.00$     | 100.09    |
| $M. mulatta$  | 28 | 77.58     | 4.76 | 30 | 68.26     | 4.12  | 7.95  | $0.00$     | 72.92     |
| $P. cynocephalus$ | 17 | 118.99    | 14.20 | 17 | 91.42     | 8.30  | 6.91  | $0.00$     | 105.21    |

Adult MAL data were calculated using the larger species samples (i.e., not only the known-age specimens).

Significant results ($p \leq 0.05$) listed in bold.
Table S4. Predictions of MAL growth rate and duration for species in this study based on model.

A. Comparisons of adult MAL and molar emergence ages between species

| Species comparison          | MAL* | Molar emergence ages** |
|-----------------------------|------|------------------------|
| G. beringei vs. H. sapiens  | >    | <                      |
| G. beringei vs. P. troglodytes | >    | =                      |
| H. sapiens vs. P. troglodytes | <    | >                      |
| H. sapiens vs. M. mulatta   | >    | >                      |
| P. troglodytes vs. M. mulatta | >    | >                      |
| G. beringei vs. M. mulatta  | >    | >                      |
| P. cynocephalus vs. M. mulatta | >    | >                      |
| P. cynocephalus vs. G. beringei | <    | <                      |
| P. cynocephalus vs. P. troglodytes | >    | <                      |
| P. cynocephalus vs. H. sapiens | >    | <                      |

B. Predictions based on model

| Species comparison          | Growth Rate Prediction | Growth Duration Prediction |
|-----------------------------|------------------------|---------------------------|
| G. beringei vs. H. sapiens  | >                      | <                         |
| G. beringei vs. P. troglodytes | >    | =                       |
| H. sapiens vs. P. troglodytes | <    | >                       |
| H. sapiens vs. M. mulatta   | <,=,>                 | >                         |
| P. troglodytes vs. M. mulatta | <,=,>   | >                       |
| G. beringei vs. M. mulatta  | <,=,>                 | >                         |
| P. cynocephalus vs. M. mulatta | <,=,>   | >                       |
| P. cynocephalus vs. G. beringei | <,=,>   | <                       |
| P. cynocephalus vs. P. troglodytes | <,=,>   | <                       |
| P. cynocephalus vs. H. sapiens | >    | <                       |

*Comparisons based on adult average MAL data in Table S3.
**Comparisons based on data in Table 1.
Table S5. Results of *t*-tests comparing Resultant-Molar to zero.

| Taxon                  | Dental emergence category | Mean  | Min.  | Max.  | t-statistic | df    | p-value |
|------------------------|---------------------------|-------|-------|-------|-------------|-------|---------|
| **Platyrrhini**        |                           |       |       |       |             |       |         |
| Alouatta palliata      | dp4                       | 15.48 | 12.27 | 18.54 | 23.19       | 9     | ***     |
|                        | M1                        | 15.01 | 12.50 | 18.16 | 27.33       | 9     | ***     |
|                        | M2                        | 15.34 | 11.00 | 15.25 | 28.87       | 9     | ***     |
|                        | M3                        | 9.34  | 4.28  | 14.19 | 14.67       | 19    | ***     |
| Ateles geoffroyi       | dp4                       | 17.73 | 16.00 | 19.54 | 42.80       | 6     | ***     |
|                        | M1                        | 17.68 | 15.00 | 19.88 | 36.84       | 9     | ***     |
|                        | M2                        | 15.78 | 13.41 | 20.73 | 21.55       | 9     | ***     |
|                        | M3                        | 15.94 | 14.02 | 18.41 | 51.74       | 19    | ***     |
| *Cebus apella*         | dp4                       | 16.95 | 13.08 | 29.80 | 10.06       | 9     | **      |
|                        | M1                        | 14.14 | 10.50 | 26.89 | 9.55        | 9     | **      |
|                        | M2                        | 12.30 | 6.71  | 17.97 | 8.23        | -     | -       |
|                        | M3                        | 19.83 | -5.70 | 44.23 | 8.62        | 29    | ***     |
| Saimiri sciureus       | dp4                       | 9.09  | 7.71  | 10.09 | 18.21       | -     | -       |
|                        | M1                        | 8.36  | 7.54  | 9.46  | 31.81       | 8     | ***     |
| *Cercopithecidae*      |                           |       |       |       |             |       |         |
| Colobus angolensis     | dp4                       | 16.15 | 10.53 | 19.85 | 16.87       | 9     | ***     |
|                        | M1                        | 17.57 | 15.31 | 19.29 | 31.94       | 8     | ***     |
|                        | M2                        | 17.40 | 13.97 | 20.00 | 32.94       | 9     | ***     |
|                        | M3                        | 18.05 | 12.75 | 22.90 | 36.09       | 18    | ***     |
| Colobus polykomos      | dp4                       | 15.22 | 14.84 | 15.81 | 51.49       | -     | -       |
|                        | M1                        | 15.12 | 13.82 | 17.16 | 22.98       | -     | -       |
|                        | M2                        | 16.40 | 13.62 | 19.00 | 24.58       | 7     | ***     |
|                        | M3                        | 15.24 | 11.55 | 18.82 | 37.24       | 19    | ***     |
| Procolobus verus       | M1                        | 15.21 | 12.90 | 17.56 | 19.52       | -     | -       |
|                        | M2                        | 12.69 | 10.67 | 15.02 | 22.00       | 6     | ***     |
|                        | M3                        | 12.05 | 10.20 | 15.00 | 34.41       | 18    | ***     |
| Macaca fascicularis    | dp4                       | 14.67 | 11.10 | 19.59 | 19.87       | 9     | ***     |
|                        | M1                        | 15.87 | 11.26 | 18.92 | 24.76       | 9     | ***     |
|                        | M2                        | 17.22 | 14.08 | 20.01 | 23.63       | 7     | ***     |
|                        | M3                        | 15.20 | 11.36 | 20.76 | 19.70       | 15    | ***     |
| Macaca mulatta         | dp4                       | 15.90 | 11.81 | 21.34 | 37.51       | 27    | ***     |
|                        | M1                        | 17.61 | 13.37 | 22.76 | 37.35       | 32    | ***     |
|                        | M2                        | 19.06 | 13.11 | 26.10 | 30.89       | 30    | ***     |
|                        | M3                        | 16.60 | 11.42 | 21.28 | 44.64       | 57    | ***     |
| Papio anubis           | dp4                       | 26.46 | 20.28 | 32.02 | 22.66       | 9     | ***     |
|                        | M1                        | 28.89 | 20.36 | 38.51 | 17.46       | 9     | ***     |
|                        | M2                        | 32.91 | 23.45 | 44.20 | 15.05       | 9     | ***     |
|                        | M3                        | 37.71 | 26.18 | 50.27 | 32.19       | 27    | ***     |
| Species                  | dp4   | 15.37 | 24.56 | 27.63 | 11   | *** |
|-------------------------|-------|-------|-------|-------|------|-----|
| Papio cynocephalus      |       |       |       |       |      |     |
| M1                      | 26.17 | 21.22 | 36.56 | 15.72 | 9    | *** |
| M2                      | 27.47 | 19.38 | 38.77 | 20.21 | 16   | *** |
| M3                      | 27.49 | 16.02 | 38.14 | 25.98 | 33   | *** |
| Hominidae               |       |       |       |       |      |     |
| Gorilla beringei        | dp4   | 30.82 | 43.86 | 33.35 | 15   | *** |
| M1                      | 36.17 | 21.22 | 50.93 | 20.93 | 13   | *** |
| M2                      | 32.37 | 24.62 | 39.57 | 20.21 | 16   | *** |
| M3                      | 27.59 | 0.43  | 56.28 | 18.66 | 56   | *** |
| Gorilla gorilla         | dp4   | 22.06 | 43.69 | 22.23 | 9    | **  |
| M1                      | 28.63 | 46.46 | 22.14 | 21.24 | 8    | *** |
| M2                      | 29.96 | 22.93 | 38.09 | 12.24 | -    | -   |
| M3                      | 22.60 | 7.69  | 44.57 | 15.14 |     |     |
| Homo sapiens            | dp4   | 18.31 | 26.40 | 62.82 | 24   | *** |
| M1                      | 16.13 | 10.11 | 21.13 | 30.89 | 30   | *** |
| M2                      | 11.38 | -1.73 | 17.27 | 19.54 | 49   | *** |
| Pan paniscus            | dp4   | 23.10 | 23.69 | 35.18 | 28.21 | *** |
| M1                      | 16.28 | 13.64 | 22.69 | 24.71 | 11   | *** |
| M2                      | 14.53 | 6.44  | 20.44 | 20.44 | 20   | *** |
| Pan troglodytes         | dp4   | 22.29 | 16.20 | 20.17 | 8    | *** |
| M1                      | 26.47 | 20.54 | 36.76 | 15.37 | 10   | *** |
| M2                      | 19.70 | 12.26 | 30.44 | 11.40 | 11   | *** |
| M3                      | 16.00 | 3.96  | 38.68 | 7.89  | 18   | *** |
| Pongo pygmaeus          |       |       |       |       |      |     |
| Strepsirrhini           | M1    | 17.98 | 17.01 | 18.95 | 18.54 | -   |
| Eulemur mongoz          | M3    | 15.47 | 11.86 | 19.25 | 22.52 | 12  |
| Lemur catta             | dp4   | 11.95 | 7.70  | 15.74 | 5.12  | -   |
| M2                      | 19.19 | 14.03 | 22.86 | 11.15 | -    | -   |
| M3                      | 16.28 | 12.92 | 20.47 | 26.10 | 17   | *** |
| Otolemur monteiri       | dp4   | 6.82  | 5.49  | 8.06  | 9.18  | -   |
| M1                      | 14.27 | 12.75 | 15.07 | 18.76 | -    | -   |
| M3                      | 13.24 | 5.55  | 20.29 | 23.46 | 30   | *** |
| Perodicticus potto      | dp4   | 10.10 | 9.25  | 10.95 | 11.86 | -   |
| M1                      | 11.23 | 5.84  | 13.90 | 12.16 | 7    | **  |
| M2                      | 13.20 | 10.10 | 16.86 | 18.40 | 7    | *** |
| M3                      | 11.91 | 4.90  | 18.69 | 16.01 | 19   | *** |

*p<0.000758, **p<0.00001, ***p<0.000001
Tests were not performed on samples that contained less than seven individuals, indicated by a dash.
Table S6. ANCOVA results comparing slopes between species.

| Species comparison                  | F-value | p-value |
|-------------------------------------|---------|---------|
| G. beringei vs. H. sapiens          | 53.920  | <0.000  |
| G. beringei vs. P. troglodytes      | 0.597   | 0.449   |
| H. sapiens vs. P. troglodytes       | 53.340  | <0.000  |
| H. sapiens vs. M. mulatta           | 285.760 | <0.000  |
| P. troglodytes vs. M. mulatta       | 34.073  | <0.000  |
| G. beringei vs. M. mulatta          | 17.890  | <0.000  |
| P. cynocephalus vs. M. mulatta      | 0.991   | 0.323   |
| P. cynocephalus vs. G. beringei     | 2.035   | 0.181   |
| P. cynocephalus vs. P. troglodytes  | 3.155   | 0.096   |
| P. cynocephalus vs. H. sapiens      | 7.606   | 0.007   |

Significant results (p≤0.05) listed in bold.
Table S7. PGLS results, Maximum Likelihood lambda.

| Response variable       | ML lambda | Slope  | $R^2$ | $p$-value |
|-------------------------|-----------|--------|-------|-----------|
| MAL growth rate         | 0.00      | 0.25   | 0.78  | 0.031     |
| MAL growth cessation    | 0.00      | -0.60  | 0.78  | 0.030     |

Significant results ($p \leq 0.05$) are in bold.
| Landmark # | Landmark description                                                                 |
|-----------|-------------------------------------------------------------------------------------|
| 1         | Left center of articular eminence*                                                  |
| 2         | Left inferior edge of zygomatic arch at the zygomaticotemporal suture                |
| 3         | Left inferior edge of zygomatic arch at the anteriormost point of origin of the superficial masseter |
| 4         | Left intersection of temporal line and frontozygomatic suture                       |
| 5         | Left pterion                                                                         |
| 6         | Left center of medial surface of lateral pterygoid plate                             |
| 7         | Right center of medial surface of lateral pterygoid plate                            |
| 8         | Right pterion                                                                        |
| 9         | Right intersection of temporal line and frontozygomatic suture                      |
| 10        | Right inferior edge of zygomatic arch at the anteriormost point of origin of the superficial masseter |
| 11        | Right inferior edge of zygomatic arch at the zygomaticotemporal suture              |
| 12        | Right center of articular eminence*                                                  |
| 13        | Left center of trigon basin of M³                                                   |
| 14        | Left center of trigon basin of M²                                                    |
| 15        | Left center of trigon basin of M¹                                                   |
| 16        | Left center of trigon basin of P⁴/dp⁴                                              |
| 17        | Left center of trigon basin of P³/dp³                                               |
| 18        | Right center of trigon basin of P³/dp³                                              |
| 19        | Right center of trigon basin of P⁴/dp⁴                                              |
| 20        | Right center of trigon basin of M¹                                                   |
| 21        | Right center of trigon basin of M²                                                    |
| 22        | Right center of trigon basin of M³                                                   |
| 23        | Left coronion                                                                        |
| 24        | Left centroid† of insertion of superficial masseter on lateral ramus                 |
| 25        | Left centroid of insertion of medial pterygoid on medial angle of mandible          |
| 26        | Right centroid of insertion of medial pterygoid on medial angle of mandible          |
| 27        | Right centroid† of insertion of superficial masseter on lateral ramus                |
| 28        | Right coronion                                                                       |
| 29        | Infraorale (midline point at apex of septum between central mandibular incisors)     |
| 30        | Left distal to I₁/i₁ alveolar border                                                 |
| 31        | Left distal to I₂/i₂ alveolar border                                                 |
| 32        | Left distal to C/c alveolar border                                                   |
33 Left distal to P₂/dp₂ alveolar border
34 Left distal to P₃/dp₃ alveolar border
35 Left distal to P₄/dp₄ alveolar border
36 Left distal to M₁ alveolar border
37 Left distal to M₂ alveolar border
38 Left distal to M₃ alveolar border

*Center of articular eminence was determined as the midpoint of the line connecting the entoglenoid process and the articular tubercle.
†Centroid of insertion of superficial masseter on lateral ramus was determined as the intersection of two lines: the first, a line between the lowest point of the mandibular notch and the base of the mandible, parallel to the posterior border of the ramus, and the second, a line at the midpoint of, and perpendicular to, the first line.
Centroids of other muscle attachment points were determined by visually inspecting the site of attachment.
Table S9. Landmarks used to establish mechanical and anatomical planes.

| Plane                      | Dental Emergence Category | Landmarks          |
|----------------------------|---------------------------|--------------------|
| Triangle of Support (TOS) Plane | M3 emerged                | Left: 1, 12, 13, Right: 1, 12, 22 |
|                            | M2 emerged                | Left: 1, 12, 14, Right: 1, 12, 21 |
|                            | M1 emerged                | Left: 1, 12, 15, Right: 1, 12, 20 |
|                            | dp4 emerged               | Left: 1, 12, 16, Right: 1, 12, 19 |
| Occlusal Plane             | M3 emerged                | Left: 13, 22, 17, Right: 13, 22, 18 |
|                            | M2 emerged                | Left: 14, 21, 17, Right: 14, 21, 18 |
|                            | M1 emerged                | Left: 15, 20, 17, Right: 15, 20, 18 |
|                            | dp4 emerged               | Left: 16, 19, 17, Right: 16, 19, 18 |
| Species                  | BW (g) | Source | GL (days) | Source | AFR (yrs) | Source | IBI (yrs) | Source |
|-------------------------|--------|--------|-----------|--------|-----------|--------|-----------|--------|
| *Gorilla beringei*      | 457.3  | 82     | 258\(^i\)| 83     | 9.5\(^{**}\) | 84     | 3.48\(^{f}\) | 84     |
| *Homo sapiens*\(^\#\)  | 1228   | 82     | 537       | 82     | 14.5      | 82     | 4.12      | 84     |
| *Pan troglodytes*       | 380    | 82     | 225\(^{\#}\) | 83     | 13.6\(^*\) | 85     | 5.7\(^*\) | 85     |
| *Macaca mulatta*        | 84.7   | 82     | 164.5     | 82     | 4.27\(^{\dagger}\) | 86     | 1.18\(^{\dagger}\) | 88     |
| *Papio cynocephalus*    | 164    | 82     | 178       | 83     | 5.82      | 87     | 1.69      | 84     |

Brain weight (BW), gestation length (GL), age at first reproduction (AFR), and interbirth interval (IBI).

* Data averaged for Gombe and Taï chimpanzees.
** AFR datum for mountain gorillas is the midpoint of the range provided in citation (9-10 yrs.).
\(^f\) Data for Karisoke mountain gorillas.
\(^\#\) Data for Gombe chimpanzees.
\(^\dagger\) Data for Cayo Santiago rhesus macaques.
\(^\|$\) Data for humans are means from several populations, as reported in 82, except the IBI datum, which is for the Dobe !Kung.
Table S11. Segmented regression results.

| Species       | $R^2$ | Breakpoint | St. Err | AIC (Breakpoint model) | AIC (OLS model) |
|---------------|-------|------------|---------|------------------------|-----------------|
| *G. beringei* | 0.80  | 17.00      | 3.78    | 175.84                 | 184.80          |
| *H. sapiens*  | 0.75  | 22.00      | 1.20    | 553.15                 | 586.87          |
| *P. troglodytes* | 0.87 | 12.46      | 0.87    | 224.36                 | 270.97          |
| *M. mulatta*  | 0.90  | 6.74       | 0.30    | 597.48                 | 708.95          |
| *P. cynocephalus* | 0.52 | 7.50       | 5.74    | 153.86                 | 152.77          |

Breakpoint = *MAL* growth cessation
| Species          | Slope | 95% CI slope (lower bound) | 95% CI slope (upper bound) | $R^2$ | $p$-value |
|------------------|-------|----------------------------|---------------------------|------|-----------|
| *G. beringei*    | 4.043 | 2.945                      | 5.141                     | 0.89 | <0.001    |
| *H. sapiens*     | 1.203 | 1.048                      | 1.358                     | 0.75 | <0.001    |
| *P. troglodytes* | 3.601 | 2.846                      | 4.356                     | 0.89 | <0.001    |
| *M. mulatta*     | 5.916 | 5.407                      | 6.424                     | 0.89 | <0.001    |
| *P. cynocephalus*| 8.236 | 5.218                      | 11.254                    | 0.94 | 0.003     |

Significant results ($p \leq 0.05$) are in bold.
Table S13. Evaluation of whether results conform to predictions.

|                | Slope comparison | Consistent with prediction? | Growth cessation comparison | Consistent with prediction? |
|----------------|------------------|-----------------------------|-----------------------------|-----------------------------|
| *G. beringei* vs. *H. sapiens* | >        | Yes                         | <                           | Yes                         |
| *G. beringei* vs. *P. troglodytes* | =        | No                          | >                           | No                          |
| *H. sapiens* vs. *P. troglodytes* | <        | Yes                         | >                           | Yes                         |
| *H. sapiens* vs. *M. mulatta* | <        | Yes                         | >                           | Yes                         |
| *P. troglodytes* vs. *M. mulatta* | <        | Yes                         | >                           | Yes                         |
| *G. beringei* vs. *M. mulatta* | <        | Yes                         | >                           | Yes                         |
| *P. cynocephalus* vs. *M. mulatta* | =        | Yes                         | >                           | Yes                         |
| *P. cynocephalus* vs. *G. beringei* | =        | Yes                         | <                           | Yes                         |
| *P. cynocephalus* vs. *P. troglodytes* | = | Yes                         | <                           | Yes                         |
| *P. cynocephalus* vs. *H. sapiens* | >        | Yes                         | <                           | Yes                         |
Table S14. Phylogenetic PCA results.

A. Lambda

| Lambda |
|--------|
| 0.00   |

B. Eigenvalues

|       | PC1    | PC2    | PC3    | PC4    |
|-------|--------|--------|--------|--------|
|        | 3.2115 | 0.7857 | 0.0022 | 0.0006 |

C. Variance explained

|       | PC1    | PC2    | PC3    | PC4    |
|-------|--------|--------|--------|--------|
|        | 0.8029 | 0.1964 | 0.0006 | 0.0002 |

D. Eigenvector loadings

| Variable                  | PC1    | PC2    | PC3    | PC4    |
|---------------------------|--------|--------|--------|--------|
| Brain weight              | -0.9300| -0.3666| 0.0231 | -0.0143|
| Age at first reproduction | -0.9620| 0.2708 | -0.0333| -0.0087|
| Gestation length          | -0.8918| -0.4521| -0.0082| 0.0172 |
| Interbirth interval       | -0.7911| 0.6113 | 0.0226 | 0.0080 |
Table S15. PGLS results bracketing lambda between 0 and 1.

| Response variable          | Lambda | Slope | R²  | p-value |
|---------------------------|--------|-------|-----|---------|
| MAL growth rate           | 0.00   | 0.25  | 0.78| 0.031   |
| MAL growth rate           | 1.00   | 0.22  | 0.61| 0.073   |
| MAL growth cessation      | 0.00   | -0.60 | 0.78| **0.030**|
| MAL growth cessation      | 1.00   | -0.59 | 0.54| 0.096   |

Significant results (p≤0.05) listed in bold.
**Data S1. Glowacka and Schwartz R Code.R**
R code to run all analyses.

**Data S2. Cebus apella M3.txt**
Example text file containing landmark (x, y, z) data for one adult *Cebus (Sapajus)* apella specimen. To be used with R code.

**Data S3. CLM results.txt**
Text file containing measured d_TMJ_MLA_occlusal, TMJ_Molar_occlusal, Resultant_Molar, and Mandibular_arch_length data for t-tests. To be used with R code.

**Data S4. Known-age data.txt**
Text file containing measured d_TMJ_MLA_occlusal, Resultant_Molar, and Mandibular_arch_length data for known-age individuals for segmented regression, OLS regressions, and ANCOVA analyses. To be used with R code.

**Data S5. Life history data.txt**
Text file containing life history data from table S10 for pPCA analysis. To be used in R code.

**Data S6. Tree.nex**
Nexus file containing phylogenetic tree downloaded from 10kTrees for five species in pPCA and PGLS analyses. To be used in R code.

**Data S7. PGLS data.txt**
Text file containing PC1 scores, MAL growth rate (slope) and MAL growth cessation (Breakpoint) data for PGLS analysis. To be used in R code.
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