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Intraspecific Analysis of Cerebral, Neurobasicranial, Mandibular, & Dental Integration: a Test of Anatomic Relationships among Superinferior Features of the Adult Modern Human Skull

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Background & Significance

•Patterns of evolutionary change show a marked increase in brain growth over the past 200,000 to 300,000 years, with a reduction in facial projection, mandibular, and dental characteristics.

•The American Association of Oral and Maxillofacial Surgeons estimates 85% of people will need to have wisdom teeth removed to prevent complications at some point in their life. (Cooper 2007).

•Genes that control quantity of teeth evolve independently from those controlling brain development (Main 2015).

•10-25% of Americans born missing one or more of their third molars with variation among other modern human groups (Main 2007).

Hypothesis 1:

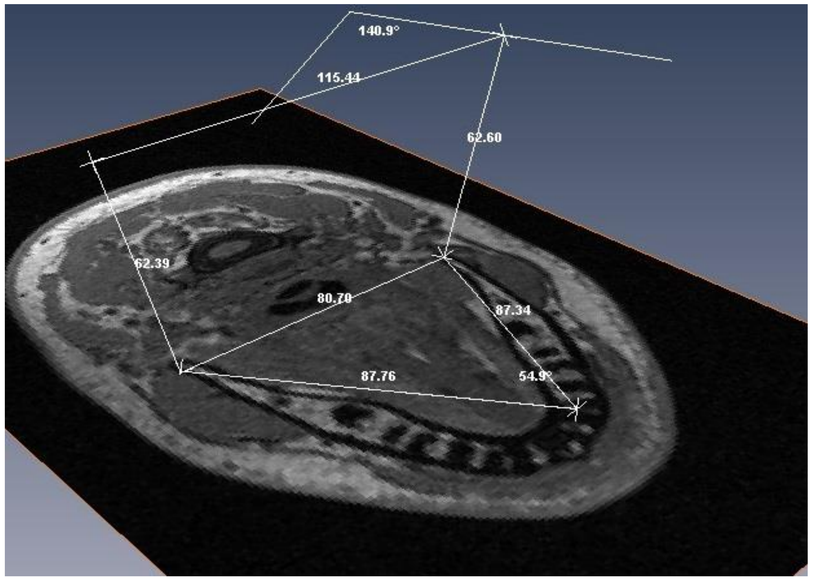
Increased frontal, temporal, and overall brain volume correlates with reduced mandibular ramus volume, reduced surface area of mandibular M1-M2.

Hypothesis 2:

Increased neurocranial metrics correlate with reduced mandibular ramus volume, and reduced surface area of mandibular M1-M2.

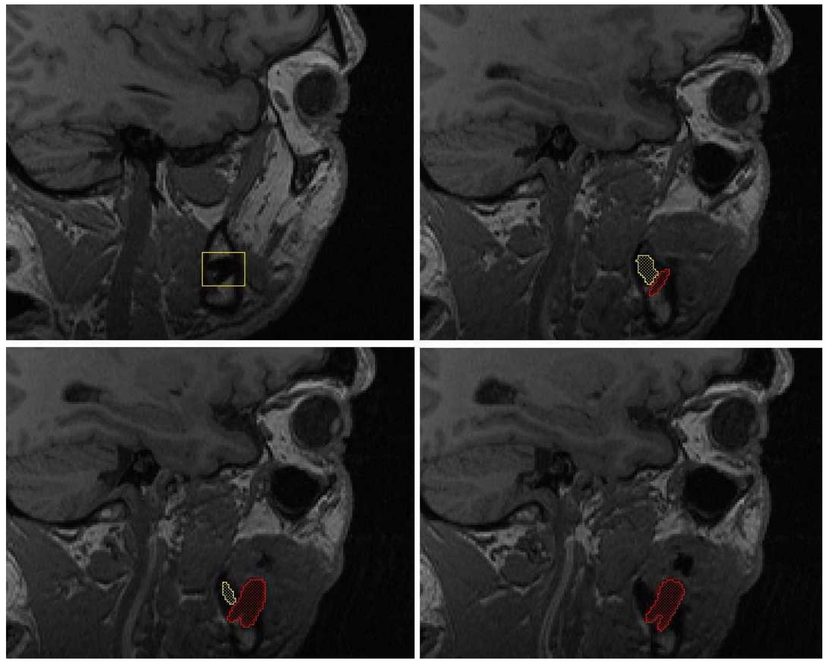
Methods

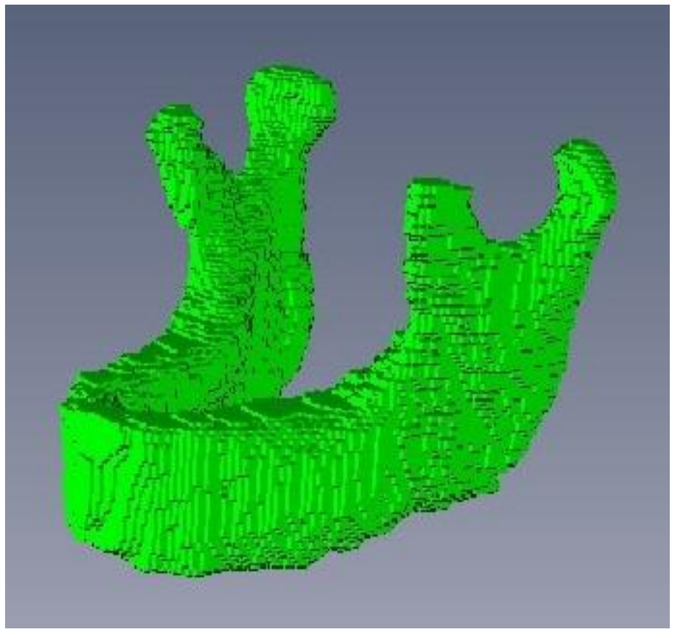
- Collected linear and volumetric measurements of mandibular and dental features from 51 individuals.
- Performed multiple regression analyses of cerebral and craniofacial measurements to test relationship among dental, cerebral, and craniofacial features
- Body height was used as a continuous predictor in each analysis to factor for overall size.



Results

Ho: 1 - Upper and Lower Craniofacial Integration	GEO Mean of Mandible	Ramus Volume	Mandibular Volume	basicranial angle	Total SA 1st 2nd Molar
Total Frontal Volume	F(47)=7.32,p=0.01	X	X	X	X
Total Occipital Gyrus	F(47)=5.48,p=0.02	X	X	X	X
Total Orbitofrontal	F(47)=12.54,p<0.01	F(48)=3.00,p=0.090	F(19)=3.89,p=0.063	X	X
Total Temporal Gyrus	F(47)=14.40,p<0.01	F(48)=3.98,p=0.05	F(19)=5.03,p=0.037	X	F(37)=4.66,p=0.037
Total Brain Volume	F(46) = 9.98, p < 0.01	F(47)=1.11, p=0.30	F(19)=2.03, p=0.17	X	F(37)=2.39, p=0.13
Ho: 2 - Upper and Lower Craniofacial Integration	GEO Mean of Mandible	Ramus Volume	Mandibular Volume	basicranial angle	Total SA 1st 2nd Molar
Anterior Cranial Base Length	X	x	X	X	X
Basicranial Angle	X	X	X	X	X
Basion-Prosthion Height	F(46)=11.70,p<0.01	F(47)=14.52,p<0.01	F(19)=19.67,p<0.01	F(47)=16.85p<0.01	F(47)=8.46, p<0.01
Geometric Mean of Neurocranium	F(46)=19.12,p<0.01	F(47)=10.03,p<0.01	F(19)=3.67,p=0.070	F(47)=2.88,p=0.10	F(36)=3.92,p=0.05
Nasion-Prosthion Height (Upper Facial Height)	X	X	X	X	X





Conclusion

The Geometric Mean of the three primary mandibular measures (height, length, breadth) are positively correlated with total temporal, frontal, and overall brain volume. The Temporal and Orbitofrontal regions of the brain showed the highest F value indicating that the more proximal the brain region is to the mandible, the greater the correlation. The null hypothesis could not be rejected at $\alpha = 0.05$ indicating that, although human evolutionary patterns show a negative correlation between neurobasicranial, mandibular, and dental traits, an intraspecific analysis reveals a positive anatomic relationship occurs in modern humans which could help explain numerous dental and mandibular problems exhibited in modern humans, such as dental crowding due to the lack of mandibular area and presence of a third molar.

Acknowledgments

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