A Morphometric Study on the Skull of Donkey (*Equus asinus*)

Estudio Morfométrico del Cráneo del Burro (*Equus asinus*)

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SUMMARY: The present study was carried out on a number of 16 skulls of adult male domestic donkeys. Craniometric measurements for 40 different parts of the skulls were made. All investigated features were expressed as Mean±SD. Cephalic indices and ratios were calculated by using the investigated features. The craniometric measurements and cephalic indices had been compared with those of local horses and ponies. A skull length of 443.07±53.57 mm and a maximum zygomatic width of 169.09±17.64 mm were obtained. The size of donkey skull was between those of local horses and ponies. A skull index of 38.23±0.85, a cranial index of 45.01±2.83 and a facial index of 67.80±3.79 were obtained. Cranial index and skull index were found to be close in value to that of local horses and ponies. The results of this study revealed that donkey had a longer nose than local horse and pony, and the difference of skull length in the three species accounted for the facial length difference.

KEY WORDS: Skull; Donkey; Craniometry.

INTRODUCTION

Donkey belongs to the family Equidae and is similar to horse in many ways. However, donkey is not just a smaller inferior type of horse, such as longer ears and short upright mane (Burnham, 2002). The knowledge of morphometric measurements of skull is of great importance for surgical treatment of pathological conditions and taxonomic affiliation. Previous studies on the skull shapes of animals measured directly from bare skulls (Simoens *et al*., 1994; Onar *et al*., 2001; Al-Sagair & ElMougy, 2002; Özcan *et al*., 2010; Zhu, 2012). Evans & Mcgreevy (2006) established a method for evaluating equine skull morphology that could also be used in live horses. Radinsky (1984) considered the ontogeny and phylogeny in horse skull evolution.

As a main source of work power and meat, donkey is an important domestic breed in high-altitude areas like Yunnan-Guizhou Plateau. Donkeys in Yunnan (a province in Southwest China) are less than 36 inches at the withers, and are identified as miniature donkey. No study on the craniometry of donkey has been reported, and this study was undertaken to establish a baseline data on the morphometric measurements of donkey skull. The skull indices and ratios were calculated and compared with the ones of local horses and ponies reported by Jie (1995). This may demonstrate the differences between the skulls of donkeys and horses.

MATERIAL AND METHOD

Sixteen skulls of adult male donkeys were used in this study. These heads were selected from an abattoir based on good health conditions and without any skeletal deformities. The skulls were macerated in accordance with the method described by Simoens *et al*. and Onar *et al*. Forty different craniometrical parameters were recorded with the help of measuring scale and thread vernier calipers. These measurements were made by using the methods described by Onar *et al*., Özcan *et al*. and Zhu. All investigated parameters were expressed as mean±SD. Definitions of measuring points of cranium were those described by Zhu. The following measurements of the cranium were made (Figs. 1–4): skull length: prosthion-akrokranion, facial length: prosthion-frontal midpoint, upper neurocranium length: frontal midpoint-akrokranion, viscerocranial length: prosthion-nasion, cranial length: nasion-akrokranion, short upper cranium length: rhinion-akrokranion, greatest length of nasals: the crossline of the two sides of the nasal bones– rhinion, nasal suture length: rhinion-nasion, least breadth between the infraorbital foramen, least breadth between the orbits: entorbitale - entorbitale, least breadth between the supraorbital foramen, least frontal breadth: breadth at the postorbital constriction, greatest neurocranium breadth: euryon- euryon, greatest breadth between the orbits: ectorbitale- ectorbitale, greatest breadth across the nasals,

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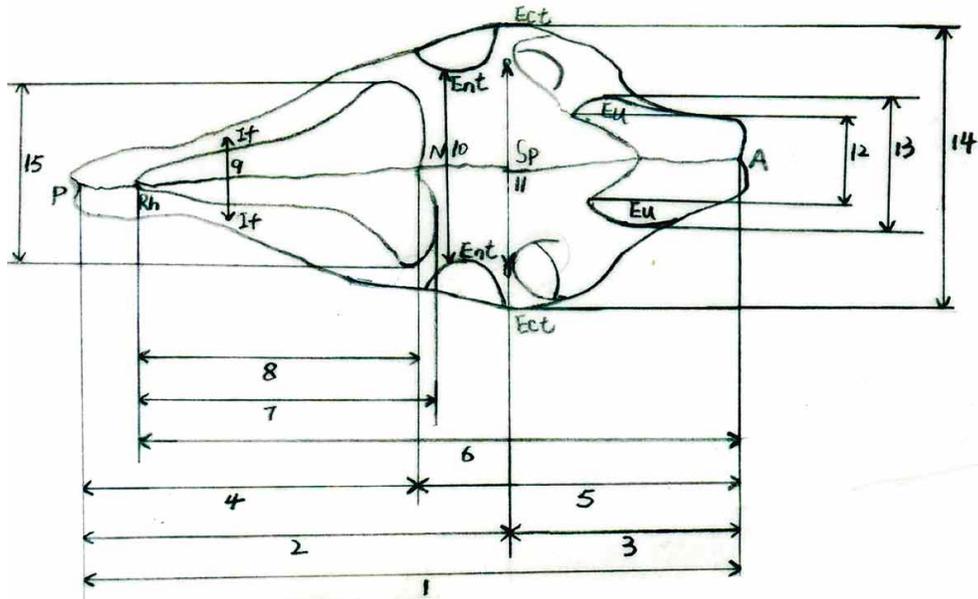
Fig. 1. Measurements of the skull of the donkey (dorsal view). A: Akrokranion, Ect: Ectorbitale, Ent: Entorbitale, Eu: Euryon, If: Infraorbitale, N: Nasion, P: Prosthion, Rh: Rhinion, Sp: Supraorbitale. 1: skull length, 2: facial length, 3: upper neurocranium length, 4: viscerocranium length, 5: Cranial length, 6: short upper cranium length, 7: greatest length of nasals, 8: nasal suture length, 9: greatest breadth across the premaxillae, 10: least breadth between the orbits, 11: least breadth between the infraorbital foramen, 12: least frontal breadth, 13: greatest neurocranium breadth, 14: greatest breadth between the orbits 15: greatest breadth across the nasals.
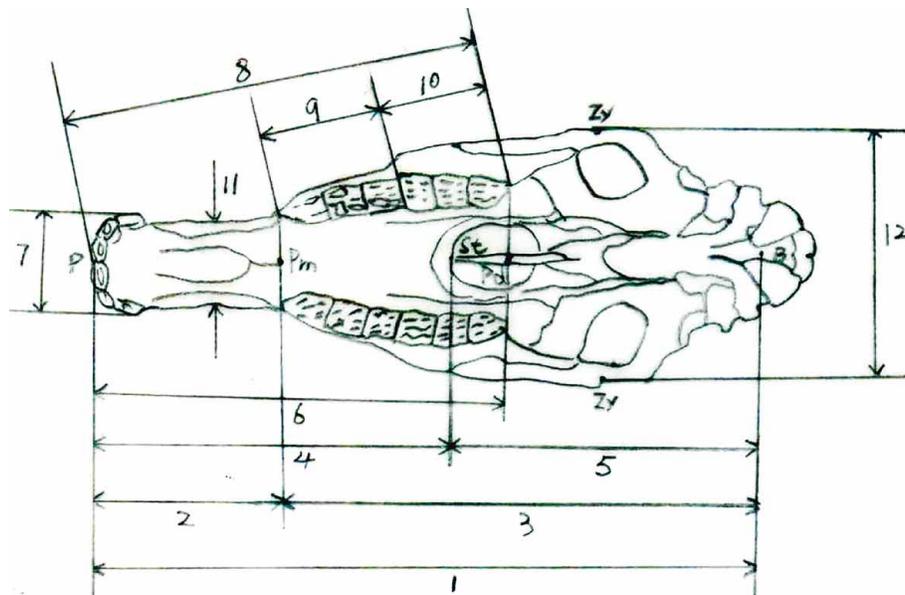

Fig. 2. Measurements of the skull of the donkey (ventral view). B: Basion, P: Prosthion, Pd: Postdentale, Pm: Premolare, St:Staphylion Zy: Zygion. 1: basal length, 2: premolare-prosthion, 3: short skull length, 4: median palatal length, 5: Basion- Staphylion, 6: palatal length, 7: Greatest breadth of snout 8: length of the tooth row, 9: length of the premolar row, 10: length of the molar row, 11: least breadth in the region of the diastema, 12: maximum zygomatic breadth.
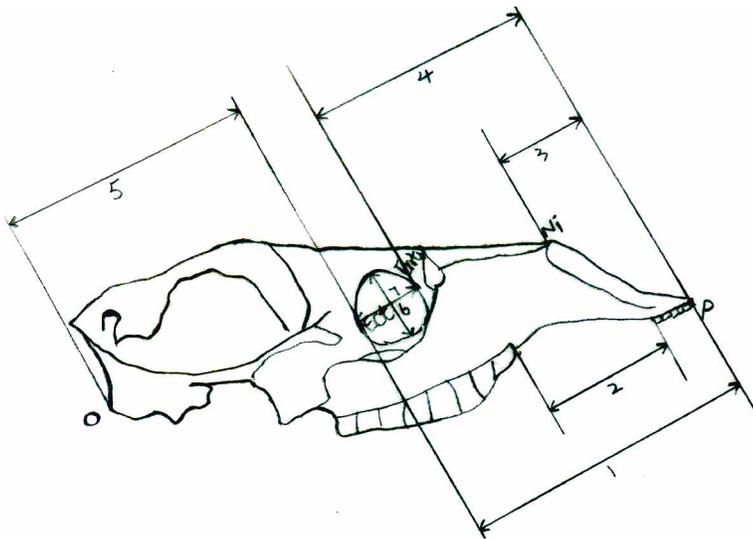
Fig. 3. Measurements of the skull of the donkey (lateral view). B: Basion, Ect: Ectorbitale, Ent: Entorbitale, Ni: Nasointermaxillare, P: Prosthion. 1: lateral facial length, 2: length of the diastema, 3: lateral length of the premaxilla, 4: short later facial length, 5: length of the braincase, 6: greatest inner length of the orbit, 7: greatest inner height of the orbit.
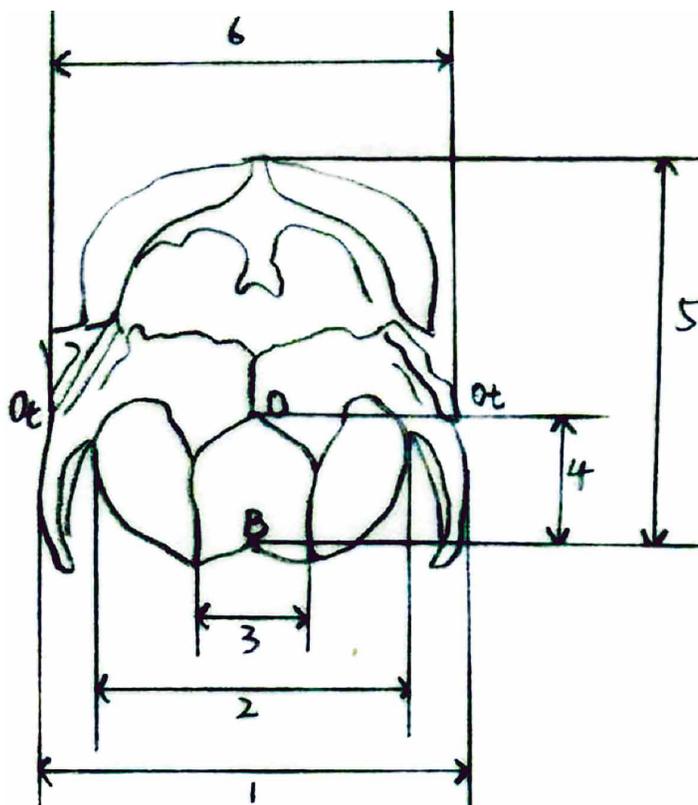

Fig. 4. Measurements of the skull of the donkey (occipital view). B: Basion, O: Opisthion, Ot: Otion. 1: greatest breadth of the bases of the paraoccipital processes, 2: Greatest breadth of the occipital condyles 3: greatest breadth of the foramen magnum, 4: height of the foramen magnum, 5: Skull height, 6: greatest mastoid breadth.

basal length: prosthion- basion, premolare- prosthion, short skull length: premolare – basion, median palatal length: prosthion- staphylion, basion- staphylion, palatal length?the median point of the intersection of the line joining the deepest indentations of the choana- prosthion, greatest breadth of snout, length of the tooth row, length of the premolar row, length of the molar row, least breadth in the region of the diastema, maximum zygomatic breadth: zygion- zygion, lateral facial length: prosthion- ectorbitale, length of the diastema, lateral length of the premaxilla: prosthion- nisointermaxillare, short later facial length: prosthion- entorbitale, length of the braincase: ectorbitale-opisthion, greatest inner length of the orbit, greatest inner height of the orbit, greatest breadth of the bases of the paraoccipital processes, greatest breadth of the occipital condyles, greatest breadth of the foramen magnum, height of the foramen magnum, skull height: basion-external occipital crest, greatest mastoid breadth: otion-otion.

The cephalic indices and ratios were calculated as described by Onar *et al*. Skull index: Maximum zygomatic width X100/ skull length, Cranial index: Maximum width of the neurocranium X100/cranial length, Facial index: Maximum zygomatic width X100/ Viscerocranial length.

RESULTS AND DISCUSSION

The craniometric measurements of donkey skulls were evaluated. The Mean±SE of the investigated features were presented in Table I. These craniometric measurements were compared with the literature about local horses and ponies reported by Jie. A skull length of 443.07±53.57 mm and a maximum zygomatic width of 169.09±17.64 mm were obtained. The skull length and maximum zygomatic width of local horse were 468.33±9.83mm and 175.12±9.35 mm, and those of ponies were 415.83±13.93 mm and 159.10±12.54 mm. This revealed that the size of the skull of donkey was between those of the local horse and pony. Radinsky and Evans & Mcgreevy argued that when evaluating skull length for comparison, it was important to consider the skull as being composed of two major components: the cranial portion and the nasal portion. The facial lengths of local horse, donkey and pony were 381.67±23.46 mm, 302.64±43.09 mm and 286.67±0.53 mm; the cranial lengths were 207.82±22.2 mm, 205.33±6.6 mm and 203.00±7.94 mm. These revealed that the face length of donkey was between those of local horses and ponies, and the difference of the skull length in the three species accounted for the facial length difference.

Evans & Mcgreevy investigated that the skull length and maximum zygomatic width of three popular equine breeds (standardbred, thoroughbred and Arabian) were 476±38.86 mm and 163.7±14.20 mm, and they used the distance of the dorsal lateral nasal cartilages to the external occipital protuberance as the skull length, so the skull length of these breeds would be longer than the data in their article if they used measure points in this study. This revealed that donkey had a shorter but wider skull than the popular equine breeds.

The maximum lengths of the nasals of donkey, horse and pony were 207.34±35.07 mm, 186.97±11.88 mm and 167.33±10.13 mm respectively. This revealed that donkey had a longer nose than local horses and ponies. Evans & Mcgreevy and Ozcan *et al.*, used the nasion-rhinion as the greatest length of the nasals, but the authors used the crossline of two sides of

Table I. The mean value of skull measurements of the adult domestic donkey (mm).

Measurements of the cranium	Mean±SD
Skull length	443.07±53.57
Facial length	302.64±43.09
Upper neurocranium length	159.11±15.75
Viscerocranium length	250.92±37.44
Cranial length	207.82±22.2
Short upper cranium length	386.77±51.95
Greatest length of the nasals	207.34±35.07
Nasal suture length	192.08±31.41
Least breadth between the infraorbital foramen	70.21±6.61
Least breadth between the orbits	125.47±13.97
Least breadth between the supraorbital foramen	116.62 ±14.11
Least frontal breadth	75.88±5.39
Greatest neurocranium breadth	93.06±5.80
Greatest breadth between the orbits	128.61±12.96
Greatest breadth across the nasals	94.34±10.48
Basal length	389.24±49.11
Premolare-prosthion	99.88±16.57
Short skull length	325.26±64.64
Median palatal length	204.11±27.00
Basion- Staphylion	190.61±17.27
Palatal length	239.82±33.81
Greatest breadth of the snout	49.42±6.69
Length of the tooth row	144.55±16.58
Length of the premolar row	75.76±12.71
Length of the molar row	70.34±7.60
Least breadth in the region of the diastema	38.98±4.37
Maximum zygomatic width	169.09±17.64
Lateral facial length	277.54±43.94
Length of the diastema	69.45±15.59
Lateral length of the premaxilla	140.14±19.27
Short lateral facial length	263.99±42.78
Length of braincase	187.71±28.57
Greatest inner length of the orbit	53.13±5.26
Greatest inner height of the orbit	47.72±4.53
Greatest breadth of the bases of the paraoccipital process	90.85±9.47
Greatest breadth of the occipital condyles	68.78±8.72
Greatest breadth of the foramen magnum	29.86±2.07
Height of the foramen magnum	31.35±2.83
Skull height	105.05±8.32
Greatest mastoid breadth	88.88±9.90

nasal bones to the rhinion instead in this study due to the nasal bones were convex at its dorsal surface.

The indices and ratios of donkeys were calculated by using the investigated features. The skull, cranial and facial indices are shown in Table II, and these indices were compared with the ones of local horses and ponies reported by Jie (1995) and three popular equine breeds reported by Evans & Mcgreevy. A skull index of 38.23±0.85, a cranial index of 45.01±2.83 and a facial index of 67.80±3.79 were obtained.

Table II. The index of the donkey comparison with literature.

	Donkey	Jie (1995)		Evans & McGreevy (2006)
		Local horse	Pony	Three popular breeds
Skull index	38.23±0.85	37.39	38.26	34.48±2.61
Cranial index	45.01±2.83	46.35	45.13	68.06±6.67
Facial index	67.80±3.79	70.33	73.15	---

Cranial index and skull index were found to be close in value to that of local horses and ponies. However, the facial index was found to be smaller than the ones of local horses and ponies. Skull index of the three popular breeds was smaller than that of donkey. However, Evans & Mcgreevy used the cranial width x 100/cranial length to calculated the cranial index, so the cranial index of the three popular breeds was found to be bigger than that of donkey. The data obtained in this study may be of some use in the clinical treatments of diseases, such as osteomyelitis of frontal bone.

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RESUMEN: Se realizó un estudio sobre una serie de 16 cráneos pertenecientes a burros domésticos adultos, de sexo masculino. Se hicieron mediciones craneométricas en 40 partes diferentes de las muestras. Todas las características investigadas se expresaron como media ± desviación estándar, calculándose índices y proporciones cefálicas. Se compararon las mediciones craneométricas e índices cefálicos con los de caballos y ponis de la zona. La longitud del cráneo obtenida fue de 443,07±53,57 mm, con una anchura máxima del hueso cigomático de 169,09±17,64 mm. El tamaño del cráneo del burro se ubicó entre el de los caballos y los ponis locales. Se obtuvo un índice de cráneo de 38,23±0,85, un índice craneal de 45,01±2,83 y un índice facial de 67,80±3,79. Los índices craneal y de cráneo encontrados fueron cercanos a los valores correspondientes a los caballos y ponis locales. Los resultados de este estudio revelaron que el burro tenía una nariz más larga que el caballo y el poni. Además, la diferencia en longitud del cráneo en las tres especies representa la diferencia de longitud facial.

PALABRAS CLAVE: Cráneo; Burro; Craneometría.

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