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Rostro-dorsal and rostro-lateral skull morphologic variability in three age-groups of the Egyptian mongoose (*Herpestes ichneumon*) (Linnaeus, 1758): implications of certain orbital parameters — angular geometric approach

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This study evaluated 30 skulls of the grey mongoose divided into three age-groups (6 pups, 10 juveniles and 14 adults) for skull shape variability determination. Specific geometric shapes were drawn from defined points. Angular geometric measurements of shapes derived from rostro-dorsal and rostro-lateral parts of the skull included; orbital angles (with and without the mandible), comprising of viscero-cranium, skull and orbital index that was calculated to evaluate the correlations, if any, with angles measured. It was observed that orbital height and width became higher with age; there was stronger correlation in this regard between pups and juveniles compared with juveniles and adults. There is a reduction (narrowing) in BrEcEc, BrEcN, EcPEc, EcEnN and NwNNw angles with concomitant enlargement of BrEcP, BrEcN, EcNEc, EnNEn, EcNNw and EnNP with age. The decline in the skull index shows a decrease in rate of skull width growth relative to rostro-facial length and demonstrates non-proportionality to zygoma bowing. Significantly varied orbital parameters include the inter-canthii distance and implications of certain significant variables observed in some geometric orbital measurements of the tropical mongoose (Herpestes ichneumon). The survey hypothesizes the observations follow typical carnivoran phylogenic affinity, differentiates this species from similar herpestid versions and is an estimation of functional morphology with respect to bite size. It is further suggested to contribute to visual acuity in timing of bite delivery as well an adaptation in prey summarisation. This study will serve as baseline information in herpestid cranial investigations. Such facial features are useful in population studies, species identification, eco-migrant species surveillance and species ontogenic evolution. (Folia Morphol 2016; 75, 4: 527–535

Key words: Egyptian mongoose, *Herpestes ichneumon*, skull allometry, skull angular geometry, orbital morphometry

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INTRODUCTION

The Egyptian mongoose (*Herpestes ichneumon*) belongs to the order Carnivora and sub-order Feliformia [4, 24] with neo-tropical distribution. It is characterised by short limbs, non-retractable clawed thumbs (http://www.oit.itd.umich.edu/bio108/) and slender body conformation and belongs to the subfamily Herpestinae [11]. They comprise of up to 17 species with the sexes sharing similar body conformations. They may be distinguished from other feliformes as the genets (*Geneta tigrina*) [18, 22]. Skull structure among the species reflects robustness of vertebrate-based diet composition [29], while a lighter lower skull structure suggests a more invertebrate-based feeding. *H. ichneumon* is selectively nocturnal but exclusively diurnal in ecology [2, 14], and is omnivore, feeding on lesser invertebrates and fruits. In Nigeria it can be found in an eco-zone between the rainforests of the southwest and guinea savannah towards the middle belt [18].

Several works exists on the carnivorans [34], discussing taxonomy [11], diet and feeding [3], and studying the biology of the Egyptian mongoose. Little literature exists on herpestid rosto-orbital skull morphology and physiology as a component of visual sensory modality in the grey mongoose (*Herpestes ichneumon*), This inquiry aims to expose some variabilities which occur in regard with skull length and age group classifications, and also evaluate the significance of some orbital geometric angular construction contributions in central vision for visual acuity as a modality in foraging in relation to eco-biology of their environment. The study will serve as a baseline data for researches into the visual acuity, predation and survival of the animal. It will also assist in wildlife management and conservation as well as contribute to studies on anthropology of skull evolution of the species.

MATERIALS AND METHODS

Animal procurements

Animals used for this investigation were wild taken in conformity with animal welfare and game hunting ordinances obtainable in Nigeria regarding number of species permitted for slaughter at a particular time (Animal welfare decree 1968). The animals were grouped initially on gender bias after body length and age estimation categorisations was done according to Androukaki et al. [1] and align to an approximate similar mean with the aid of a weighing scale.

Aging, skull maceration and categorisation

Thirty heads harvested by cervical decapitations were aged through dental eruptions and wear prior to skull maceration procedures as described by Onar et al. [28] and Olopade [26]. Macerated skulls were grouped on the basis of size, dental eruptions and wears [15]. The skulls were grouped into age categories: pups, juveniles, adolescents and adults, based on the method utilised by Androukaki et al. [1] following which geometric angles from assessed landmarks were measured.

Skull orientation for morphometry

Skull samples were positioned dorso-ventrally without mandibles on a flat surface in antero-posterior direction for dorsal view. Linear assessments for skull and orbital widths, heights and indices were taken with digital callipers with a precision of 0.1 mm, after appropriate scaling and objective lens magnification corrections for images. Repeatability and accuracy of measurements using this software was compared to direct assessments, the error value observed was insignificant. Ten morphometric landmarks were evaluated

Photography

Lateral and dorsal Image photographs of *H. ichneumon* skulls were taken at a horizontal plane DIN of 30 cm, focal distance of 5.6 cm from the skulls on a flat surface and a lateral central midpoint of the skull length positioned perpendicularly with a 90° camera angulations utilising a digital CANON 1200D camera equipped with a stabiliser and HAMA© tripod with a screened background was used alongside a Microsoft windows software version 6.1 (Build 760 1 service packs). Dorsal pictures were taken on a tripod with a similar vertical distance and angular camera disposition. The measuring points were marked on the skulls as described by Onar et al. [28], von den Driesch [33], and Evans [8]. The picture image was transferred to a computer and processed with Moticam1000® software (Moticam 1000® camera with Motic Images 2.0 software [both from Motic, Hong Kong, China]) for orbital geometric angle measurements.

Definitions of rostro-facial and orbital variables measured in *H. ichneumon*

- Bregma (Br) — median point of the parieto-frontal suture;
- Ectorbitale (Ec) — the most lateral point of the frontal bone on the occipital side of the orbit;

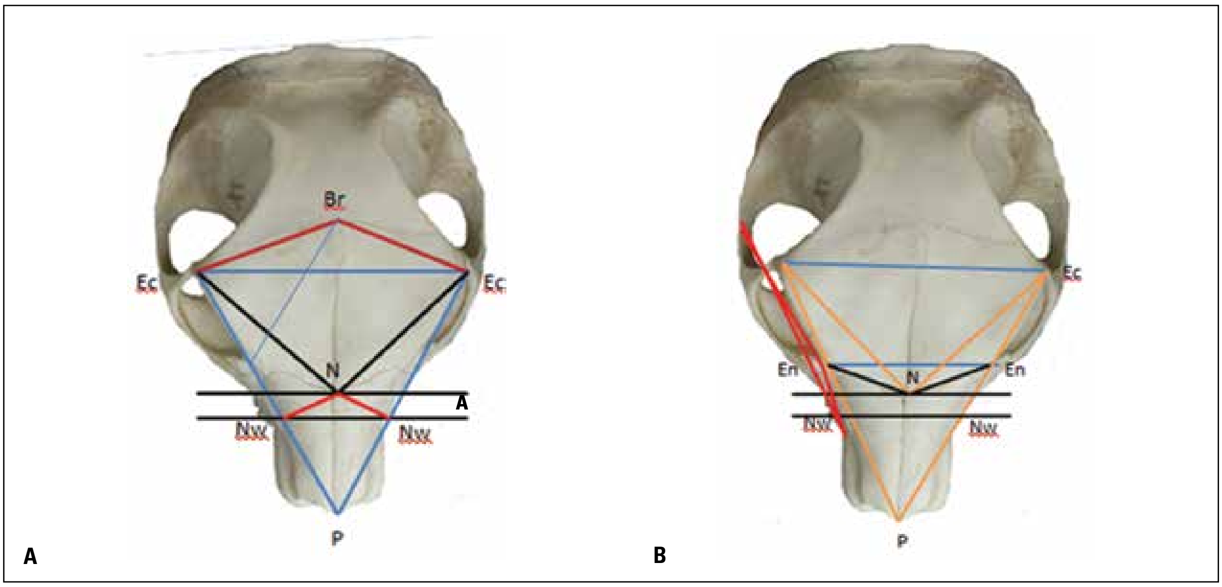

Figure 1A, B. Measuring points and geometric shapes for categories 1, 2, 3 and 4; abbreviations — see text.

- Entorbitale (En) — the naso-medial indentation of the orbit;
- Nasion (N) — the most dorsal portion of the nasal bone;
- Prosthion (P) — anterior end of the inter-incisive suture, located between the upper central interdental space;
- Zygion (Z) — the most lateral point on the zygomatic arch;
- Orbital width (OW) — maximum medio-lateral distance of the orbital rims of both eyes (separately) measured from the lacrimal process of the lacrimal bone to the zygomatic process of the frontal bone;
- Orbital height (OH) — maximum height of the left and right orbits measured from the midpoint of the dorsal rim to a similar point on the ventral part of orbital rim;
- Zygomatic width (ZW) — maximum distance across the zygomatic arches;
- Orbital index (OI) — (OH/OW × 100) for both orbits.

Geometric viewpoints categorisation

The geometric shapes were divided into viewpoint areas on which five basic categories were derived for rostro-facial analysis: (1) analysis based on bregma point, (2) analysis based on ectorbitale points, (3) analysis based on entorbitale points, (4) analysis based on the narrowest lateral points of the nose and (5) analysis based on the skull index.

From these viewpoints three geometric shapes were generated in categories 1, 2 and 4, two shapes in categories 3 and 5:

- **Category 1** — taking the bregma as the aboral point three geometric shapes were generated in this category; (a) the first shape as viewed from the prosthion point, (b) a second and third (c) shapes as viewed from the nasion and ectorbitale points (Fig. 1);
- **Category 2** — taking the ectorbitale as the aboral point three shapes were deduced (a), as viewed from the nasion (Fig. 1) (b), as viewed from the prosthion (Fig. 1);
- **Category 3** — taking the entorbitale as the aboral point another two geometric shapes were generated (a), as viewed from the nasion (b), as viewed from the prosthion (Fig. 1);
- **Category 4** — from the narrowest width of the nasal bone three geometric shapes were formed as viewed from the prosthion (Fig. 1) ectorbitale, and entorbitale points (Fig. 2);
- **Category 5** — taking the zygion as the most lateral point on this surface two geometric shapes was formed, (a) as viewed from prosthion and nasion points (Figs. 1, 2) and the second as viewed from the ectorbitale, entorbitale and zygion points;
- **Category 6** — analysis based on skull and orbital index — the correlation between angle measurements and skull index (SI) was analysed in this category; SI = skull height / skull width × 100, orbital height / orbital width × 100 (Fig. 3).

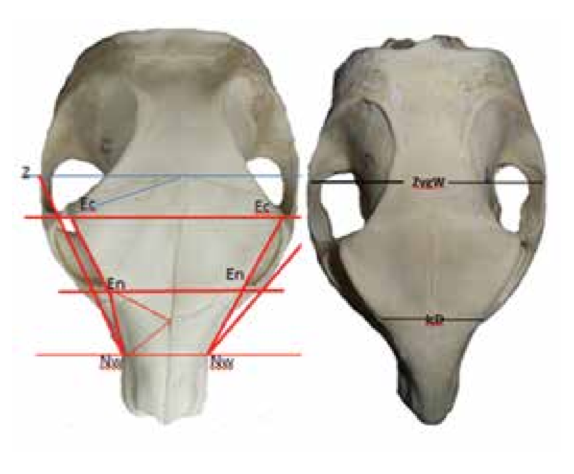

Figure 2. Measuring points and geometric shapes for categories 4 and 5; abbreviations — see text.

In order to assess age related geometric variability, following categorisation a correlation of each angular measurement in the groups with skull index was investigated among ages using Paleontological statistics PAST [17]. To achieve our objectives an attempt was made to expose the morphological features of the viscero-cranium in the formation of the shapes.

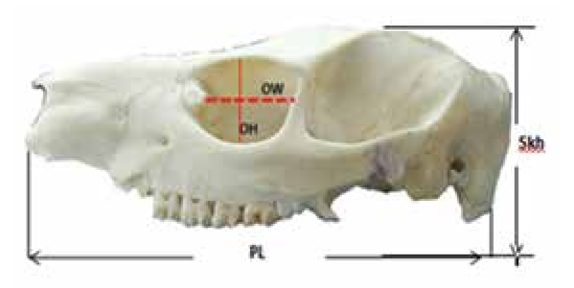

Figure 3. Measuring points and geometric shapes for category 6; abbreviations — see text.

RESULTS

The mean values and standard deviation of the age-group angle measurements were determined and presented in Table 1 showing variability with age values; skull index to skull angles correlations and between each angle measurements were calculated. Statistically significant observations of the analysis were further grouped into six separate categories and presented in Tables 2 and 3. All uninformative rows and columns were removed from the tables.

Observations were as follows: The maximum zygomatic width (MZW) in pups was found to be wider than total profile length (PL), similar morphologic

Table 1. Group statistics showing non-gender biased overall age group angle measurements in degrees and expressed as mean ± standard deviation (SD)

	No.	Mean ± SD (pups)	No.	Mean ± SD (juveniles)	No.	Mean ± SD (adults)
BrEcP [º]	10	22.4 ± 6.29	10	46.53 ± 4.91	14	78.18 ± 8.29
BrEcN [º]	10	15.33 ± 9.3	10	38.3 ± 1.80	14	68.12 ± 1.64
BrEcEc [º]	10	64.31 ± 2.44	10	37.91 ± 4.21	14	20.11 ± 3.11
EcNEc [º]	10	34.68 ± 4.68	10	38.8 ± 13.05	14	81.85 ± 7.86
EcPEc [º]	10	45.16 ± 3.49	10	34.97° ± 3.59	14	14.9 ± 3.58
EcEnN [º]	10	120.81 ± 2.97	10	94.12 ± 4.21	14	74.22 ± 0.55
EnNEn [º]	10	131.50 ± 7.11	10	126.53 ± 1.76	14	134.25 ± 4.49
EnPEn [º]	10	68.68 ± 3.21	10	57.25 ± 3.20	14	43.68 ± 1.69
NwPNw [º]	10	49.37 ± 2.63	10	35.95 ± 2.39	14	30.47 ± 2.67
NNwP [º]	10	89.15 ± 1.57	10	131.33 ± 1.25	14	139.95 ± 2.56
EcNNw [º]	10	22.54 ± 4.55	10	67.33 ± 3.22	14	71.42 ± 2.11
NwNNw [º]	10	139.79 ± 3.44	10	120.2 ± 1.22	14	100.33 ± 3.66
NwZZ [º]	10	10.56 ± 2.11	10	15.34 ± 2.99	14	17.88 ± 3.92
MZW	10	42.00 ± 3.00	10	68.00	14	89.35 ± 2.44
PL	10	34.90 ± 2.11	10	97 ± 1.00	14	100.90.11 ± 0.33
SI	10	43.10 ± 2.00	10	55.17 ± 1.99	14	46.15 ± 0.41

Abbreviations — see text

Table 2. Age group correlation analysis of geometric features of mongoose (*H. ichneumon)* skulls

	BrEcP	BrEcN	BrEcEc	EcNEc	EcPEc	EcEnN	EnNEn	EnPEn	NwPNw	NNwP
BrEcP (p)						0.00050#	0.00141#			
BrEcP (j)	–82.83^									
BrEcP (a)					0.0446*					
BrEcN (p)		–4.36^			0.0010#	0.0027#				
BrEcN (j)	–0.076*									
BrEcN (a)					17.99#					
BrEcEc (p)		25.23#	46.77#	58.98#						
BrEcEc (j)	–6.58^	–2.94^	77.06#							
BrEcEc (a)		–0.022^	59.95#	15.15*	–0.0022^		–0.0022^	59.15#		
EcNEc (p)	–162.13^	123.33*	–0.227^	–841.71^	0.000111^	0.00037^				
EcNEc (j)		–4.80^	–0.227^	–4.80^				–1567.4^	–0.02^	
EcNEc (a)		–20.26^	–0.227^	–20.26^						
EcPEc (p)	24.92*	–24.77^		–24.77^				95.48#	–0.022^	
EcPEc (j)	–0.171^					23.4*			0.023#	
EcPEc (a)	–7.99^	–3.715^	–0.022^		–0.035^	20.70*	–0.02^	–63.88^		
EcEnN (p)	–0.164^	–2.24^	0.022	–2.26^	–0.035^		0.022#	–5.029^	–0.022#	
EcEnN (j)				66.34#	15.98		**22.27#**		2.03*	66.34*
EcEnN (a)							24.08#			
EnNEn (p)		12.98#								0.0004^
EnNEn (j)	0.002#									
EnPEn (p)				162.7#						
NNwP (j)	0.101#									
EcNNw (p)	0.000273^									
NwNNw (j)	0.3294*									
NwZZ (j)	0.0029#									
MZW (j)	0.00027^									

*$p < 0.5$; #$p < 0.005$; ^$p < 0.0001$; a — adults; p — pups; j — juveniles; rest abbreviations — see text

Table 3. Age-group correlation analysis of geometric features of mongoose (*H. ichneumon)* skulls continued

Pups	EcNNw	NwNNw	NwZZ	MZW
BrEcP		0.00280**		
BrEcN	0.00513**			
EcNEc	0.000824***			
EcPEc	0.000237***			
EcEnN	0.00166**			
EnNEn			0.0040881**	0.000146***
EnPEn	162.16*	0.00023***		
NwPNw	0.000135***			
EcNNw	0.0027**			
NwNNw			0.0074***	0.00035***

*Significant; **Very significant; ***Highty significant; abbreviations — see text

changes were observed in the juveniles as growth occurs, the increase in zygomatic width in the second group was not proportional to skull length and remained so in adulthood with a stronger bowing of the zygoma (Fig. 4C). Skull height remained insignificantly different. Ontogenetic variations that occurred in the skulls of the present species are shown in the composite picture (Fig. 4A–C). It was observed that in summation most significant cranial changes were seen in the juveniles group

Category 1

Age trends examination of angles in this category demonstrated that angles of BrEcP and BrEcN increases with age becoming wider, EcPEc and EcNEc

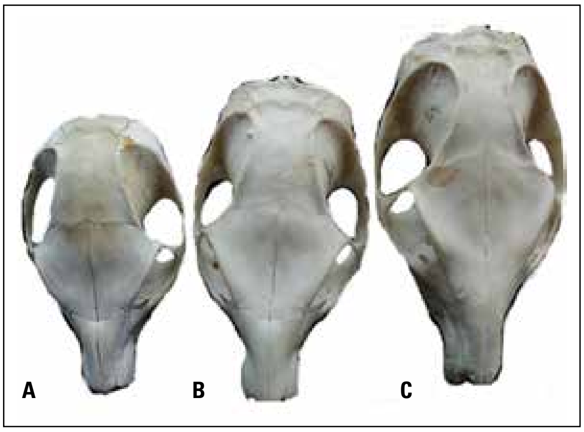

Figure 4. Age group pictures showing pups' **(A)**, juveniles' **(B)** and adults' **(C)** skulls in dorsal view.

decreases in degrees by becoming narrower with the same predictor variable.

- **Shape "a"** — prosthion as original point of assessment. A highly negative correlation of statistical significance was observed among angles BrEcP and EcPEc in constancy across age groups.
- **Shape "b"** — nasion as original point of assessment. Another highly significant negative correlation was found among the angles of BrEcN and EcNEc which was clearly significant across ages.
- **Shape "c"** — ectorbitale as original point of assessment. EcNEc was found significant in all age groups whereas EcPEc was significant only in adulthood.

Category 2

Similar to the observed increases in EcNEc and EcNNw angle dimensions with age, BrEcEc and EcPEc decreases in degrees with age where this dropped from 45.16° in pups to 14.9° in adults of this species. EcEnN dropped in magnitude from 120.81° to 94.12° in juveniles with a further narrowing 74.22° in adults demonstrating acute angle ectorbitale-nasal bone bridging overlap over each half of the face.

- **Shape "a"** — nasion as original point of assessment. EcNEc was observed to be extremely significant ($p < 0.001$) among all ages whereas EcNNw was only statistically significant to any extent in pups only.
- **Shape "b"** — prosthion as original point of assessment. Geometric shape analysis revealed that EcPEc was positively correlated with EcNP and was not included in shown analysis. It was however highly negatively correlated with BrEcEc in adulthood but not in younger ages, while with EcNEc in pups and not in older animals. However, the correlations lost significance with most age groups of other facial angle evaluations.

Category 3

- **Shape "a"** — nasion as original point of assessment. EnNEn correlated negatively and significantly ($p < 0.001$) with BrEcP where lost its significance in puppies, BrEcEc in adults but highly and negatively with EcEnN which remained constant throughout as the species grows as well as EnPEn in the young (pups and juveniles).
- **Shape "b"** — prosthion as original point of assessment. No correlations of statistical value were observed between EnPEn and EnNEn despite the inverse relation in magnitude of the degrees across age progressions. While EnPEn decreases with age EnNEn increases though not in any appreciable way.

Category 4

It was noted in this category that NwNNw and NwPNw reduces in size insignificantly with growth, NNwP, EcNNw and NwZZ increases proportionately with age. However, the largest morphological change occurred during growth in juvenile age with EcNNw.

- **Shape "a"** — prosthion and nasion taken as original point of assessment. No correlations of importance exist in angle sizes between NwPNw and NwNNw.
- **Shape "b"** and **"c"** — ectorbitale and entorbitale taken as original point of assessment. Here it was revealed that EcNNw exhibited a highly significant ($p < 0.0001$) negative correlation with NwPNw demonstrating a marked orbital variability in the neonatal period but loses significance with advancing age to adolescence. EnNwP and EnNwN were not correlated significantly among ages and were removed from the analysis.

Category 5

Proportional incremental degree changes in NNwP size with age occurred in his analysis whereas similar decrease with the same age predictor was observed in EcEnN. We noted a strong negative correlation between NNwP and EcEnN as well EnNEn at $p < 0.001$, EnNEn reduced insignificantly in juvenile values but peaked at adulthood. NwZZ and NwEnZ were only positively correlated while NwEnZ, NwEnEc were described as extremely correlated demonstrating a rostro-medial growth of the entorbitale with age advancement.

- **Shape "a"** — prosthion and nasion taken as original point of assessment. NNwP and NNwNw were insignificantly correlated.
- **Shape "b"** — ectorbitale, entorbitale and zygion taken as original point of assessment. ZNwP and NwPNw which had an initial positive correlation in pups and juveniles became significant with a negative correlation in adults (supporting information). NwPNw correlated strongly with EcNEc in juveniles only, this significance wanes and disappears in adulthood with EcEnN and EcPEc. EnPEn correlated negatively and significantly EcNEc juveniles but adults only with BrEcEc.

Category 6

Category analysis of skull index and skull angle correlations revealed non-significance in geometric angle degree changes among age groups with only a slight showing of this in juveniles where this index peaked at 55.17 but reduced in adulthood to 46.15 which was not profoundly varied from those of juveniles (43.10). A slightly different situation was observed with orbital index where pups had the highest index value (45.45) which diminished slightly significantly through the age groups and lowest in adulthood (40.00). Positive correlations prevailed between PL and angle dimensions across age groups.

DISCUSSION

The ancestral mongoose consists of about 34 members and are sometimes only distinguished by diet criteria or time of activity [13] as observed between the diurnal dwarf mongoose (*Helogale parvula*) and nocturnal white-tailed mongoose (*Atilax paludinosus*). Intra specific polymorphisms exhibited in terms of rostro-facial morphology by members in this family makes skull morphometric indices important in morpho-type determination for species discrimination. Developmental change peculiarities may be investigated within and between species for both identification and conservation. Ontogenetic mapping of skull growth trajectories may also be derived by researchers in conjunction with relevant genetic support for proper taxonomic classifications.

The present investigation revealed that *H. ichneumon* pups start out with a short dorso-laterally flattened facial structure. It was noted that some architectural construction such as the manifestation of the prominent dorsal orbital ridge, the lacrimal tubercle and the maxillary process of the zygomatic bone occurs between late adolescence and adulthood along with SI reduction. A relatively wider MZW in juveniles compared with PL was responsible for a high SI in the group; this value however did not increase proportionately with increasing age in adult group hence the fall in index value in adults suggesting a maximum horizontal growth but minimal perpendicular (vertical) growth as was confirmed in a similar canine study [27]. The angular measurements correlations to each other demonstrate the directions of growth shape in *H. ichneumon* skulls and establishes the fact that nose extends beyond the premaxilla [19].

Ontogenetic skull profiling

It has been reported that changes in architecture of the dorsal crania may have developmental consequences on cranio-facial modelling [16, 19, 28]. Allometric derivations of growth changes expressed by correlations between facial bones angle dimensions and SI represent the ontogenetic pattern in this species. Skulls in early life have a short snout with less dorsal inclination of ventral margin of the orbit probably due to less bowing of the zygomatic process of maxillary bone; and these features remain constant till early adulthood [16, 25]. Maxillary elongation during ontogeny is most remarkable in adults when angle EnNEn becomes a fractal of EcNEc in dorsal view. Rostral flattening of the skull roof plate is anteriorly inclined in rostro-lateral view with anterior tapering. The presence of a subnarial ridge between the premaxilla and maxilla for canine tooth root further contribute to bluntness of the naso-maxillary base. A wider MZW in comparison to PL conferred a higher skull index on this group; this value did not increase proportionately with skull profile length in adults resulting in a subsequent decline for the value in adults of this species, suggesting a more transverse growth than longitudinal in juveniles, but a reverse in pups. Our observation was corroborated by similar investigation in dogs by Onar and Gunes [27]. The interrelationship between angle measurements is consistent with the fact that slender rostrofacial morphology is exhibited by pups with anterior spherical shape of the orbit while juveniles display a more robust morphology due to zygomatico-maxillary changes whereas strong facial expressions structures are demonstrated in adults.

Zygion point and ectorbitale analyses (Figs. 1, 2) showed that disproportionality exists in the rate of zygomatic width increase relative to skull profile length increase (which slows down) as age advances. Conversely, BrEcEc and EcNEc angle measurements decreases with age and positively correlated with skull index showing that profile length increases more than width revealing a dorso-ventrally flattened and narrow shape of skull. This view was supported by BrEcP and BrEcN extensions in time. Geometric analysis based on both left and right entorbitale points (Figs. 1, 2) showed that angles EnNEn, EnPEn and NwPNw decreased with advancing age resulting in facial bones elongation giving a long narrow appearance. A narrowing of EcBrEc (not shown) indicated that the bregma point proceeded anteriorly as a consequence of altered morphology of the frontal bone.

Analysis of the narrowest lateral points of the nose (Figs. 1, 2) it was observed that angles of NwNNw and NwPNw narrowed with age whereas NNwP widened thereby contributing to the slender narrow construction of the aboral surface of the viscerocranium a non-correlation with the SI notwithstanding. The post orbital region becomes narrower and shorter but expands postero-laterally. Though both the dorsal and ventral components of the skull play some roles in crania modelling processes [8, 25], this has been extensively investigated in other canids [27]. However, this study has only discussed dorso-rostral cranial changes in a geometric perspective and the authors believe that such geometric observations validate explanations on shape allometric changes during skull growth.

Functional morphology

The ability to detect and differentiate between raptor species many kilometres away before any human vision as observed in *Helogale parvula* [11] and a peculiar ability of colour discrimination in *H. edwardsi* might not be unrelated to antero-rostral skull architecture, whereas specific diet type determines visceral maxillo-facial skull bones and dental morphotypes of species as observed in the slender mongoose (*Galereta sanguinea*) and the Meerkat (*Suricata suricata*) [9]. Such forms also indicate size of prey and location where bites are intended as reported in skull oriented bites of the common cusimanse (*Crossarchus obscurus*) [5, 13] and neck oriented bites of *Atilax paludinosus* (slender mongoose). Diet vertebrate/invertebrate content proportionality also gives insight to skull typology with the flattened skull type seen in long-nosed mongoose (*Xenogale naso*) and flat headed cusimanse (*Crossarchus platycephalus*) [23].

Similar-sized species such as the opossum (*Didelphys marsupialis cancrivora*) which are arboreal in habitat, similar in plantigrade locomotion have been reported to be comparatively visually deficient [30]. The skull structure observed by the results of this study supports visual acumen in nocturnal carnivores for prey-predator interaction [7, 10]. It is likely that the shape changes seen in the snout of *H. ichneumon* (including the relative increase in the snout length and depth, the formation of a subnarial ridge as well as the shape changes of the ventral margin of the maxilla) are rather related to changes in diet preferences and feeding behaviour through ontogeny [16, 23]. Puppies of the Egyptian mongoose possessing skulls with a short slender and pointed snout feed predominantly on small lizards, frogs and shoreline invertebrates (e.g. insects, beetles and snails) [6, 20, 21], whereas adults possessing markedly prominent sabre-shaped canine teeth, high and elongated subnarial ridge feed on medium-sized prey, such as capybaras (*Hydrochoerus hydrochaeris*), white-lipped peccaries (*Tayassu pecari*), and piranhas [12, 21, 31, 32]. Similar dietary shifts from small invertebrates to medium-sized vertebrates during ontogeny have been earlier reported in similar invertebrate feeder such as the *Melanosuchus niger.*

CONCLUSIONS

The results from the investigation has demonstrated the variabilities in orbital shape in relation to cranial indices and that such relationships are species specific and associated with pattern of feeding in their eco-environment. This study will serve as baseline information in herpestid cranial investigations. Such facial features are useful in population studies, species identification, eco-migrant species surveillance and species ontogenic evolution.

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