

Short Communication

GROSS AND MORPHOMETRICAL STUDIES ON SCAPULA OF STUMP-TAILED MACAQUE (*MACACA ARCTOIDES*)

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ABSTRACT: The scapula was a flat triangular bone with three borders, three angles and two surfaces. Dorsal border was slightly convex and undulating whereas cranial border was much convex and thinner and ended up distally forming a distinct notch. Posterior border was thick and straight in distal 2/3rd whereas the proximal 3rd was rounded. It presented a distinct groove in the distal 2/3rd. The cranial angle was indistinct. The distal extremity was composed of the elongated glenoid cavity, well developed tuber scapulae and massive coracoid process which was bent postero-medially. The lateral surface was unequally divided by scapular spine into supra-spinous and infra-spinous fossae. The infra-spinous fossa was triangular in outline. The scapular spine ended in a well developed acromion process which was bent cranially. The medial surface lodged a nutrient foramen at its distal part. The maximum length of scapula along the spine (without scapular cartilage) was 7.95 cm for right scapula and 8.04 cm for the left. The maximum width of scapula was 6.35 cm for right scapula and 6.37 for left scapula. The scapular index was 79.8 for the right scapula and 79.22 for the left one. The total length of scapular spine was 8.53 cm and 8.49 cm for right and left scapulae, respectively. The ratio of supra-spinous to infra-spinous fossa was 1:3.4 for right scapula and 1:3.5 for left scapula.

Key words: Gross morphology, Morphometry, Scapula, Macaque.

The stump-tailed macaque is also known as bear macaque is mainly found in South Asia. It is found in south of the Brahmaputra River and the north-eastern part of the India (Choudhury 1988). They belong to order primates, family cercopithecidae, genus *Macaca* and species *arctoides*. Their body is covered by long, thick fur except face and short tail. Males are generally larger than the females.

The scapula serves as attachment site for numerous muscles between the head, neck and forelimb of primates (Larson 1993). The shape of scapula is largely associated with the functional demands of the forelimb (Larson 1995). Literature is available on the scapula of domestic animals (Raghavan 1964), lion (Nzalak *et al.* 2010), chital (Choudhary *et al.* 2013), Indian tiger (Mahapatra *et al.* 2016), cheetah (Rosu *et al.* 2016), civet cat (Sarma *et al.* 2017) and barking deer (Sasan *et al.* 2018). Due to the paucity of literature on the anatomy of scapula of monkey, the present study has been undertaken.

STUDY AND DISCUSSION

The present study was conducted on the right and left scapulae of an adult male stump-tailed macaque which was obtained after its death from the Veterinary Clinics, F.V.Sc & A.H, R.S Pura. The bone was processed as per standard technique (Raghavan 1964) and subsequently studied to record gross morphological features. Different biometrical parameters were measured with help of thread, meter scale and Vernier calipers as follows:

- Maximum length (cm): Along the scapular spine
- Diagonal length (cm): From the coracoid process to caudal angle of scapula
- Width of scapula (cm): At three levels of the scapula i.e. proximal, middle and distal
- Length of scapular spine (cm)
- Height of scapular spine (cm) at three levels i.e. proximal, middle and distal

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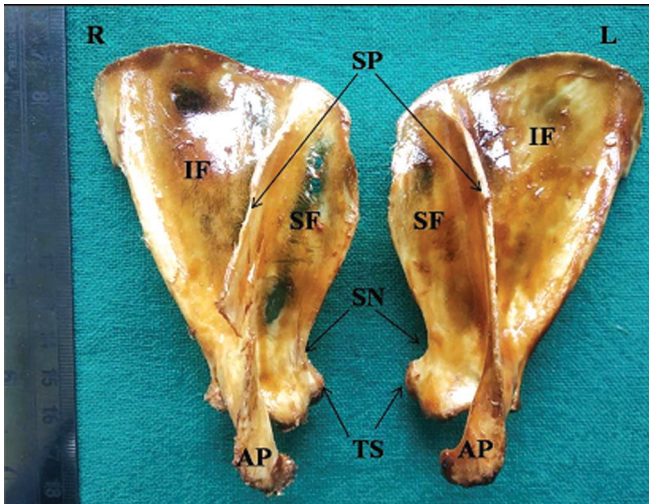


Fig. 1. Photograph of lateral surface of right (R) and left (L) scapulae of stump-tailed monkey showing supra-spinous fossa (SF), infra-spinous fossa (IF), scapular spine (SP), acromion process (AP), scapular notch (SN) and tuber scapulae (TS).



Fig. 2. Photograph of medial surface of scapula of stump-tailed monkey showing well developed coracoid process (CP) and nutrient foramen (encircled).

- f. Length (cm) of the acromion process
- g. Antero-posterior and transverse diameters (cm) of glenoid cavity
- h. Length of coracoid process (cm)
- i. Maximum width of coracoid process (cm)

- j. Width (cm) of supra-spinous fossa at three levels i.e. proximal, middle and distal
- k. Width (cm) of infra-spinous fossa at three levels i.e. proximal, middle and distal
- l. Ratio of supra-spinous and infra-spinous fossa eat three levels i.e. proximal, middle and distal
- m. Scapular index (SI). It was calculated as the ratio between maximum length and maximum width of scapula (Bharti and Singh 2017). $SI = (\text{Maximum length}/\text{Maximum width}) \times 100$

The scapula was a flat triangular bone as described by Preuschoft *et al.* (2010) in primates. It was situated over the cranio-lateral wall of the thoracic cavity. Chan (2007) and Preuschoft *et al.* (2010) reported that the scapula of arboreal monkeys was situated more dorsally than the terrestrial ones.

In the present study, the scapula of stump-tailed monkey presented three borders, three angles and two surfaces. The dorsal border was slightly convex. It was undulating owing to the depressions (fossae) presented on the medial surface that extended up to the dorsal border. The cranial border was much convex and thinner as compared to the dorsal border. It was also undulating which ended up distally forming a distinct notch. The posterior border was thick and straight in its distal 2/3rd whereas the proximal 1/3rd was rounded and met with the dorsal border. It presented a distinct groove in the distal 2/3rd which terminated in a fossa just above the glenoid cavity. Similar observation was made by Verma *et al.* (2017) in *Macaca mulata*.

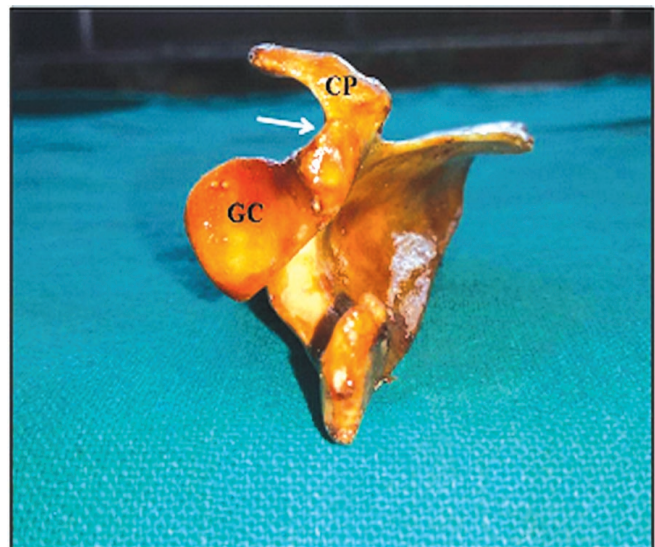


Fig. 3. Photograph of distal angle of scapula of stump-tailed monkey showing well developed coracoid process (CP), groove formed by coracoid process and medial surface of scapula (arrow) and glenoid cavity (GC).

The cranial angle was rounded and indistinct. The caudal angle was placed much above the cranial angle and was acute (Fig. 1). Verma *et al.* (2017) observed rounded cranial border and acute caudal border in the scapula of rhesus monkey. Preuschoft *et al.* (2010) also reported acute caudal border in arboreal monkeys. The distal extremity was composed of the glenoid cavity, tuber scapulae and coracoid process. The glenoid cavity was shallow and elongated (Fig. 3) in shape as also observed by Verma *et al.* (2017) in rhesus monkey. Preuschoft *et al.* (2010) observed narrow and elongated glenoid cavity in terrestrial monkey. The rim of the glenoid cavity was

pear-shaped. Bharti and Singh (2017) observed deep and circular glenoid cavity in blue bull. Glenoid notch was indistinct. The tuber scapulae was well developed and placed in front of the glenoid cavity. The coracoid process was massive and bent postero-medially (Fig. 2) which formed a distinct groove with the distal part of the medial surface of the scapula (Fig. 3).

The lateral surface was unequally divided by scapular spine into a small supraspinous and larger infraspinous fossae (Fig. 1). The infraspinous fossa was triangular in outline. The scapular spine ended in a well-developed acromion process (Fig. 1) which was bent cranially to

Table 1. Biometry of scapula of stump-tailed Macaque.

Parameters	Right side	Left side
Maximum length (along spine)	7.95 cm	8.04 cm
Diagonal length	9.95 cm	9.84 cm
Width of scapula		
a. Dorsal	6.35 cm	6.37 cm
b. Middle	4.84 cm	4.91 cm
c. Distal	3.39 cm	3.47 cm
Length of scapular spine	8.53 cm	8.49 cm
Height of scapular spine		
a. Dorsal	1.23 cm	1.11 cm
b. Middle	1.74 cm	1.81 cm
c. Proacromion level	1.97 cm	1.92 cm
Length of acromion process	1.54 cm	1.45 cm
Antero-posterior diameter of glenoid cavity	1.95 cm	1.94 cm
Transverse diameter of glenoid cavity	1.43 cm	1.37 cm
Length of coracoid process	1.63 cm	1.61 cm
Maximum width of coracoid process	0.85 cm	0.93 cm
Scapular index	79.8	79.22
Width of supra-spinous fossa		
a. Dorsal	1.35 cm	1.31 cm
b. Middle	1.93 cm	1.82 cm
c. Distal	1.51 cm	1.52 cm
Width of infra-spinous fossa		
a. Dorsal	4.65 cm	4.64 cm
b. Middle	3.26 cm	3.35 cm
c. Distal	1.66 cm	1.56 cm
Ratio of supra-spinous to infra-spinous fossa		
a. Dorsal	1:3.4	1:3.5
b. Middle	1:1.7	1:1.8
c. Distal	1:1.1	1:1.03

give origin to the strong acromial head of deltoideus muscle in this species. The spine was not tuberos in middle. The acromion process extended beyond the glenoid cavity. A prominent acromion process has also been reported by Preuschoft *et al.* (2010) in terrestrial monkey and Verma *et al.* (2017) in *Macaca mulata*. The edge of the spine was thicker at its proximal 1/3rd. The medial surface presented 2 deep undulating fossae for the insertion of subscapularis muscle. It also lodged a nutrient foramen at its distal part (Fig. 2). Verma *et al.* (2017) observed nutrient foramen in the middle of the infraspinous fossa in *Macaca mulata*. Bharti and Singh (2017) however observed nutrient foramen at the distal third of the caudal border in blue bull.

The biometry of right and left scapulae of adult stump-tailed monkey has been presented in Table 1. The maximum length of scapula along the spine (without scapular cartilage) was 7.95 cm for right scapula and 8.04 cm for the left. The diagonal length was 9.95 cm for right scapula and 9.84 cm for left scapula. The width of scapula was measured at three levels. For right side, it was 6.35cm, 4.84 cm and 3.39 cm at dorsal, middle and distal levels, respectively. The decrease in width from dorsal to middle part was 23.78 % whereas it was 29.96 % from middle to distal part. The overall decrease in width from dorsal to distal part was 46.61 %. For the left scapula, width was 6.37 cm, 4.91 cm and 3.47 cm at dorsal, middle and distal parts, respectively. The overall decrease in width from dorsal to distal part was 45.53 %. The decrease was 22.92 % from dorsal to middle part and 29.33 % from middle to distal part. The mean width of the scapula of rhesus monkey was recorded to be 70.5 mm (Verma *et al.* 2017).

The scapular index was 79.8 for the right scapula and 79.22 for the left one. Verma *et al.* (2017) recorded the scapular index of monkey (*Macaca mulata*) to be 74. The same was 56.60 for blue bull (Bharti and Singh 2017), 65.83 for sheep, 62.43 for buffalo, 57.51 for deer, 52.59 for ox, 45.45 for Nilgai and 43.62 for goat as recorded by Dalvi *et al.* (1997). Mahapatra *et al.* (2016) observed scapular index of adult Indian tiger to be 83.77±2.16.

The total length of scapular spine was 8.53 cm and 8.49 cm for right and left scapulae, respectively. The height of scapular spine was measured at three levels. For right scapula, it was 1.23 cm at dorsal, 1.74 cm at middle and 1.97 cm at distal level. The same were 1.11 cm, 1.81 cm and 1.92 cm for left scapula. The spine thus showed an increase in height distally. The overall increase in height from dorsal to distal part of the scapula was 60.16 % for right and 72.97 % for left scapula, respectively. The length of the acromion process was 1.54

cm and 1.45 cm for right and left scapulae, respectively. However, Verma *et al.* (2017) measured the mean length of acromion process as 26 mm in rhesus monkey.

For the right scapula, the antero-posterior diameter of the glenoid cavity was 1.95 cm and its transverse diameter was 1.43 cm. The same for left scapula was 1.94 cm and 1.37 cm, respectively. The greater antero-posterior diameter gives an idea about the shape of the glenoid cavity to be more elongated. The length of the coracoid process was 1.63 cm and 1.61 cm for right and left scapula, respectively. The maximum width of the process was 0.85 cm and 0.93 cm for right and left scapula, respectively.

The width of supraspinous and infraspinous fossae was taken at three levels. For right scapula, the width of supraspinous fossa was 1.35 cm proximally, 1.93 cm at middle and 1.51 cm distally. The same values for the infraspinous fossa were 4.65 cm proximally, 3.26 cm at middle and 1.66 cm distally. The ratio of supraspinous to infraspinous fossa was 1:3.4 proximally, 1:1.7 at middle and 1:1.1 distally. For left scapula, the width of supraspinous fossa was 1.31 cm proximally, 1.82 cm at middle and 1.52 cm distally. Similar values for the infraspinous fossa were 4.64 cm proximally, 3.35 cm at middle and 1.56 cm distally. The ratio was 1:3.5 proximally, 1:1.8 at middle and 1:1.03 distally. It was 1:2.97 in blue bull (Bharti and Singh 2017), 1:4.15 in chital (Choudhary *et al.* 2013) and 1:3.21 in black buck (Choudhary 2015).

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