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Cutaneous Muscle of Javan Porcupines (*Hystrix javanica*)

Supratikno*, Halim Bakti Harjo, Danang Dwi Cahyadi, Srihadi Agungpriyono

Department of Anatomy Physiology and Pharmacology, Faculty of Veterinary Medicine,
Bogor Agricultural University (IPB), Jl. Agatis, Kampus IPB Dramaga, Bogor 16680, Indonesia

*Corresponding author: *supra_koko@yahoo.com*

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INTRODUCTION

Javan porcupine (*Hystrix javanica*) is a big rodent which has unique defense mechanism behavior using its quills. When disturbed, the animals raise and fan the quills to create an illusion of greater size. If the disturbance continues, they stamp their feet, whirl quills and charge the enemy, back end first, attempting to stab with the thicker, and shorter quills [1]. They also make a noise by using rattle quills that found at the tip of tail. To support this defense mechanism, the porcupines have well-developed cutaneous muscle. This study was conducted to observe the anatomical structure of cutaneous muscles in javan porcupine included their origin and insertion in order to get a better understanding on their functions.

MATERIAL AND METHODS

Two adult male porcupine specimens preserved in 10% formalin were used. Determination of structure, origin, and insertion of muscle was done by dissecting the dorsal and ventral layers of cutaneous muscle.

RESULTS AND DISCUSSION

The javan porcupine body are covered by a thousand quills that have variation in size, shape, and color. The quills can be differentiated into 4 types: spines, true quills, transitional quills, and rattle quills [2]. Most of the spines are found in head, neck, shoulder, forelimb, cranial part of the thorax, ventral body, and distal of hind limb. True quills are the greater, straight, rigid and sharp quills which arise dominantly at caudal part of the thorax, lumbar area, flank, pelvic, and base of the tail. Transitional quills are longest and flexible quills that distributed randomly between true quills. The rattle quills are specific quills with wine glass-shape that only found at the end of the tail (Figure1). The function of 4 types of the quills was assumed based on their morphology and cluster pattern form. Function of spines might be similar to mammal's hair, while true quills, transitional quills, and rattle quills might function as a defense instrument.

Javan porcupine has extensive, thick and complex structure of cutaneous muscle that covers their body from shoulder to the hip and the tail. This muscle consists of two layers with different fiber direction. The dorsal layer has longitudinal fiber direction from shoulder caudally to the tail, while the direction of the ventral layer varied from caudo-dorsad (cranial part), ventro-dorsad (middle of trunk) and caudo-dorsad (caudal part) (Figure 2 &3). The muscle has various thicknesses depend on the quills growth. The interesting finding was found at the area with true quills and transitional quills. This area showed thickest cutaneous muscle that was difficult to be separated from the skin. The cutaneous muscle in this area was thick and acts as a place of the rigid and sharp quills. The follicles of the true and transitional quills were inserted into this muscle. This structure was considered as a very effective way to erect true quills during threatened.

The dorsal layer of cutaneous muscle had several origins: spine of scapula, fascia of brachiocephalic and transverse pectoral muscles, humeral crest and lateral of deltoid tuberosity. This muscle covered the shoulder and continued to latero-dorsal of the trunk, and inserted to the spinous and transverse processes of the fourth and fifth caudal vertebrae. The main function of

this muscle layer was to erect the quills cranially. The ventral layer of cutaneous muscle had wide origins. Cranial part of ventral layer has three origins: medial humeral crest, medial of deltoid tuberosity and sternum. This part extends caudo-dorsally then inserted and fused into profundal of the dorsal layer (Figure 3). The middle part of ventral layer extends from sternum and continues caudally along the linea alba then inserted to the ventral border of superficial layer. The caudal part extended caudo-dorsally from tibial crest and crural fascia to the insertion of the dorsal layer. The action of ventral layer was to pull cranio-ventrally (craniolaterad) the dorsal layer.

When both muscles were contracted, the quills erected cranially by dorsal layer and cranio-laterally by ventral layer to form fan like-shape quills to make greater size illusion (Figure 4). The insertion of this muscle at the fourth to fifth caudal vertebrae allows the tail movement to make rattling noise. Combination of greater illusion and rattling noise are thought to be a perfect defense mechanism.



Figure 1. Porcupine quills distribution.
 1. Spines, 2. True quills, 3. Transitional quills, 4. Rattle quills

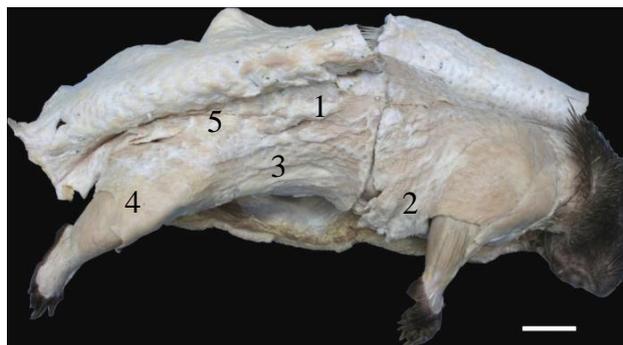


Figure 2. Cutaneous muscle of javan porcupine.
 1. Dorsal layer, 2. Cranial part of ventral layer, 3. Middle part of ventral layer, 4. Caudal layer of ventral layer, 5. Follicle of true quills inserted into cutaneous muscle.

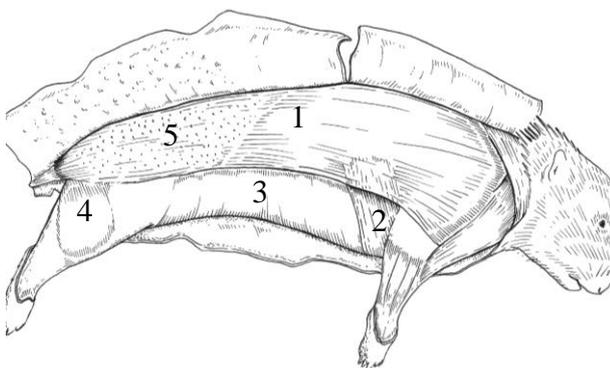


Figure 3. Schematic illustration of cutaneous muscle of javan porcupine



Figure 4. Fan like-shape of erected true quills

CONCLUSION

Javan porcupine had two layers, dorsal and ventral layers of cutaneous muscle that act as synergic mechanism to erect the quills. The cutaneous muscle of javan porcupine was very well-developed and able to accommodate the formation of fan like-shape quills and rattling noise as defense mechanism when threatened.

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