



Research Article

Morphological Study of the Restricted and Moving Structures of the Tongue Muscle in Dromedary Camels (*Camelus dromedarius*)

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ABSTRACT

The purpose of this study was to establish description of the restricted and moving structures of the tongue muscle in dromedary camels. Ten clinically healthy of both sexes and different age, 4-9 years old, were used in this study. The head of the camels were euthanized, preserved with 10% formalin solution and used to determine the description of the restricted and moving structures of the tongue muscle. This study has shown that the tongue was attached by many structures. Such the frenulum linguae, the lingo-mandibular, the glosso-palatine folds, the glosse-piglottic fold and the glosso-pharyngeal folds. The frenulum linguae which connected the tongue with the floor of the mouth. The lingo-mandibular folds were associated to the mandible. The glosso-palatine folds were connected to the soft palate. The glosse-piglottic fold was between the tongue and the epiglottic cartilage and the glosso-pharyngeal folds formed the wall of the pharynx. Moreover; They were three tongue muscles responsible for the movement were styloglossus, hyoglossus, Genioglossus muscles.

Key words: Structure, Tongue, Muscles, Camels

INTRODUCTION

The morphology study of the restricted and moving structures of the Tongue muscle in dromedary camels is very important because of the presence of the attachments and relationships with the other structures such as the oral cavity, soft palate, epiglottic cartilage and pharynx. The tongue is highly moving muscular organ in the digestive system for prehension (Dyce *et al.*, 2010), mastication and deglutination (Nickel *et al.*, 1979). It helps in taking food swallowing and rumination, manipulation of food in the mouth (Igado, 2011). The anatomy of the tongue was previously studied in most domestic animals by (Nickel *et al.*, 1979). In camel (Lilianlian *et al.*, 2012; Shoghy and Saber, 2013; Alsafy *et al.*, 2014 and Saidu *et al.*, 2015). In bovine (Budras and Habel, 2011). In Buffalo (Prakash, 1980; Parvez and Rahaman, 2005). In goat (Lahkar, 1985 and Kumar *et al.*, 2015). The adult dromedary tongue (of both sexes) was very flexible (Saidu *et al.*, 2015).

From the ventral surface of the tongue a median fold of mucous membrane (Nickel *et al.*, 1979) in domestic animals and (Alsafy *et al.*, 2014) in camel. The frenulum linguae extended from the root of the tongue to the 3-4 cm rostral to the level of the first cheek tooth in Indian

Bos (Parvez and Rahaman, 2005). The body of the tongue (basihyoid) gave off a stubby median lingual process, attached to the floor of the oral cavity is the broad, double frenulum of the tongue (Budras and Habel, 2013) in bovine. In One-Humped Camel there were two folds of mucous membranes extended from each side of the tongue root and these met dorsally to form a triangular enlargement of the soft palate (Alsafy *et al.*, 2014). stated that in sambar deer the root was connected with the soft palate by two lateral mucosal folds, the palatoglossal arches. On the other hand, the root begins at the level of the palatoglossal arch and slopes toward the base of the epiglottis in horse (Budras *et al.*, 2009). In bovine the root and on both sides of the median glossoepiglottic fold (Budras and Habel, 2011). The lingual process is missing in the hyoid bone of the camel (Shoghy and Saber, 2013). On the other hand, (Lilianlian, *et al.*, 2012) in the bactrian camel mentioned that The basihyoideum had no lingual process. The central bone of the hyoid Apparatus presents a prominent lingual process in horse (Budras *et al.*, 2013). Therefore, the present study was conducted to describe the restricted structures and dynamics of the camels naturally than adults Arabian camels.

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MATERIALS AND METHODS

Ten heads with tongues of apparently healthy adult camels of both sexes, and different ages were collected from the slaughter house in Qassim region in KSA. All the heads were cut off at the level of the occipital-atlas joint.

The oral cavity was examined to describe the restricted structures of the tongue and to observe the topographical relationship of tongue with the oropharyngeal cavity. The oral cavity and the tongue were washed and rinsed in running tap water to remove the blood and to eliminate food remains and other substances.

They were preserved in 10% formalin for 3-4 days. The fixed specimens were used to study morphological and topographic restricted structures of the tongue movement. Then, the mandible was separated from one side at the level of the Paracondylar process, and the second was cut behind the mental foramen by saw, then separates the buccal, digastric and medial alar muscles were separated from the ramus of mandible, by a scalpel, while the mylohyoideus muscle was left to observed and describe the extrinsic linguistic muscle. The photography was photographed digitally recorded using a 6 mega pixels, Dsc - w 50 Camera.

RESULTS

The tongue of the camel occupies the floor of the proper oral cavity between the two horizontal rami of the mandible. It consists of three parts, apex (the cranial part), body (middle part) and root (the caudal part). The tongue extends from the entrance of the proper oral cavity freely to the oropharyngeal part of the pharynx, where it is fixed. It is restricted between the lingual surfaces of the of the ramus of mandible by the lingo- mandibular folds and the extrinsic lingual muscles laterally, basihyoid part of the hyoid bone caudally, glosso-pharyngeal arches caudolaterally, and the floor of the mouth by the frenulum linguae ventrally and free cranially.

The results revealed that the camel tongue was restricted by many structures in spite of its muscles movement. This restriction corresponds with the physiological functions of the camel such as, respiration, taking food, swallowing and manipulation of food in the mouth. These restricted structures are: frenulum linguae, lingo- mandibular folds, glosso-palatine folds, glosso-epiglottic fold and glosso-pharyngeal folds.

The Frenulum linguae (Fig. 1, 2, 3, 5, 6) is represented by a median crescentic membrane, elastic fold, at the beginning body of the tongue. It extends from the ventral surface of the body tongue to the floor of the proper oral cavity, caudal to the level crancula, in the middle distance between the canine teeth and the first Premolars tooth cheek. The frenulum linguae becomes thick and wide due to the extension increasing caudally.

The frenulum linguae extends cranially in the middle of the ventral surface of the tongue forming something fibers cordis, it reaches to the tongue apex.

The lingo- mandibular folds (Fig. 4, 5) are paired, thick and strong folds. They begin at the level of the middle distance between the canine teeth and the first Premolars check tooth and at the level frenulum linguae. They extend from both of the lingual surfaces of the

horizontal ramie of the mandible body to the lateral surfaces of the body and the tongue root. These folds increase widely caudally on both sides to incorrupt at the caudo-ventral side of the tongue root with the glosso-palatine folds

These folds have a zigzag shape on the dorsal surfaces and small folds which restrict the tongue movement between the two horizontal ramus of mandible.

The glosso-palatine folds (Fig.7, 8) represent the lateral mucosal folds. It extends from both lateral sides of the tongue root. These folds meet with each other dorsally forming a triangular expansion of the soft palate. They begin at the tongue body end in the caudal part of the oral cavity and slopes dorsally toward soft palate forming Glosso- palate arches. Each glosso-palatine fold contains glosso-palate ligament. It presents an elastic fibers bands. It extends along a free arch border to give the flexibility and support to the glosso-palate arches.

The glosso-epiglottis fold (Fig.9, 10) is a middle fold. Its represented by a thick mucosal membranes from the dorsal surface of the tongue root to attach to the free border in the middle of the lingual surface of the epiglottis ventrally. The glosso-epiglottis fold is very small according to the tongue size. It is narrow cranially, wide caudolaterally. It continues laterally by glossopharyngeal folds.

The glossopharyngeal folds (Fig.9) are the continuation of the craniolateral of the glossoepiglottic fold on the both sides of tongue root. They are very thick and large bilateral projections, extending over the caudal part of the root tongue and the rostral part of the pharynx wall. They attach the tongue root to the entrance of the pharynx, forming the cranial wall of the pharynx through, which likes the glossopharyngeal arches.

There isn't a lingual process to support the installation of the tongue. There is only a basihyoid part of hyoid bone to lean on the caudal part of the tongue at the Genioglossus muscle

The results revealed that the tongue has three main extrinsic muscles. They are responsible tongue movement, in different directions, cranially, caudally and two sides. These muscles are arranged as follows:

1-styloglossus muscle (Fig.11, 12, 13) is situated under the geniohydeus muscle. It has strap shape. It arises from the caudal part of the lateral surface of stylohyoid bone and passes cranially to insert inside by muscular bundles fibers in the cranial part of the tongue apex. Right and left muscles fuse together near the tip of the tongue. Each muscle is responsible for tongue movement due to its situation and fibers direction. The Right and left muscles pull the tongue caudodorsally and shorten it. Each one of these muscles moves the tongue in unilateral contraction to the side.

2-hyoglossus muscle (Fig.11, 12, 13) lies dorsolaterally on the styloglossus muscle. It occupies the space between the genioglossus medially and the styloglossus laterally. It appears in strapping shape, arising from the basihyoid part of hyoid bone at the tongue root.

The muscle fibers are directed cranially towards the free part of the tongue to insert inside the apex. This muscle has muscular bulging body in the middle to turn into muscular tendon inserting the tongue body and root near a median plane. It shortens and pulls the tongue in a pair action caudoventrally.



Fig. 1: A photograph shows the Frenulum linguae in camel; (fl) frenulum linguae, tongue (t), check (ch) and the floor of the mouth (fm).

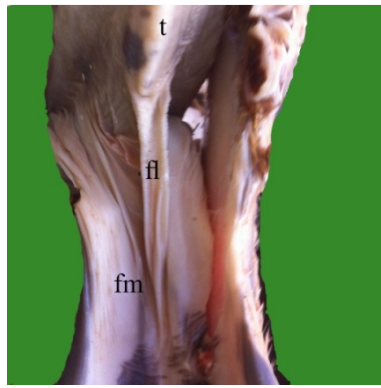


Fig. 2: A photograph shows the Frenulum linguae attaching the tongue and floor of the mouth in stiu; Frenulum linguae(fl), tongue (t) and the floor of mouth (fm).

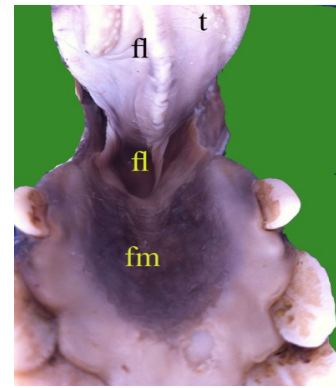


Fig. 3: A photograph shows the extension of the frenulum linguae fibers cordis on the ventral surface of tongue; frenulum linguae (fl), tongue (t) and the floor of the mouth (fm).

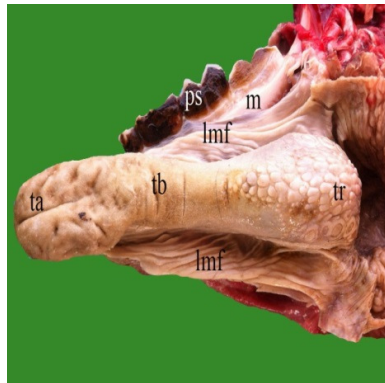


Fig. 4: A photograph shows the lingo-mandibular folds attaching the tongue of camel to the mandible; lingo-mandibular fold (lmf), ramus of mandible (m), Premolars (Ps), tongue apex (ta) tongue body (tb) and the tongue root (tr).

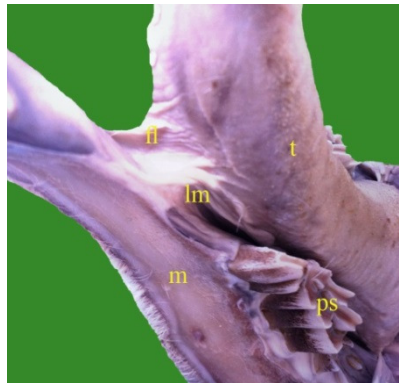


Fig. 5: A photograph shows the lingo-mandibular fold and the frenulum linguae; tongue (t), frenulum linguae (fl), lingo-mandibular fold (lm), Ramus of mandible (m) and Premolars (Ps).

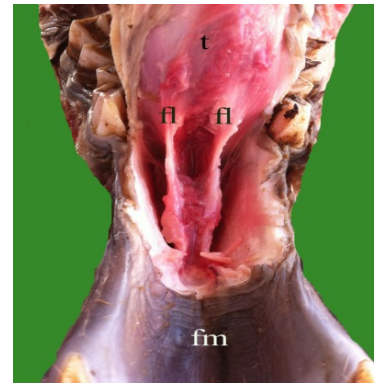


Fig. 6: A photograph shows the speclizes cases frenulum linguae in camel; (fl) frenulum linguae, tongue (t), and the floor of the mouth (fm).

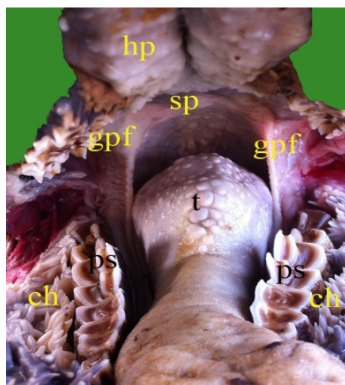


Fig. 7: A photograph shows the glosso-palatine folds (gpf), hard palate (hp), soft palat(sp), Premolars(Ps) and cheek (ch).

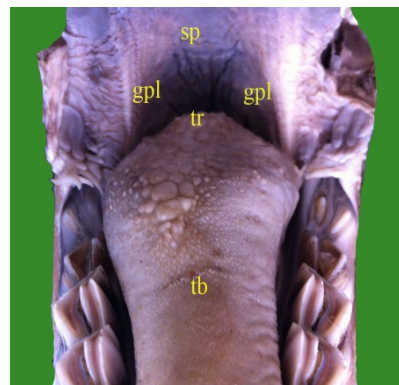


Fig. 8: A photograph shows the glosso-palatine folds with their ligaments; glossopalate ligament(gpl), soft palate(sp), tongue root(tr) and the tongue body (tb)

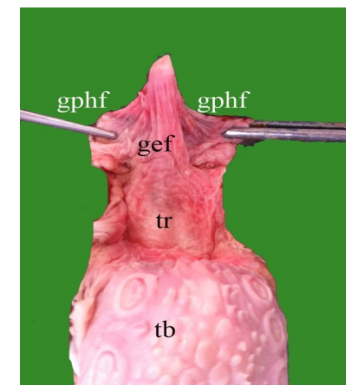


Fig. 9: A photograph shows the relation of the glosso-epiglottic fold with tongue root and the epiglottis; glossoepiglottic fold (gef), glosso-pharyngeal fold (gphf) and tongue root (tr) and the tongue body (tb).

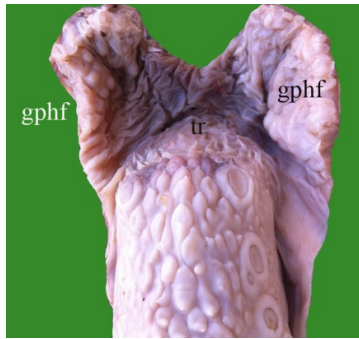


Fig. 10: A photograph shows the relation of glossoepiglottic folds with tongue root; glosso-pharyngeal fold (gphf), glossoepiglottic fold (gef) and the tongue root (tr).

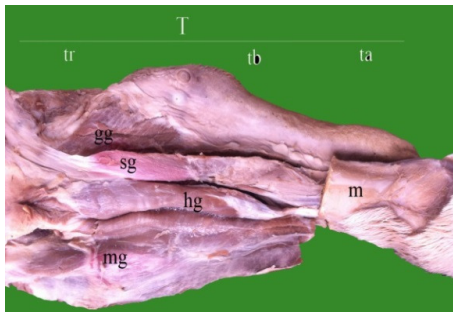


Fig. 11: A photograph shows the muscles of the tongue; genioglossus (gg), styloglossus (sg), hyoglossus (hg). The incisive part of the mandible body (m) and mylohyoides (mg).

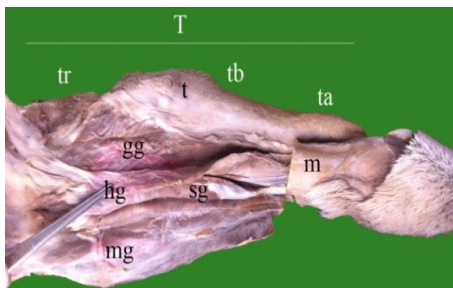


Fig. 12: A photograph shows the muscles of the tongue; genioglossus (gg), styloglossus (sg), hyoglossus (hg).The incisive part of the mandible body (m) mylohyoides (mg), tongue apex (ta), tongue body (tb) and the tongue root (tr).

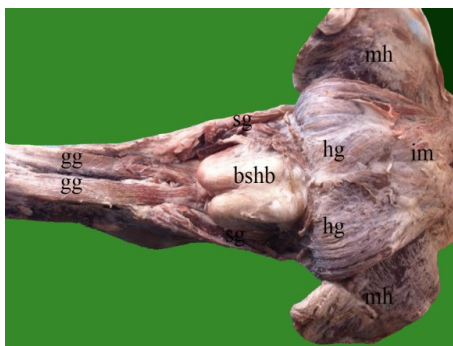


Fig. 13: A photograph shows the ventral surface of the tongue muscles and its relation with the hyoid bone; genioglossus (gg), styloglossus (sg), hyoglossus (hg).The incisive part of the mandible body (m) mylohyoides (mg) and basihyoid part of the hyoid bone.

3-Genioglossus muscle (Fig.11, 12, 13) is covered by the hyoglossus and geniohyoideus muscles laterally. It has fan, flat shape. It situates along the median plane in the tongue between the two horizontal ramus of mandible. It arises from the incisive part of the mandible then the muscle divides into bundles which direct cranio-ventrally in the sagittal plane to the tongue apex cranially and inserts in the tongue mass from the inferior surface of the tongue into the tip toward the root. Functionally it draws the tongue forward and ventrally.

DISCUSSION

In this study, it has been investigated the anatomical characteristics of the restricted structures of the camel tongue by morphological descriptions and observation among them. The results were compared with previous researches conducted on camels and some similar animals.

This study has shown that frenulum linguae in the camel tongue was a median crescentic membrane, elastic fold, It extended from the ventral surface of the body tongue to the floor of the ventral surface of the tongue forming something fibers cordis. Similar results for the frenulum linguae have been reported in various domestic animals (Nickel *et al.*, 1979; Dyce *et al.*, 2010) bovine (Budras and Habel, 2011) and horse (Budras *et al.*, 2013) and in sambar deer (Seeranjini, *et al.*, 2010). Moreover; the frenulum linguae extended from the root of the tongue to the 3-4 cm rostral to the level of the first check tooth in Indian Bos (Parvez and Rahaman, 2005). On the contrary of this study the frenulum linguae extended cranially in the middle distance between the canine teeth and the first Premolars tooth check, while in goat it was fragile fold of mucous membrane (Kumar *et al.*, 2015). In emu the posterior part of frenulum enclosed the basihyale and its lateral edges enclosed the paired ceratohyale on either side. On the other hand, the frenulum linguae was a broad, double frenulum of the tongue (Budras and Habel, 2011) in bovine. It was observed in one sample of specimens and studied in this research.

The results revealed that the lingomandibular folds were paired, a thick and strong folds. They extended from both of the lingual surfaces of the mandible body to the lateral surfaces of the body and the tongue root. These folds increase in wide caudally and they had a zigzag shape on the dorsal surfaces and a small folds. It did not record any information about these folds and the study on this point does not exist

The gloss-palatine folds in this study were lateral mucosal folds. It extended from both lateral sides of the tongue root. These folds met with each other dorsally, forming a triangular expansion of the soft palate. They formed Gloss- palate arches. Each glosso-palatine fold contained glosso-palate ligament. Similar results for the gloss-palatine folds had been recorded that the root connected with the soft palate by two lateral mucosal folds, the palatoglossal arches. In various domestic animals (Nickel *et al.*, 1979; Dyce *et al.*, 2010) bovine (Budras and Habel, 2013) and horse (Budras *et al.*, 2013) and in sambar deer and added (Budras *et al.*, 2013) the root begins at the level of the palatoglossal arch and slopes toward the base of the epiglottis in horse. While in

the bovine the palatoglossal arches were attached to the sides of the root of the tongue (Budras and Habel, 2011).

The glossopharyngeal folds were very thick and large bilateral projections. It formed the cranial wall of the pharynx through which was like the glossopharyngeal arches. This observation was similar to bovine (Budras and Habel, 2011) and horse (Budras *et al.*, 2013).

The glosso-epiglottis fold is a thick mucosal membranes. It extended from the dorsal surface of the tongue root to attach to the free border in the middle of the lingual surface of the epiglottis ventrally. But in the bovine, on the root and on both sides of the median glosso-epiglottic fold are many small orifices of the crypts of the lingual tonsil (Budras and Habel 2011). In goat the root of the tongue slopes caudo-ventrally toward the base of the epiglottis (Kumar *et al.*, 2015). In sambar deer the glossoepiglottic fold was a central connecting the root of tongue to the base of epiglottis.

This study demonstrated that there wasn't linguae process in the camel tongue to restrict of the tongue, but the basihyoid part of the hyoid bone provided support and price to the tongue muscles. Similar results for the linguae process have been mentioned by (Lilianlian, *et al.*, 2012 and Shoghy and Saber, 2013) in the Bactrian camel. Conclusions which differ from those of the bovine, the body (basihyoid) gives off a stubby median lingual process. (Budras and Habel, 2011) and horse, the hyoid Apparatus presents a prominent lingual process (Budras *et al.*, 2013.)

In the present findings, three main muscles of tongue camel included styloglossus, hyoglossus, geniglossus muscles; the styloglossus muscle was striping shape. It originated from the styloid bone and inserted to insert at the middle of the tongue by muscular bundles fibers in the cranial part of the tongue apex. The hyoglossus had muscular bulging body in the middle to turn into muscular tendon. It originated from the basihyoid bone, lingual process and the thyrohyoid bone and inserted at the root of the tongue near a median plane, while the geniglossus had fan, flat shape. It situated along the median plane in the tongue between the two horizontal ramus of mandible and attached to the symphysis and adjacent body part of the mandible. It inserted in the tongue, this results were similar in tongue muscles of camel have been (Smuts and Bezuidenhout, 1987; Chibuzo 2006 and Saidu *et al.*, 2015), bovine (Budras and Habel, 2011) and horse (Saidu *et al.*, 2015; Budras *et al.*, 2013) mentioned that the hyoglossus muscle originated from the basihyoid bone and lingual process in camel. On the contrary; this study revealed that there isn't a lingual process and the hyoglossus muscle originated from the basihyoid bone only.

Conclusion

The tongue of the adult dromedary just like those of other ruminants are completely resilient organs and their sizes are relatively small when compared to the overall sizes of the animals. The tongue attached in its situation by many structures were frenulum linguae related the tongue to the floor of the mouth. The lingo- mandibular folds associated with the mandible. The glosso-palatine folds connected to the soft palate. The glosse-piglottic fold was between the tongue and the epiglottic cartilage

and glosso-pharyngeal folds formed the wall of the pharynx with absence the lingual process in addition they were three tongue muscles responsible the movement were styloglossus, hyoglossus, Geniglossus muscles

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