

# The rhinoceros lingual intrinsic musculature

by

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La dissection des muscles de la langue chez les rhinocéros (*Rhinoceros*, *Ceratotherium*, *Diceros*) montre une continuité anatomique entre les muscles intrinsèques et les muscles extrinsèques. Le m. verticalis linguæ est en continuité avec le m. genioglossus et le m. transversus linguæ avec le m. hyoglossus. Ceci prouve que les muscles intrinsèques de la langue ne sont pas des entités morphologiques mais seulement des parties modifiées des muscles extrinsèques. Ainsi les rapports morphologiques réciproques des muscles de la langue des rhinocéros répondent exactement à ceux observés par Lesbre chez le cheval.

## INTRODUCTION

Conventionally the mammalian tongue muscles are classified as extrinsic or intrinsic according to their relationship to the lingual mass, the extrinsic muscles lying mostly outside that mass, the intrinsic muscles entirely within it. Such topographical classification has the merit of convenience but it ignores any possible morphological association of the two muscle groups and leaves unexplained the exact status of the intrinsic muscles. This status is little considered in the literature of descriptive myology, so that a general impression prevails that these muscles are independent morphological entities. However, this view has long been challenged by some comparative anatomists who have suspected the intrinsic tongue muscles to be nothing other than differentiated portions of the extrinsic muscles; and Lesbre (1922) has adduced anatomical evidence in support of this interpretation. No later veterinarian author appears to have repeated Lesbre's investigations so that the question remains unsettled and further information relevant to the issue remains still desirable. Accordingly some such information derived from the myological investigation of the rhinoceros tongue, is submitted herein.

Though McMurrich (1912) pleaded for more intensive study of the subject, little precise information is available concerning the mode and sequence of origin of the mammalian lingual intrinsic muscles. For *Homo*, on embryological grounds, Kallius (1901) derived the intrinsic verticalis and transversus muscles from the extrinsic genioglossus muscle and Jonnesco (1901), on anatomical grounds, derived the intrinsic longitudinal muscles from the extrinsic styloglossus and hyoglossus muscles. For *Equus*, by direct anatomisation of the tongue, Lesbre (1922) demonstrated continuity of the intrinsic transversus muscle with the extrinsic hyoglossus muscle and from his researches concluded that all the equid intrinsic muscles were essentially extensions of the extrinsic muscles. Lesbre's findings for the horse tongue are confirmed by present findings in the rhinoceros tongue.

The extrinsic and intrinsic lingual muscles develop from a common mass of occipital myotomic tissue which invades the embryonal tongue and duly differentiates

into the canonical tongue muscles. During this differentiation the major (extrinsic) muscles precede the minor (intrinsic) muscles (Frazer, 1931).

Any particular intrinsic muscle can develop in one or other of two ways only — either by direct metamorphosis of the original myotomic tissue or by detachment from the mass of an antecedent extrinsic (major) muscle. The balance of the embryological evidence favours the latter mode of development.

For most mammalian forms embryological investigation of the development of tongue muscles is precluded by absence of the requisite study material. Hence, where practicable, direct anatomisation of the tongue itself may yield evidence not otherwise obtainable, evidence, that is, of continuity between a given intrinsic, and a given extrinsic, muscle, such continuity being presumptive evidence of the derivation of the minor (intrinsic) muscle from the major (extrinsic) muscle. Tongues so studied require to be of suitably large size and to present few and obstrusive intrinsic muscles. Such an organ is the rhinoceros tongue.

## MATERIALS AND METHODS

The general morphology of the rhinoceros tongue has been detailed elsewhere (Cave, 1977) : the descriptive terms introduced there are employed herein. The single tongues of *Rhinoceros unicornis*, *Ceratotherium simum* and *Diceros bicornis* utilised in the morphological study were subsequently investigated myologically by longitudinal and transverse section and by fine dissection. Special attention was paid to the anatomical relationship of the intrinsic muscles (mm. verticalis et transversus linguae) to the extrinsic muscles (mm. genioglossus, hyoglossus, styloglossus) with the object of determining any structural connexion between them. The particulars of this relationship are summarised below and constitute evidence relevant to the true nature of the rhinoceros intrinsic tongue musculature.

## OBSERVATIONS

### 1. GENERAL

The tongue muscle fasciculi, both intrinsic and extrinsic, terminate individually in tendons of extreme strength and fineness, most of which insert into the corium of the dorsal mucosa. The perimysium clothing the dorsum of the lingual mass is converted into a thick, tough fibrous helmet (galea tendinea) by the interlacement upon and within it of those multitudinous filiform tendons, prior to their insertion fanly into the mucosa corium. This corium is everywhere much thickened and indurated, particularly so over the pass elliptica linguae, wherein it forms a tough collagenous plate, dorsally augmented posteriorly to form the core of the intermolar eminence.

The symmetrical moieties of the tongue are unseparated by any complete median septum, but a partial septum is developed within the dorsal region of the corpus linguae. This is a strong, fibrous, localised partition, ovoid in coronal section, which extends dorso-ventrally through some one third of the tongue thickness (Fig. 1). It divides the tongue mass into para- and infraseptal districts. The intrinsic muscles are confined to the paraseptal district and one of them, the m. transversus linguae,

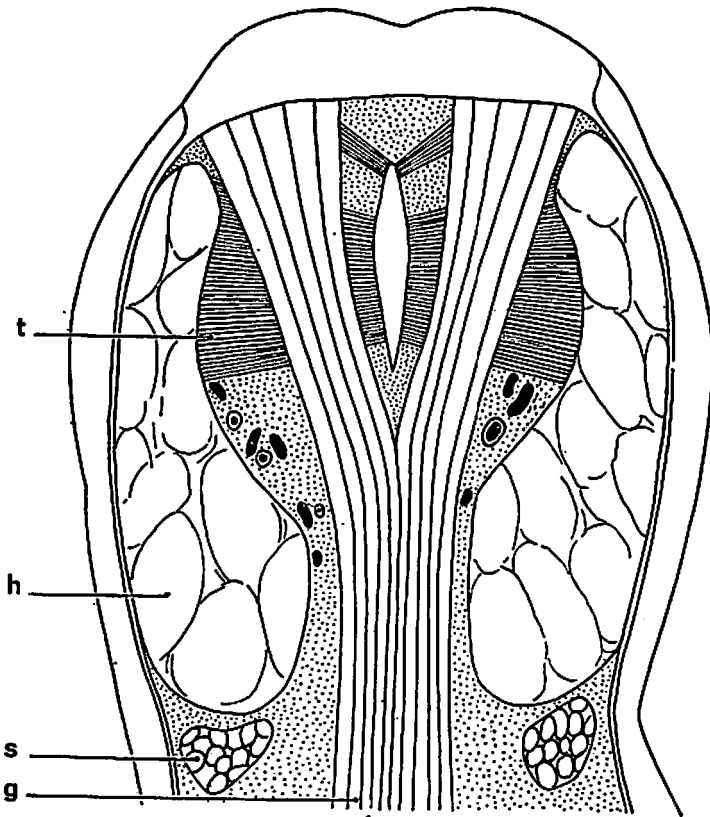


Fig. 1. — Rhinoceros tongue. Coronal section through corpus linguae to show muscle relationships. g = m. genioglossus; h = m. hyoglossus; s = m. styloglossus; t = m. transversus linguae.

has exclusive insertion into the entire lateral aspect of the septum. The fasciculi of this muscle so interdigitate with those of the m. verticalis linguae, as to render much of the paraseptal region a rectangular fascicular latticework.

## 2. THE MUSCLES

The topographical relationships of the several tongue muscles are admirably demonstrated by coronal sections of the corpus linguae (Figs 1, 2). Such sections show the extrinsic genioglossus muscle to increase considerably in width ventro-dorsally, to be infraseptally in opposition with its contralateral fellow and paraseptally to be separated therefrom by the lingual septum. Paraseptally it is separated laterally from the incurving dorsal portion of the hyoglossus muscle by an interval containing soft fibro-fatty tissue and accommodating the deep lingual bloodvessels and establishes contiguity to the hyoglossus at its superior extremity only. Some of the genioglossus fasciculi are traceable in unbroken continuity from the intraseptal mass of the muscle

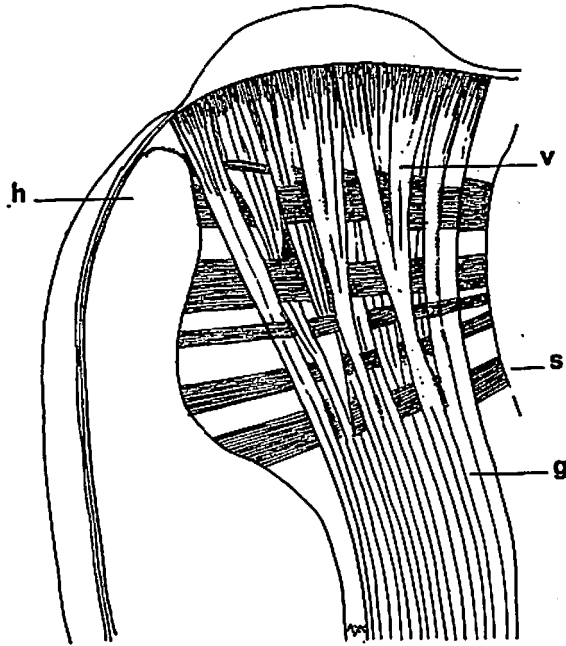


Fig. 2. — Rhinoceros tongue. Paraseptal region of corpus linguae to show detailed relationships of intrinsic (verticalis, transversus) muscles. Diagrammatic. g = genioglossus muscle; h = hyoglossus muscle; s = lingual septum; t = transversus linguae muscle; v = verticalis linguae muscle.

to their insertion into the galea tendinea and the collagenous plate of the pars elliptica linguae : others, however, appear to terminate within the paraseptal region and to be there replaced by the somewhat scattered fasciculi of the intrinsic verticalis muscle.

Coronal sections of the corpus linguae show the extrinsic hyoglossus muscle to be of pyriform outline, with a ventral (infraseptal) bulbous portion at least twice as wide as its dorsal (paraseptal) portion, which incurves to meet the genioglossus muscle superiorly. The narrower paraseptal portion of the muscle is obtrusively associated with the appearance immediately medial to it of the fasciculi constituting the intrinsic transversus linguae muscle and the localised lingual septum into which these fasciculi insert (Fig. 1).

The intrinsic m. verticalis linguae is restricted to the paraseptal region. It is a discontinuous series of vertically disposed fasciculi, showing a texture alignment and dorsal insertion exactly similar to those manifested by the genioglossus fasciculi and like that muscle situated between the septum medially and the hyoglossus laterally. Its fasciculi have likewise no attachment to the septum but interdigitate intimately in rectangular fashion with those of the m. transversus linguae. Consecutive coronal sections show that a verticalis fasciculus which appears in one such section to be an independent entity is seen in a subsequent section to be directly continuous with the infraseptal (ventral) mass of the genioglossus muscle. Thus the presence of any anatomically distinct intrinsic verticalis muscle is illusory, this so-called muscle

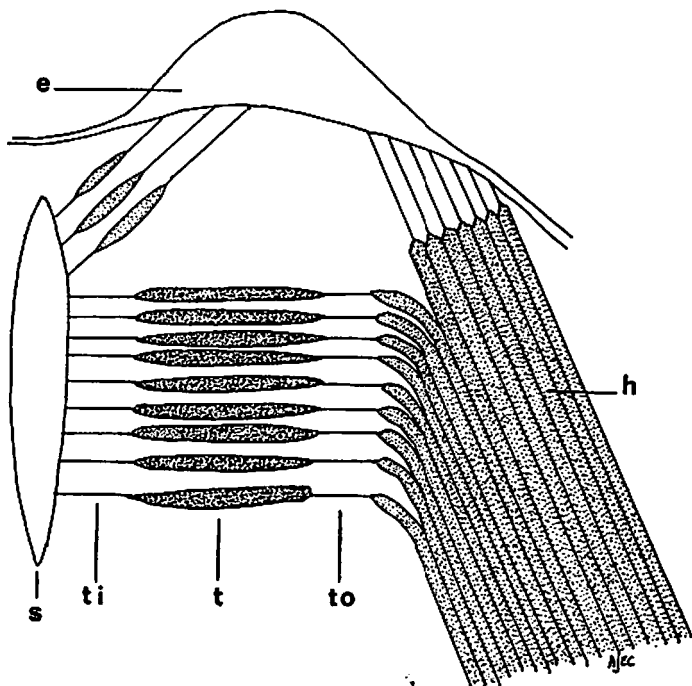


Fig. 3. — Rhinoceros tongue. Coronal section to show constitution of the hyoglossus muscle and its relationship to the transversus muscle. Diagrammatic. e=intermolar eminence; h=hyoglossus muscle; s=septum linguae; t=transversus muscle; ti=transversus tendons of insertion; to=transversus tendons of origin.

being merely the paraseptal (dorsal) portion of the genioglossus muscle modified in appearance by the passage through its substance to the fasciculi representing the m. transversus linguae.

This transversus muscle is also restricted to the paraseptal region, wherein its horizontally disposed fasciculi lie between the narrow dorsal portion of the hyoglossus laterally and the lingual septum medially. Its fasciculi are coarser and less closely packed than those of the genioglossus muscle and resemble those of the hyoglossus muscle: they are most obtrusive immediately medial to the hyoglossus and immediately lateral to the septum, being obscured in the intervening region by their passage through the paraseptal portion of the genioglossus muscle. They arise by fine tendons from the hyoglossus and insert by equally fine tendons into the lingual septum. The tendon of origin of a particular transversus fasciculus is common to that fasciculus and to a hyoglossus fasciculus in the deep aspect of that muscle and is thus akin to the intermediate tendon of a canonically digastric muscle (Fig. 3). Fine dissection reveals that, indeed, the m. transversus linguae and the deep portion of the m. hyoglossus are a continuum composed of multiple digastric muscles with a belly in each muscle mass and that the intermediate tendons are simultaneously the hyoglossus tendons of inversion and the transversus tendons of origin.

The hyoglossus muscle is therefore bilaminar in constitution. It comprises two strata of fasciculi, namely (1) a superficial stratum of vertically disposed, monogastric fasciculi inserting into the corium of the dorsal mucosa and (2) a deep stratum of horizontally disposed, digastric fasciculi inserting into the septum linguae.

## CONCLUSIONS

Myological investigation of the rhinoceros tongue demonstrates a direct structural continuity to obtain between the extrinsic and intrinsic muscles of conventional description. The intrinsic m. transversus linguae is continuous with the extrinsic m. hyoglossus, the intrinsic m. verticalis linguae with the extrinsic m. genioglossus. The so-called intrinsic tongue muscles are not therefore, morphological entities but merely continuations of the extrinsic muscles. These findings in the rhinoceros tongue confirm those of Lesbre in the horse tongue and vindicate his assessment of the true nature of the intrinsic lingual musculature.

The thickened corium of the dorsal mucosa gives insertion to all the tongue muscle fasciculi save those of the deep (transverse, horizontal) portion of the hyoglossus muscle, which (as the conventional m. transversus linguae) inserts wholly into the lingual septum. In view of its intra-lingual dorsal location and its exclusive reception of the transversus fasciculi the septum would appear to have developed solely in response to the functional requirements of the hyoglossus muscle and so to have provided an additional and more stable insertion site for that muscle's transverse element. The morphological dominance of the hyoglossus over the remaining tongue muscles is attested by its evocation of a septal structure and by its topographical disruption of the dorsal genioglossus fasciculi.

## SUMMARY

A description is given of the anatomical relationship found by dissection to obtain between the intrinsic and extrinsic muscles of the rhinoceros (*Rhinoceros*, *Ceratotherium*, *Diceros*) tongue. This relationship, one of continuity, proclaims the intrinsic muscles to be extensions of the extrinsic muscles and not independent morphological entities. In this respect the rhinoceros tongue resembles the horse tongue.

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