

The Musculus mylohyoideus and M. interhyoideus in Necturus

Joseph P. Harris, Jr.

Casual dissection of the ventral surface of the head in *Necturus* reveals an extensive area of muscle fibers crossing the throat and extending from the tip of the lower jaw to the gular fold. The connective tissues and fascia in this area partly mask the fibers; and the muscle fibers collectively have in several instances been described as constituting a single muscle, the *M. mylohyoideus*. In reality two separate muscles are involved, and each consists of two parts. Here follows a tabulation of the synonymy, and a brief description of the muscles:

M. Mylohyoideus (both parts)

Mylohyoideus (*Mylohyoidien*, *Mylohyoid*, *Mylohyoidei*)
Siebold 1828; Carus 1828; Cuvier 1836-40 (partim); Martin-St. Ange 1831; Mayer 1835; Stannius 1854-56; Léon-Vaillant 1863; Schmidt, Goddard & Van der Hoeven 1862; Fischer 1864; Owen 1866; Van der Hoeven 1867; Mivart 1869; Walter 1887; Coghill 1902, 1906

Mylohyoideus (et interhyoideus), Walter 1887

Mylohyoideus (et interhyoideus et interhyoideus posterior), Funk 1827

Intermaxillaire ou mylohyoïdien, Meckel 1838

Intermandibularis anterior, Gegenbaur 1901

Intermandibularis posterior, Drüner 1903, 1904; Luther 1914; Norris 1908, 1913

Sous-maxillaire ou mylohyoïdien, Dugès 1834

Intermaxillaris anterior, Hoffman 1873-78; Wilder 1891, 1892, 1896; von Plessen and Rabinowicz 1891

C_{mv} (post.), Ruge 1896

Mandibular part of the mylohyoideus, Platt 1897

Partie antérieure du mylo-hyoïdien, Rusconi 1837

Mylohyoideus anterior, Fischer 1864; Mivart 1869; Fürbringer 1873; Osawa 1902

Intermandibularis, Francis 1934; Edgeworth 1935

M. Mylohyoideus anterior

Intermandibularis anterior, Drüner 1901; Luther 1914; L. Smith 1921; Edgeworth 1920, 1935; Francis 1934; Piatt 1935, 1938, 1940; Eaton 1936, 1937

Submentalis, Fischer 1843; Mivart 1869; Osawa 1902; Houghton 1903.

(?) Submentalis (agraphic portion of C_{sv} 1, or C_{sv} 1a), Kesteven 1941

Genio-glossus, Schmidt, Goddard and Van der Hoeven 1864

Submaxillaris, Hoffman, 1873-78

C_{mv} (antr.), Ruge 1896

M. Mylohyoideus

Intermandibularis posterior, Drüner 1901; Luther 1914; L. Smith 1920; Edgeworth 1920 et seq.; Francis 1934; Piatt 1935, 1938; Eaton, 1936, 1937

Mylohyoideus anterior, Fischer 1843; Mivart 1869; Osawa 1902

Partie antérieure du mylohyoïdien, Rusconi 1854

- Mylohyoideus, Schmidt, Goddard & Van der Hoeven, 1864
 Intermaxillaris anterior, Hoffman 1873-78; Plessen & Rabinowicz, 1891
 Mylosternoideus, Walter 1887
 C₂vd, Ruge 1897
 Quadrato-pectoralis, Drüner 1901, 1904
 Cephalo-dorso-pectoralis, Drüner 1901, 1904
 Interbranchialis 1, Drüner 1901, 1904
 Quadrato-pectoralis, Drüner 1901, 1904; Piatt 1935
 Omo-humero-maxillaris, Hoffman 1873-78
 Levator maxillae inferioris ascendens, Fischer 1864
 Posterior part of intermandibularis posterior (larva), constrictor colli gularis (adult), L. Smith 1920
 C_{sv} 2 (Superficial ventral constrictor of hyoid arch), Vetter 1874; Kesteven 1941
 Gularis, L. Smith 1921; Eaton 1936, 1937

The two interhyoideus muscles form a broad, thin sheet of muscle covering the under surface of the throat behind the *M. mylohyoideus*.

The *M. interhyoideus* takes its origin on the distal half of the ceratohyal cartilage. Its fibers are directed cranio-mesad to insert on a connective tissue raphe which passes dorsad to the caudal portion of the *M. mylohyoideus*, and which lies just ventral to the *M. geniiohyoideus*. Some of the fibers of the connective tissues of the raphe attach to the posterior and mesial borders of the aponeurosis of the *M. genioglossus*. The origin of the *M. interhyoideus* posterior is on the superficial ventral fascia of the *M. myo- or branchiomandibularis* and of the *M. branchiohyoideus externus*. The fibers pass transversely across the throat, and at their posterior border form an opercular or gular fold. Their insertion is on a median raphe which is a continuation of the raphe of the *M. interhyoideus* anterior. Anterior and posterior parts of this muscle can be distinguished only at their origins; although this method of distinguishing them is easily used, it may be entirely artificial.

M. Interhyoideus (both parts)

- Mylohyoideus, Mylohyoid, Mylohyoidien (partim), Stannius 1854; Schmidt, Goddard & Van der Hoeven 1862; Owen 1866; Humphry 1872
 Intermandibularis posterior, L. Smith 1920
 Mylohyoideus posterior, posterior part of mylohyoid, partie postérieure du mylohyoïdien, Van der Hoeven 1867; Mivart 1869; Fischer 1864; Platt 1897; Osawa 1902
 Adult interhyoideus/larval intermandibularis posterior plus posterior part of intermandibularis anterior, Piatt 1955

M. Interhyoideus

- Interhyoideus, Drüner 1903, 1904; Eaton 1936, 1937; Francis 1934; Edgeworth 1935; Piatt 1938; Kesteven 1941
 Constrictor pharyngis internus, Siebold 1828
 Mylohyoïdien, portion moyenne, Rusconi 1854
 C₂hv, Ruge 1897

- Inter-ossa-quadrata, Drüner 1901
 Subhyoideus s. genio-hyoideus lateralis, Walter 1887
 Anterior part of intermandibularis posterior (larva), interhyoideus (adult), L. Smith 1920
- M. Interhyoideus posterior
 Interhyoideus posterior, Francis 1934; Edgeworth 1935; Piatt 1938, 1940
 Constrictor pharyngis externus, Siebold 1828
 Mylo-hyoïdien, partie postérieure, Rusconi 1854
 C₂mv (post.), Ruge 1896
 C₅v 1b, Kesteven 1941
 M. submaxillaris, Houghton 1903

The two divisions of the mylohyoideus form a thin sheet of muscle stretching across the chin between the rami of the lower jaw. The M. mylohyoideus anterior is located in the broad angle formed by the symphysis of the dentary bones. It is perhaps 3 mm. wide in fully grown *Necturus*. Its fibers are araphic, and cross the midline of the chin between the dentary bones. It is therefore not possible to name the origin and insertion.

The M. mylohyoideus is located posterior to the M. mylohyoideus anterior. It originates along the median border of the anterior three-fourths of the dentary bone, and inserts along an extensive median raphe. Its fibers are long and straight, and (with minor exceptions) are strictly transverse.

Innervation of both parts of the mylohyoideus is provided by the ramus mandibularis of cranial N. trigeminus (V), as it is in *Salamandra* (Francis 1934), *Ambystoma* (Piatt 1938), and other vertebrata (Edgeworth 1935). The mylohyoidei arise from the ventral end of the embryonic mandibular arch. The posterior part originates first; from it a large mass of cells buds off anteriorly to become the mylohyoideus anterior (Piatt 1938).

The mylohyoidei are constrictor muscles, functioning in swallowing and in bucco-pharyngeal respiration. Eaton (1936) though that if the mylohyoideus anterior had any function in *Dicamptodon* it was to resist separation of the mandibles during the swallowing of large prey.

Innervation of the M. interhyoideus is from a ventral ramus of the cranial N. facialis (VII). The ramus has been named the jugularis by Francis (1934) and Piatt (1938), and hyomandibularis by Edgeworth (1935). The embryonic origin of both parts of the M. interhyoideus is from the hyoid arch (Piatt 1938).

The interhyoidei are constrictor muscles, and function in swallowing and in movement of the external gills.

Discussion

Several minor errors have helped to create the confusion that surrounds the names of these two muscles in the Urodela. Both muscles have been several times described as constituting the *M. mylohyoideus* in whole or in part, as the tables of synonymy show. Only when the innervation has also been studied (Francis 1934; Edgeworth 1935; Piatt 1938) has it been possible to recognize the muscles as superficial ventral constrictors of the mandibular and hyoid visceral-arches.

The *M. mylohyoideus* anterior has been described as a strictly "larval" muscle which disappears at metamorphosis. Francis (1934) reported the muscle present in larval *Salamandra*, but not in the adult. Piatt (1938) described it in larval *Ambystoma punctatum*, but not in the adult. Edgeworth (1935) noted the presence of an anterior portion of the muscle in *Salamandra*, *Amphiuma*, and *Cryptobranchus*, but did not specify whether he was treating of larval or adult stages. Eaton (1936) found the *mylohyoideus* anterior present in larval *Dicamptodon ensatus*, but disappearing at metamorphosis. Kesteven (1941) stated that an anterior portion of the *mylohyoideus* (his "submentalis" or Csv 1a) is "of very general occurrence" in the Amphibia, as well as present in all reptiles and in many birds. He suggested it is the "submentalis" and not the more posterior part of the *M. mylohyoideus* which gives rise to the *M. mylohyoideus* of the Theria. This conclusion Kesteven based upon his finding that the "submentalis" is commonly deeper than the more superficial and posterior *M. mylohyoideus*. Eaton (1936) printed a quotation from *Bronn's Klassen und Ordnungen des Thier-Reiches* to the effect that the *mylohyoideus* anterior is lacking in all perennibrachiates and in *Amphiuma*, but is strongly developed in *Cryptobranchus*.

I have dissected several specimens of Urodela to discover the presence or absence of the *M. mylohyoideus* anterior. The muscle is consistently present in *Necturus*, in the axolotl of *Ambystoma tigrinum*, and in *Siren lacertina*. The muscle is absent in metamorphosed *Ambystoma tigrinum*, *A. maculatum*, *A. jeffersonianum*, *Amphiuma means tridactylum*,

Aneides lugubris, *Cryptobranchus alleghaniensis*, *Plethodon cinereus*, *Triturus torosus*, *T. viridescens*. There is some doubt about the presence of the muscle in the adult *Eurycea melanoplura*, for in the one small specimen I had for dissection there appeared to be a narrow band of araphic transverse fibers in the position appropriate to the *M. mylohyoideus anterior*.

I found a muscle answering the description of the "submentalis" of Kesteven in all of my specimens, including those in which the *M. mylohyoideus anterior* was present. It is possible that Kesteven used the name "submentalis" to describe the *M. genioglossus* of the Urodela; a muscle used for manipulation of the tongue, and not a derivative of the mandibular arch.

The position and attachments of the *M. interhyoideus* in *Necturus* have been described by Edgeworth (1935) as essentially "larval." In *Caducibranchiata* the muscle at metamorphosis undergoes considerable change—the extent of which is correlated with the changes in the position of the ceratohyal. Usually the *M. interhyoideus posterior* is lost at metamorphosis.

The homologies of the muscles treated here appear to be clear. Because of their origin, innervation, and obvious structural affinities, the *M. mylohyoideus* and *M. interhyoideus* of *Necturus* are homologous with the mandibular and hyoidean ventral constrictors of the *Elasmobranchii*, and with the *mylohyoideus* and *stylohyoideus* muscles of *Amniotes*.

Edgeworth (1935) used the names "intermandibularis" and "interhyoideus" to denote the superficial ventral constrictor muscles and their phylogenetic derivatives (as he interpreted them) in the vertebrate classes. His system has much merit, but the name "mylohyoideus" is so widely used that it is doubtful that it can or should be supplanted. Hence I have used the name *mylohyoideus* for this muscle in *Necturus*. I follow Edgeworth (and others), however, in the matter of a name to be applied to the hyoidean ventral constrictor in *Necturus*, and hence call it the *M. interhyoideus*. Kesteven (1941) noted that while the *M. interhyoideus* is truly interhyoid, the *M. interhyoideus posterior*, arising from the superficial fascia, is not. Accordingly, he recommended that the anterior part be named "interhyoid" and

the posterior part "Cv 2" (hyoidean superficial ventral constrictor). Eaton (1937) had previously recommended that the *M. interhyoideus posterior* be called the "gularis" since this name is brief, clear as to the position of the muscle, and non-committal as to its origin and insertion. Worthy though these suggestions are, it seems better to use the names *interhyoideus* and *interhyoideus posterior*, since these tell the approximate position, and indicate a common segment of origin for the two portions.

LITERATURE CITED

- CARUS, CARL GUSTAV 1828-55
Tabulae anatomiam comparativam illustrantes. Lipsiae: G. Fleischneri, 1828-55.
 9 fascicles.
- COGHILL, G. E. 1901.
 The rami of the fifth nerve in Amphibia. *Jour. Comp. Neur.* 11:48-60.
- COGHILL, G. E. 1902.
 The cranial nerves of *Amblystoma tigrinum*. *Ibid.* 12:205-89.
- COGHILL, G. E. 1906
 The cranial nerves of *Triton taeniatum*. *Ibid.* 16:247-64.
- CUVIER, G. 1835-46.
Leçons d'anatomie comparée. Paris: C. L. Dumeril, 2nd ed., 8 vols.
- DRUENER, L. 1901.
 Studien zur Anatomie des Zungenbein-, Kiemenbogen-, und Kehlkopf-muskels der Urodelen. I Teil. *Zool. Jahrb.* 15:435-622.
- DRUENER, L. 1903.
 Ueber die Muskulatur des Visceralskelettes der Urodelen. *Anat. Anz.* 23:545-71.
 (Also, *Verh. Anat. Ges.* 17:142-44)
- DRUENER, L. 1904.
 Studien zur Anatomie des Zungenbein-, Kiemenbogen-, und Kehlkopf-muskulatur der Urodelen. II Teil. *Zool. Jahrb.* 19:361-690.
- DUGES, A. 1834.
 Recherches sur l'ostéologie et la myologie des Batraciens à leurs différents âges. *Mém. Savans Étrangers* 6:1-216.
- EATON, THEODORE H. 1936.
 The myology of salamanders with particular reference to *Dicamptodon ensatus* (Eschscholtz). I. Muscles of the head. *Jour. Morph.* 60:31-76.
- EATON, THEODORE H. 1937.
 The gularis muscle in urodeles. *Ibid.* 60:317-24.
- EDGEWORTH, F. H. 1920.
 On the development of the hyobranchial and laryngeal muscles in Amphibia. *Jour. Anat.* 54:125-62.
- EDGEWORTH, F. H. 1935.
The Cranial Muscles of Vertebrates. Cambridge University Press, 1935, pp. 1-493.
- FISCHER, JOHANN GUSTAV 1864.
Amphibiorum nudorum neurologiae specimen primum. Berolini: W. Besser, pp. 1-75.
- FISCHER, JOHANN GUSTAV 1864.
Anatomische Abhandlungen über Perennibranchiaten und Derotremen. Erstes Heft. Die Visceralbogen und deren Muskels. Die Gehirnnerven. Hamburg: O. Meissner, pp. 1-172.
- FRANCIS, ERIC T. B. 1934.
The Anatomy of the Salamander. Oxford: Clarendon Press, pp. 1-381.
- FUNK, ADOLPHUS FRIDERICUS 1827.
De Salamandrae terrestri vita, evolutione, formatione tractatus. Berolini: Dunckeri et Humboldtii, pp. 1-60.
- FUERBRINGER, MAX 1873.
 Zur vergleichenden Anatomie der Schultermuskeln. *Jenaische Zeitschr. f. Med. u. Naturw.* 7:237-320.
- GEGENBAUR, CARL 1901.
Vergleichende Anatomie der Wirbelthiere mit Berücksichtigung der Wirbellosen. Band 2. Leipzig: W. Engelmann, pp. 1-696.
- HOFFMANN, C. K. 1873-78.
Bronn's Klassen und Ordnungen des Thier-Reiches. "Amphibien." Bd. VI, Abth. 2, pp. 1-240.
- HOUGHTON, HENRY SPENCER 1903.
 Muscular and skeletal elements in *Spelerpes longicaudus*. *The Ohio Naturalist*, 3:379-93.
- HUMPHRY, G. M. 1872.
 The muscles and nerves of the *Cryptobranchus japonicus*. *Jour. Anat. & Physiol.* 6:1-61.
- KESTEVEN, H. LEIGHTON 1941
 Comments on Piatt's terminology in salamander myology. *Copeia* 1941:252-54.

- LUTHER, A. 1914.
Ueber die vom N. trigeminus versorgte Muskulatur der Amphibien mit einem vergleichenden Ausblick ueber der Adductor mandibulae der Gnathostomen und einem Beitrag zum Verstaendnis der Organisation der Anuren-larven. Acta Soc. Sci. Fenn. 44:1-151.
- MARTIN-ST. ANGE, G. J. 1831.
Recherches anatomiques et physiologiques sur les organes transitoires et la metamorphose des Batrachiens. Ann. Sci. Nat. 24:366-434.
- MAYER, A. F. J. C. 1835.
Analecten für vergleichenden Anatomie. Bonn: E. Weber, pp. 1-95.
- MECKEL, JOHANN FRIEDRICH 1828-38.
Traité général d'anatomie comparée. Paris: Villaret et Cie. 10 vols.
- MIVART, ST. G. 1869.
Notes on the myology of Menopoma alleghaniense. Proc. Zool. Soc. London 1869: 254-69.
- MIVART, ST. G. 1869.
Notes on the myology of Menobranchius lateralis. *Ibid.* 1869:450-66.
- NORRIS, H. W. 1908.
The cranial nerves of Amphiuma means. Jour. Comp. Neur. 18:527-68.
- NORRIS, H. W. 1913.
The cranial nerves of Siren lacertina. Jour. Morph. 24:245-338.
- OSAWA, G. 1902.
Beiträge zur Anatomie des japanischen Riesensalamanders. Mitteil. med. Facultät Kais-japan. Univ., Tokio 5:221-427.
- OWEN, RICHARD 1866-68.
On the Anatomy of Vertebrates. London: Longmans, Green & Co. 3 vols.
- PIATT, JEAN 1935.
A comparative study of the hyobranchial apparatus and throat musculature in the Plethodontidae. Jour. Morph. 57:213-51.
- PIATT, JEAN 1935.
Morphogenesis of the cranial muscles of Amblystoma punctatum. *Ibid.* 63:531-87.
- PIATT, JEAN 1940.
Correct terminology in salamander myology. II. Transverse ventral throat musculature. Copeia 1940:9-14.
- PLATT, JULIA BARLOW 1897.
The development of the cartilaginous skull and of the branchial and hyoglossal musculature in Neoturus. Morph. Jahrb. 25:377-464.
- PLESSEN, JOSEPH VON, & JOHN RABINOWICZ 1891.
Die Kopfnerven von Salamandra maculosa in vorgerückten Embryonalstadium. München: J. F. Lehman, pp. 1-20.
- RUGE, G. 1896.
Ueber das peripherische Gebiet des Nervus facialis bei Wirbelthieren. Fetscher. f. Gegenbaur. 3:193-348.
- RUSCONI, MAURO 1854.
Histoire naturelle, développement et métamorphose de la Salamandre terrestre. Pavie: J. Morganti.
- SCHMIDT, F. J. J., Q. J. GODDARD & J. VAN DER HOEVEN 1864.
Aantaekeninge over de Anatomie van Cryptobranchus japonicus. Natuurk. Verh. v. d. Hollandsche Maatschappij d. Wetensch. te Haarlem 1864:1-66.
- SIEBOLD, C. T. E. DE 1828.
Observationes quaedam de Salamandris et Tritonibus. Berolini. (Abstract and review by J. T. Cocteau: Ferussac. Bull. Sci. Nat., 38:81, 1831).
- SMITH, LOUISE 1920.
The hyobranchial apparatus of Spelerpes bislineatus. Jour. Morph. 33:527-50.
- STANNIUS, HERMANN 1856.
Handbuch der Zootomie. Zweiter Teil: Die Wirbelthiere. Zweites Buch: Zootomie der Amphibien. Berlin: Von Veit & Co. Zweite Auflage, pp. 1-271.
- VAN DER HOEVEN, J. 1867.
Ontleed en dierkundige Bijdragen tot de Kennis van Menobranchius, den Proteus der Meren van Noord-Amerika. Leiden: E. J. Brill, pp. 1-40.
- VETTER, B. 1874.
Untersuchungen zur vergleichenden Anatomie der Kiemen- und Kiefer-Muskulatur der Fische. Jenaische Zeitschr. Naturw. 8:405; 12:431.
- WALTER, F. 1887.
Das Visceralskelett und seine Muskulatur bei den einheimischen Amphibien und Reptilien. *Ibid.* 21:1-45.
- WILDER, H. H. 1891.
A contribution to the anatomy of Siren laertina. Zool. Jahrb. 4:653-96.
- WILDER, H. H. 1892.
Studies in the phylogenesis of the larynx. Anat. Anz. 7:570-80.
- WILDER, H. H. 1896.
The amphibian larynx. Zool. Jahrb. 9:273-318.
Aantaekeningen over de Anatomie van Cryptobranchus japonicus. Natuurk. Verh.