

## Anatomy of the Orbicularis Oris Muscle A historical review

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### Abstract

A literature review (1543-2014) of 39 scientific sources concerning the anatomy of the orbicularis oris muscle (OOM) is presented.

The nomenclature of the OOM is either descriptive-morphological (e.g. M. annularis) or functional (e.g. Sphincter oris/labiorum, Constrictor labiorum).

Historical literature sources had different opinions concerning the number of parts, segments, compartments or layers of the OOM: Most authors described two, other authors divided the OOM in four, six or eight separate units. The terminology of radiating facial muscles has changed several times, both descriptive-morphological and functional names were used (e.g. M. triangularis = M. depressor anguli oris, M. caninus = M. triangularis superioris = M. levator anguli oris).

For routine clinical practice, the anatomy of the OOM is relevant in several aspects:

- 1 The superficial layer represents the evolutionary younger, secondary functions of the lips (articulation, facial expression, gesture, aesthetics). The deep layer with its sphincter represents the evolutionary older, primary function of the lips (closing of the mouth during food intake).
- 2 This arrangement of layers is surgically relevant in cleft lips, injuries and excisions of lip tumors: The OOM should be sutured multilayered for accurate functions of the lips. For plastic reconstruction of the philtrum in congenital cleft lips, it is important to suture corresponding fibres of the different OOM bundles.

### Key words

*Orbicularis oris muscle, radiating facial muscles, anatomical nomenclature, descriptive-morphological and functional terminology, clinical relevance*

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### Introduction

The orbicularis oris muscle (OOM) consists of a superficial and a deep portion. The deep layer has the shape of a hockey stick with two parts: Pars marginalis (PM) and Pars peripheralis (PP). The PM is located in the curvature of the red portion, the PP is located mainly in the white portion of the lip. The superficial portion consists of eight irradiating facial muscles: Musculus levator anguli oris, Musculus depressor anguli oris, Musculus depressor labii inferioris, Musculus levator labii superioris, Musculus levator labii superioris alaeque nasi, Musculus buccinator, Muscu-

lus zygomaticus, Platysma, and Musculus depressor septi nasi. This is the present state of knowledge<sup>1,2</sup>.

In actual standard surgical textbooks the lip muscle is not described in detail. There is hardly any information concerning structure and layers of the OOM. Since the impact on clinical practice has a high significance for us, we emphasize the clinical relevance of those anatomical descriptions.

In the past, many different anatomical reports of the parts and layers of the OOM were published. Therefore, the aim of our study is to review the historical development of the anatomical points of view concerning the lip musculature. We compare these diverse anatomical opinions in a literature review.

### Methodology

Based on primary sources<sup>3,4</sup> over the

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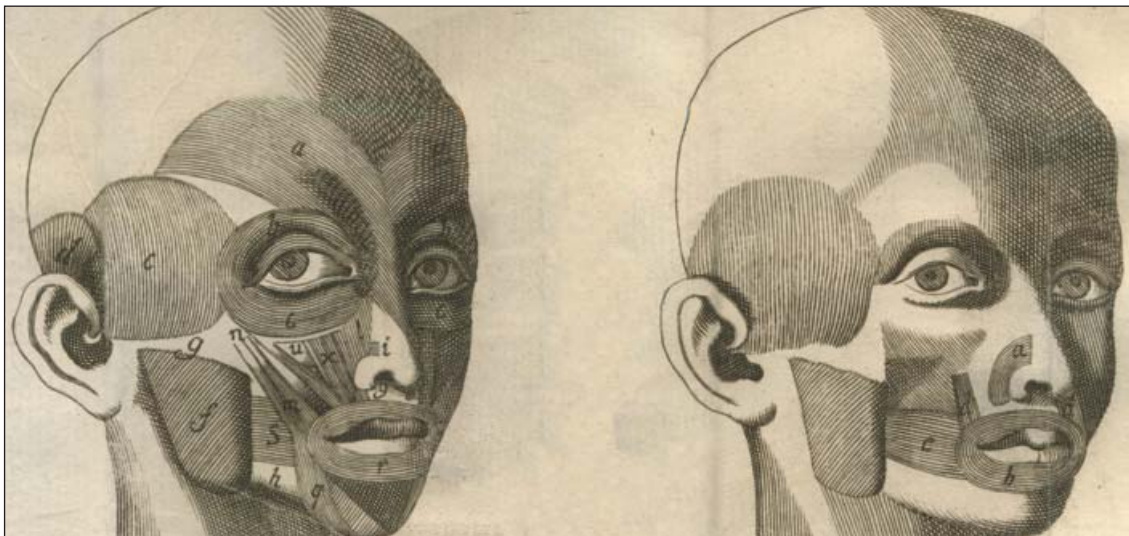


Fig.1: OOM as a genuine sphincter (Winslow 1732)

last 470 years (e.g. Vesalius 1543<sup>5</sup>, Gray 1858<sup>6</sup>, Lefarth et al. 2014<sup>1</sup>), we essentially selected sources and illustrations which include new ideas or new approaches in terms of originality and variation in terminology (e.g. the “Demi-ovalaires”<sup>7</sup> [semi-oval muscles]; four quadrants of the OOM<sup>8</sup>). Concerning the illustrations, we focus on a high degree of detail. The selected illustrations have unique selling points respectively distinguishing features with a unique characteristic (e.g. the OOM as a sphincter<sup>7</sup>; OOM with an inner and outer portion<sup>9</sup>). We critically evaluate these literature sources and show limitations concerning the availability of historical publications (Gray’s anatomy<sup>6,8,10-13</sup>, Rauber/Kopsch<sup>14-16</sup>). All in all, we finally and selectively analyzed 39 representative scientific sources concerning the anatomy of the OOM, thereof 7 original papers (with 7 different first authors), one medical thesis (“dissertation”) and 31 textbook sections.

#### Nomenclature of the lip muscle

Even the name of the lip muscle has not always been the same. The anatomical nomenclature of the OOM may either be descriptive-morphological or functional (**Table 1**, p. 241): The most common descriptive-morphological term is “Musculus orbicularis (oris)”<sup>1,2,5,6,8,15,17-31</sup> (1543-2014). Similar descriptive names are “Orbicularis labiorum”<sup>32</sup> (1694), “Orbiculaire des lèvres” (circular muscle of the lips)<sup>33-35</sup> (1834-1912), “Ring-muskel des Mundes” (circular muscle of the mouth)<sup>18,21,25</sup> (1788-1908) or “Musculus annularis”<sup>21</sup>(1820). All these authors refer to the

OOM as an annular muscle. Another morphological term stresses the connections of the OOM to the cheek and is therefore called “Musculus bucco-labialis”<sup>14,15,26</sup> (1910-1929). The functional nomenclature of the OOM emphasizes its important activity in closing the mouth: “Sphincter oris/labiorum”<sup>18,21,23-25,32,36,37</sup> (1694-1941) or “Schließer/Schliess-muskel des Mundes“ (closer/closing muscle of the mouth)<sup>19,21,23</sup> (1800-1870). Other authors stress the important function of regulating the tension of the lips, therefore calling the OOM “Constrictor labiorum/labiorum”<sup>18,23,32,36,38</sup> (1694-1870). Some authors use both descriptive-morphological and functional terminology<sup>18,19,21-25,32,38</sup> (1694-1908).

#### Layers and compartments of the lip muscle

Historical literature sources have different opinions concerning the number of parts, segments, compartments or layers of the OOM (**Table 2**, p. 243). A large number of authors<sup>6,7,9,18,21-25,27,33,39</sup> (1724-1912) divides the OOM in two layers: Winslow<sup>7</sup> (1732) for example depicts the OOM as a genuine sphincter (**Figure 1**, p. 240). In the corresponding text however he names two portions called “Demi-orbiculaire superieur” and “Demi-orbiculaire inferieur” (superior and inferior semi-orbicular muscle). He describes the shape of the OOM as the two “Demi-ovalaires” (semi-oval muscles). Exactly the same illustrations can already be found in Eustachius<sup>38</sup> (1722) book. Virchow<sup>25</sup> (1908) also states that the OOM has two parts, namely the “upper” and “lower” orbicularis.

Table 1:  
Nomenclature of lip musculature

author(s) (year)	descriptive-morphological	functional
Vesalius (1543)	M. orbicularis	
Riolan (1650)	M. orbicularis	
Spigelius (1627)		Labia constringens
Cowper (1694)	Orbicularis labiorum	Sphincter/Constrictor labiorum
Eustachius (1722)	Mm. labrorum communes	Constrictor labrorum
Santorini (1724)		
Albinus (1734)	M. orbicularis oris	
Loder (1788)	M. orbicularis oris Ringmuskel des Mundes (circular muscle of the mouth)	Sphincter/Constrictor labiorum
Sömmerring (1800)	Orbicularis oris	Mundschließer (closing muscle of the mouth)
Bell (1806)	M. orbicularis	
Meckel (1820)	Ringmuskel des Mundes (circular muscle of the mouth) M. annularis Orbicularis oris	Schließer des Mundes (closing muscle of the mouth) Sphincter oris
Cruveilhier (1834)	Orbiculaire des lèvres (orbicular muscle)	
D'Alton (1850)	M. orbicularis oris	Sphincter labiorum
Henle (1858)		Sphincter oris/Constrictor labiorum
Gray (1858)	M. orbicularis oris	
Hoffmann (1870)	M. orbicularis oris	Sphincter oris/Constrictor labiorum
Merkel (1885-1890)	Orbicularis oris	Sphincter
Roy (1890)	Muscle orbiculaire des lèvres (orbicular muscle)	
Sobotta (1907)		Sphincter oris
Virchow (1908)	M. orbicularis oris Ringmuskel des Mundes (circular muscle of the mouth)	Sphincter
Gegenbaur (1910)	M. orbicularis oris M. bucco-labialis	
Charpy (1912)	Muscle orbiculaire des lèvres (orbicular muscle)	
Eisler (1912)	M. orbicularis oris	
Rauber/Kopsch (1914)	M. orbicularis oris M. buccolabialis	
Lightoller (1925)	M. orbicularis oris	
Rauber/Kopsch (1929)	M. orbicularis oris M. buccolabialis	
Nairn (1975)	M. orbicularis oris	
Nicolau (1983)	M. orbicularis oris	
Rauber/Kopsch (1987)	M. orbicularis oris	
Park/Ha (1995)	M. orbicularis oris	
Gray's anatomy (2008)	M. orbicularis oris	
Bo/Ningbei (2014)	M. orbicularis oris	
Lefarth et al. (2014)	M. orbicularis oris	

Sappey<sup>39</sup> (1876) and Cruveilhier<sup>33</sup> (1834) also agree with Winslow<sup>7</sup> (1732): For them the OOM consists of two muscles (“Muscle demi-orbiculaire supérieur et inférieur”/ superior and inferior semi-orbicular muscle) intersecting at the right and left angle of the mouth. Loder<sup>18</sup> (1788) divides the OOM of the upper lip and lower lip in two compartments: He declares that there is an outer portion (“Die übrigen Fasern dieses Muskels, die mehr aussen herum laufen... entstehen aus der

Vermischung aller der Muskeln, die sich zu beiden Seiten in die Lippen und Mundwinkel senken”/ The remaining fibres of this muscle, mostly located in its outer portions... arise from an intermingling of all those muscles, which descend into the lips and the angles of the mouth on both sides) formed by facial muscle fibres radiating into the lips. Furthermore he describes an inner portion with marginal fibres building up a ring. These statements are based on the work of San-



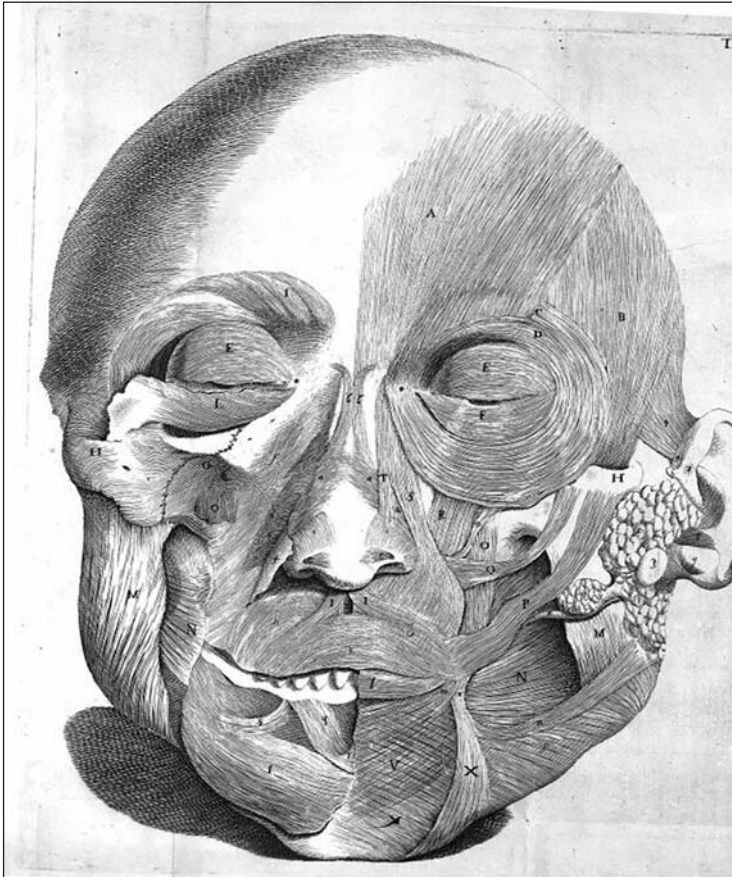


Fig. 2: Inner and outer fibres of the OOM (Santorini 1724)

torini<sup>9</sup> (1724) (**Figure 2**, p. 242). He mentions two layers of the OOM, namely inner and outer fibres. Hoffmann<sup>23</sup> (1870) also reports two parts, the “inner department” called “Pars/Portio labialis” or “marginalis”, and the “peripheral department” called “Pars facialis”. Gray<sup>6</sup> (1858) sees an outer and inner circumference of the OOM. The outer circle intermingles with many other facial muscles, the inner circle runs without other muscles. Roy<sup>34</sup> (1890) (**Figure 3**, p. 242) divides the OOM into a peripheral and a marginal part: The peripheral part is the “Pars superficialis” and stands for the facial muscles radiating into the lips. The marginal part is the central, concentric department of the OOM. Roy<sup>34</sup> (1890) describes it as the only and true orbicularis or sphincter (“...qui est pour nous le seul et reel orbiculaire ou sphincter.”/ This is for us the one and real

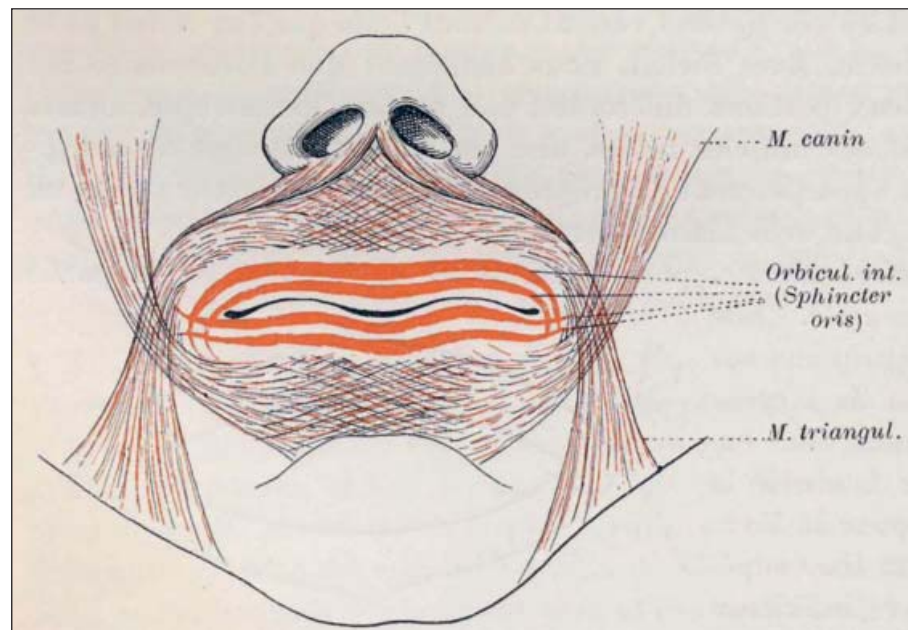


Fig. 3: Marginal (sphincter) and peripheral part of the OOM (black and white original by Roy 1890, coloured reprint by Charpy 1912)

Table 2:  
Layers and compartments of the lip muscle

number	author(s) (year): nomenclature
1	Bell (1806): zirkuläre Fasern (circular fibres)
2	Riolan (1650): interne Fasern/externe Fasern (internal fibres/ external fibres)  Santorini (1724): innere Fasern/externe Fasern (inner fibres/ external fibres)  Winslow (1732): Demi-orbitaire superieur/Demi-orbitaire inferieur (superior semi-orbicular muscle/ inferior semi-orbicular muscle)  Loder (1788): innere Portion/äußere Portion (inner portion/ outer portion)  Meckel (1820): innere/äußere Fasern (inner fibres/ outer fibres)  Cruveilhier (1834): Demi-orbitaire supérieur/Demi-orbitaire inférieur (superior semi-orbicular muscle/ inferior semi-orbicular muscle)  D'Alton (1850): innere Lage/äußere Lage (inner layer/ outer layer)  Gray (1858): innerer Umkreis/äußerer Umkreis (inner circumference/ outer circumference)  Hoffmann (1870): innere Abteilung (Pars labialis/marginalis)/peripherische Abteilung (Pars facialis) (inner department [Pars labialis/marginalis]/ peripheral department [Pars facialis])  Sappey (1876): Muscle demi-orbitaire supérieur/Muscle demi-orbitaire inférieur (superior semi-orbicular muscle/ inferior semi-orbicular muscle)  Merkel (1885-1890): „hinterer Teil“ am freien Rand der Lippen/„peripherischer Teil“ ("back part" at free margin of the lips/ "peripheral part")  Virchow (1908): oberer Orbicularis/unterer Orbicularis (upper orbicular muscle/ lower orbicular muscle)  Eisler (1912): Innenzone/Außenzone (inner zone/ outer zone)
4	Albinus (1734): Pars buccinatoris/Pars depressoris/Pars zygomaticus/Pars levatoris
6	Roy (1890): Partie concentrique (marginale)/ Partie excentrique (concentric part [marginal part]/ excentric part)  Charpy (1912): L'orbitaire interne (Sphincter oris)/L'orbitaire externe (internal orbicularis [sphincter oris]/ external orbicularis)  Nicolau (1983): UL: Pars superficialis + PP and PM / LL: Pars superficialis + PP and PM  Park/Ha (1995): UL: Pars superficialis + PP and PM / LL: Pars superficialis + PP and PM  Lefarth et al. (2014): UL: Pars superficialis + PP and PM / LL: Pars superficialis + PP and PM
8	Lightoller (1925): M. orbicularis superior: PP left/right + PM left/right / M. orbicularis inferior: PP left/right + PM left/right  Nairn (1975): UL: PP left/right + PM left/right / LL: PP left/right + PM left/right  Gray's anatomy (2008): UL: PP left/right + PM left/right / LL: PP left/right + PM left/right

abbreviations: UL= upper lip

LL= lower lip

PM= Pars marginalis (marginal part)

PP= Pars peripheralis (peripheral part)



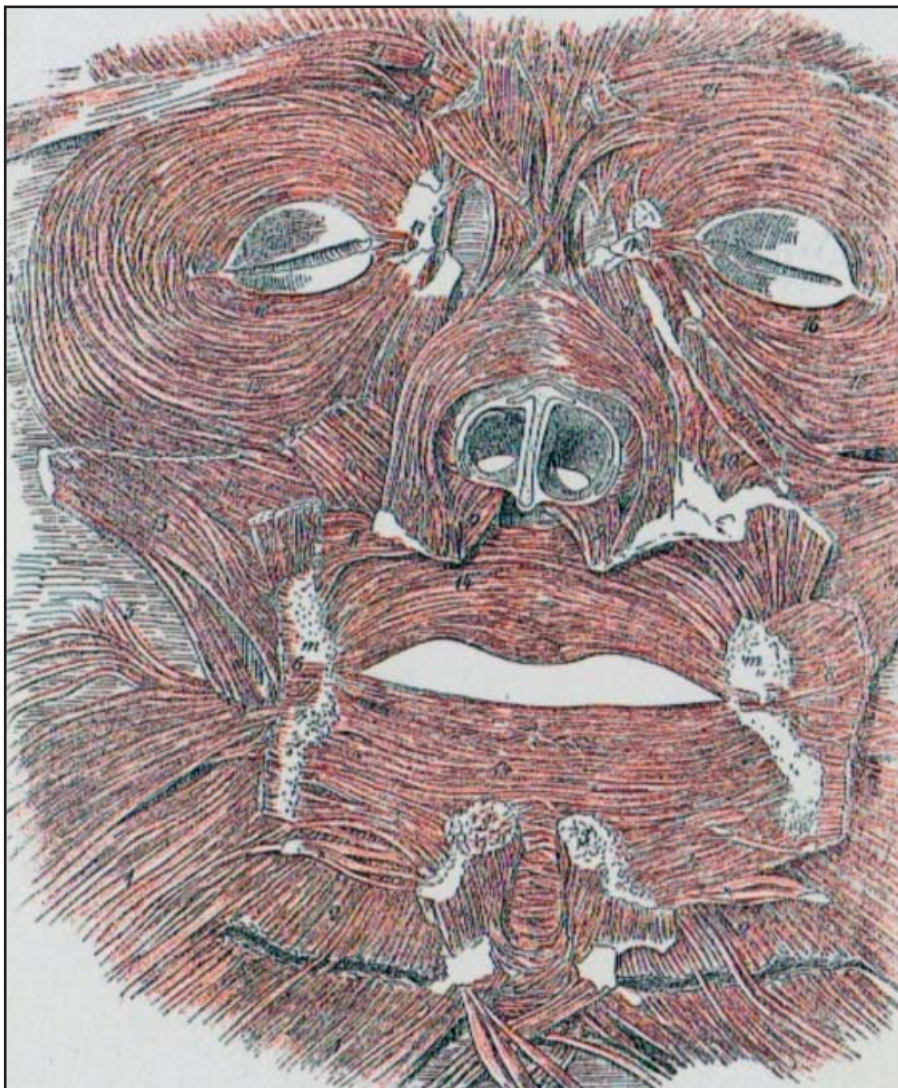


Fig. 4: Preparation of the facial muscles (Eisler 1912)

orbicular muscle or sphincter). Eisler<sup>27</sup> (1912) (**Figure 4**, p. 244) has a similar view when talking about an outer (“Außenfläche”/ outer surface) and inner (“Innenfläche”/ inner surface) aspect of the OOM. Charpy<sup>35</sup> (1912) (**Figure 5**, p. 245) distinguish a sphincter and a system of radiating fibres (“Fibres radiées”/ radial fibres). Spalteholz<sup>40</sup> (1898) (**Figure 6**, p. 245) clearly shows the superficial part of the OOM with its irradiating facial fibres, but the inner part of the OOM (sphincter) can also be seen. Dalla Rosa and Toldt<sup>41</sup> (1914) (**Figure 7**, p. 250) show a narrow, whitish Pars marginalis and a substantially thicker Pars peripheralis reaching from the base of the nose to the mentolabial fold.

Quite a few other authors divide the OOM in more than two layers<sup>1,2,8,28-30,35</sup> (1912-2014).

Charpy<sup>35</sup> (1912) for example separate the “Orbicularis externus” in four and the “Orbicularis internus” in two compartments. Therefore, the whole OOM consists of six parts. Lightoller<sup>28</sup> (1925) classifies eight different compartments: He divides the lip musculature into a superior and an inferior OOM, each of these consisting of a Pars peripheralis and a Pars marginalis. Furthermore, Pars peripheralis and Pars marginalis of upper and lower lip are split into a right and a left portion. Thus, all together eight compartments result, namely four left-sided and four right-sided portions (**Figure 8**, p. 250). - According to Gray<sup>8</sup> (2008), the OOM is separated into four quadrants, each of these four quadrants contains a Pars peripheralis and a Pars marginalis. Therefore, again eight segments result. Nairn<sup>29</sup> (1975) also reports eight parts, two in each quadrant of the lips.

Some authors<sup>1,2,29,30</sup> (1975-2014) name special subdivisions of the OOM: Like other authors<sup>6,7,9,18,21-25,33,39</sup> (1724-1912), they divide the OOM into a superficial and a deep layer. The superficial layer, called Pars superficialis, consists of radiating muscles<sup>1,30</sup> (1983,2014), which are important for facial expressions<sup>2</sup> (1995). The group of authors mentioned above<sup>1,1,2,29,30</sup> (1975- 2014) further divides the deep layer into a Pars peripheralis (PP) and a Pars marginalis (PM). Thus, these authors

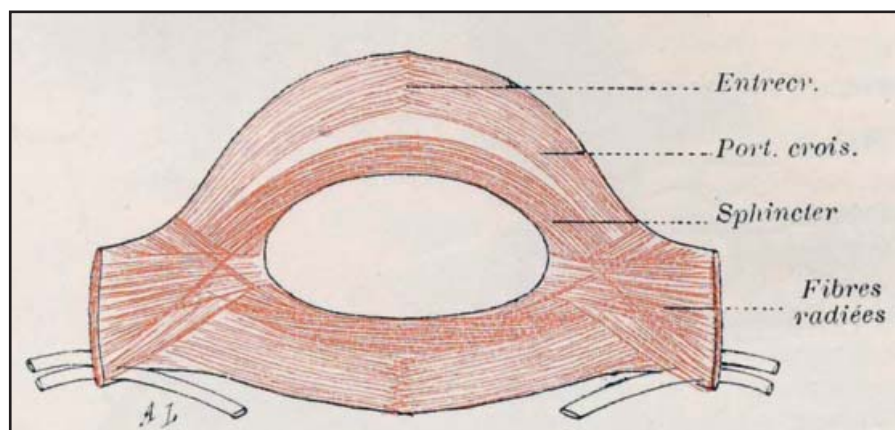


Fig. 5: Sphincter and crossing radiating fibres of the OOM (Charpy/Nicolas 1912)

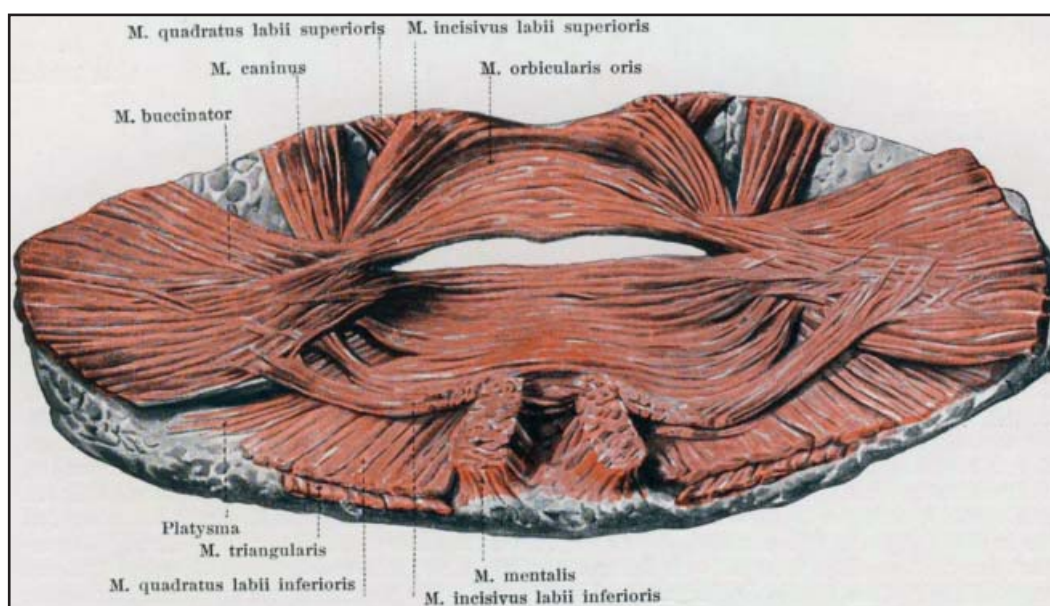


Fig. 6: Superficial part of the OOM with irradiating facial fibres (Spalteholz 1898)

describe a superficial layer (Pars superficialis) and a deep layer, which is divided into a PP and a PM. In their opinion, the OOM has three segments in the upper lip and in the lower lip respectively.

### Terminology of radiating facial muscles

The terminology of radiating facial muscles has changed several times (see tab. 3, pp. 246-248): Some authors<sup>7,25,28,32,34,38</sup> (1694-1925) define the facial muscles exclusively in a morphological and descriptive way. Other authors<sup>1,2,6,8,17-23,29-31,39</sup> (1734-2014) prefer functional names for these muscles. For example, *Musculus caninus*<sup>6,7,24,27,28,34-36,39</sup> (1732-1925) or *Musculus triangularis superioris*<sup>34</sup> (1890) are the descriptive names for a facial muscle. The functional name of this

muscle is *Musculus levator anguli oris*<sup>1,6,8,17-23,30,31</sup> (1734-2014) for the upper lip.

The corresponding muscle of the lower lip is called *Musculus triangularis (oris/inferioris)* in descriptive anatomy<sup>20,22,24,25,27,28,34,39</sup> (1806-1925) or *Musculus depressor anguli oris* in functional anatomy<sup>1,6,8,17,19,21-23,30</sup> (1734-2014).

*Musculus quadratus menti/Carré du menton* (square of the chin)<sup>6,18,22,24,36,39</sup> (1788-1876), *Musculus proprii labii inferioris*<sup>7</sup> (1732) or *Musculus quadratus labii inferioris*<sup>28</sup> (1925) are different descriptive names for the *Musculus depressor labii inferioris* (functional terminology<sup>1,6,8,17,19,21-23,29,32</sup> [1694-2014]).

The *Musculus nasalis labii superioris* (descriptive name<sup>17,18</sup> [1734,1788]) or *Musculus*



Table 3:  
Terminology of radiating facial muscles (= Pars superficialis of the OOM)

author(s) (year)	descriptive-morphological	functional
Riolan (1650)	M. buccinator M. zygomaticus	M. levator labii superioris
Cowper (1694)	Buccinator Zygomaticus Platysma myoides	Elevator labii superioris Depressor labii inferioris
Eustachius (1722)	Buccinator Zygomaticus	
Winslow (1732)	M. buccinator M. zygomaticus major M. zygomaticus minor M. proprii labii superioris M. caninus M. proprii labii inferioris M. triangularis	
Albinus (1734)	M. buccinator M. zygomaticus major M. nasalis labii superioris	M. levator labii superioris alaeque nasi M. levator anguli oris M. depressor anguli oris M. depressor labii inferioris
Loder (1788)	M. buccinator (Backenmuskel)  M. zygomaticus major M. zygomaticus minor M. nasalis labii superioris M. quadratus menti	M. levator labii superioris alaeque nasi M. levator anguli oris M. levator labii superioris proprius M. depressor anguli oris M. risorius M. compressor alae nasi M. depressor alae nasi
Sömmerring (1800)	Buccinator (Backenmuskel) Zygomaticus major Zygomaticus minor Latissimus colli	Levator labii superioris alaeque nasi Levator anguli oris Levator labii superioris Depressor anguli oris Depressor labii inferioris
Bell (1806)	M. buccinator M. zygomaticus M. triangularis oris Platysma myoides	M. levator labii superioris alaeque nasi M. levator anguli oris M. levator labii superioris proprius M. compressor alae nasi M. depressor alae nasi
Meckel (1820)	M. buccinator (Backenmuskel)  M. zygomaticus	= Trompetermuskel  M. levator anguli oris M. levator labii superioris alaeque nasi M. levator labii superioris M. depressor anguli oris M. depressor labii inferioris
Cruveilhier (1834)	M. buccinateur M. naso-labial	

Table 3, part one (of three)

naso-labial/labialis (descriptive name<sup>23,33</sup> [1834,1870]) is also called Musculus depressor septi (nasi) (functional name<sup>8</sup> [2008]) or Musculus depressor septi mobilis narium (functionalname<sup>23</sup>[1870]).

There are several muscles in the nasolabial region, which connect the nose with the upper lip. One of these is called Musculus nasalis (descriptive terminology<sup>1,27,28,31</sup> [1912-2014]) with a Pars transversa (descriptive terminology<sup>35</sup> [1912]), which is also called Musculus compressor alae nasi (functional terminology<sup>18,20,23</sup> [1788-1870]). The Pars alaris (descriptive terminology<sup>1,31</sup> [2014]) of the Musculus nasalis is also referred to as Musculus depressor alae nasi (functional terminology<sup>18,20,23</sup> [1788-1870]).

Another muscle in the nasolabial region is the Caput angulare of the Musculus quadratus labii superioris (descriptive terminology<sup>24,28,36</sup> [1858-1925]) or Musculus pyramidalis (descriptive terminology<sup>22</sup>[1850]), also called Musculus levator labii superioris alaeque nasi (functional terminology<sup>1,2,6,8,17-21,23,29-31</sup> [1734-2014]) or Musculus levator alae nasi et labii superioris (functional terminology<sup>22</sup> [1850]).

The Musculus buccinator (descriptive terminology<sup>7,17-19,32,38</sup> [1694-1800]) or Musculus buccinatorius (descriptive terminology<sup>24</sup> [1863]) is also called “cheek muscle” (descriptive terminology<sup>18,19,27</sup> [1788-1912]) or “trumpeter’s muscle/ muscle de la trompette” (functional terminology<sup>35</sup> [1912]). Some authors<sup>14,21-23,36</sup>



D'Alton (1850)	M.buccinator (Backenmuskel)  M. pyramidalis  M. quadratus menti  M. triangularis  M. zygomaticus major M. zygomaticus minor	= Trompetermuskel  = M. levator alae nasi et labii superioris  = M. depressor labii inferioris  = M. depressor anguli oris  M. levator labii superioris proprius M. levator anguli oris M. risorius
Henle (1858)	M.buccinator (Backenmuskel)  M. zygomaticus M. quadratus labii superioris M. caninus M. quadratus menti M. subcutaneus colli	= Trompetermuskel
Gray (1858)	M. buccinator M. zygomaticus major      Caninus  Quadratus menti	M. levator labii superioris alaeque nasi M. depressor alae nasi M. levator labii superioris proprius M. depressor anguli oris M. levator labii inferioris (Levator menti)  = M. levator anguli oris  = M. depressor labii inferioris
Hoffmann (1870)	M.buccinator (Backenmuskel)  M. zygomaticus major M. zygomaticus minor M. subcutaneus colli/ M. latissimus colli   M. naso-labialis	= Trompetermuskel  M. levator labii superioris alaeque nasi M. levator labii superioris proprius M. levator anguli oris M. risorius M. depressor anguli oris M. depressor labii inferioris M. levator menti M. compressor alae nasi M. depressor alae nasi  = M. depressor septi mobilis narium
Sappey (1876)	M. buccinateur M. petit zygomatique M. canin M. triangulaire des lèvres Carré du menton	M. élévator commun superficiel M. élévator commun profond
Merkel (1885-1890)	M. zygomaticus M. quadratus labii superioris M. caninus M. buccinaterius M. triangularis M. quadratus menti M. subcutaneus (colli)	M. risorius
Roy (1890)	M. buccinator M. zygomaticus major M. triangularis (inferioris) M. caninus	= M. triangularis superioris

Table 3, part two (of three)

(1820-1914) use multiple terminologies (Musculus buccinator, trumpeter's muscle, cheek muscle).

The platysma muscle has different descriptive names: Platysma<sup>28</sup>(1925), Platysma myoides<sup>20,27,32</sup> (1694-1912), Musculus latissimus colli<sup>23</sup> (1870), Musculus subcutaneus colli<sup>23,24,36</sup> (1858-1870) or Muscle

peaucier/skin muscle<sup>35</sup> (1912). The word "platysma" has a Greek origin meaning "plate", "disc" or "board"<sup>42</sup>.

### Discussion

For a complete overview, all different editions of each literature source should be compared. However, for older historical sources we were limited to those editions

Virchow (1908)	M. buccinator M. triangularis M. mentalis	
Charpy (1912)	Le buccinateur  Le triangulaire Le canin M. peaucier Transverse du nez Dilatateur des narines	= „muscle de la trompette“
Eisler (1912)	M. buccinator (Backenmuskel) M. triangularis M. caninus Platysma myoides M. nasalis	M. risorius
Lightoller (1925)	M. buccinator M. triangularis M. caninus M. quadratus labii superioris M. quadratus labii inferioris Platysma M. nasalis	
Nairn (1975)	M. zygomaticus minor	M. levator labii superioris alaeque nasi M. levator labii superioris M. depressor labii inferioris
Nicolau (1983)	M. zygomaticus major M. zygomaticus minor	M. levator labii superioris alaeque nasi M. levator labii superioris M. levator anguli oris M. depressor anguli oris
Park/Ha (1995)	M. zygomaticus major M. zygomaticus minor	M. levator labii superioris alaeque nasi M. levator labii superioris
Gray's anatomy (2008)	M. buccinator M. zygomaticus major Platysma M. mentalis M. incisivus labii superioris M. incisivus labii inferioris	M. depressor septi M. levator labii superioris alaeque nasi M. levator labii superioris M. levator anguli oris M. depressor labii inferioris M. depressor anguli oris
Bo/Ningbei (2014)	M. buccinator M. zygomaticus major M. zygomaticus minor M. nasalis	M. levator labii superioris alaeque nasi M. levator labii superioris M. levator anguli oris
Lefarth et al. (2014)	M. buccinator M. zygomaticus major M. zygomaticus minor M. transversus nasi M. nasalis M. mentalis	M. levator labii superioris M. levator labii superioris alaeque nasi M. depressor anguli oris M. levator anguli oris M. depressor labii inferioris M. risorius

Table 3, part three (end of table 3)

which were available in libraries or in the internet. Therefore, we do not know all editions of all historical sources. And we cannot always determine definitely the year of the first edition of certain anatomical illustrations. For example, we looked at six different editions<sup>6,8,10-13</sup> (1858,1918,1985,1989,1995,2008) of Gray's anatomy with regard to terminology of the lip muscle, parts and layers of the OOM and with regard to the nomenclature of radiating facial muscles (Table 4, p. 249).

The anatomical nomenclature did not change. In all editions we consulted, this

muscle was called “Orbicularis oris”. - Concerning the parts and layers of the OOM, older editions<sup>6,10,11</sup> (1858,1918,1985) divide this muscle into inner/proper fibres and outer fibres derived from surrounding facial muscles. In younger editions<sup>8,12,13</sup> (1989,1995,2008), we found that the OOM is divided into four quadrants respectively eight segments: Each quadrant of the upper and lower lip consists of a Pars marginalis and a Pars peripheralis. The anatomical nomenclature of the radiating facial muscles is the same in all editions except for the one published in 1918<sup>10</sup>: Instead of Musculus levator

Table 4:  
Exemplary comparative literature survey of lip musculature in different editions of Gray's anatomy

edition (year)	nomenclature of lip musculature	parts/layers of the OOM (number)	nomenclature of radiating facial muscles
Gray's anatomy (1858)	Orbicularis oris	„inner and outer circumference“  (n=2)	M. levator labii superioris alaeque nasi M. depressor alae nasi M. levator labii superioris proprius M. levator anguli oris (M.caninus) M. zygomaticus major M. levator labii inferioris (Levator menti) M. depressor labii inferioris (Quadratus menti) M. depressor anguli oris M. buccinator
Gray's anatomy, 20 <sup>th</sup> ed. (1918)	Orbicularis oris	„fibers proper to the lips“  „fibers derived from the other facial muscles“  (n=2)	Platysma Quadratus labii superioris (Caput angulare, Caput infraorbitale, Caput zygomaticus) Caninus (Levator anguli oris) Zygomaticus (Zygomaticus major) Quadratus labii inferioris (Depressor labii inferioris; Quadratus menti) Triangularis (Depressor anguli oris) Buccinator
Gray's anatomy, 30 <sup>th</sup> American ed. (1985)	Orbicularis oris	„proper“/ „intrinsic fibers“  „...fibers...derived from other facial muscles“  (n=2)	Levator labii superioris alaeque nasi Levator labii superioris Levator anguli oris Zygomaticus major Depressor labii inferioris Depressor anguli oris
Gray's anatomy, 37 <sup>th</sup> ed. (1989)	Orbicularis oris	UL: PP left/right + PM left/right  LL: PP left/right + PM left/right  (n=8)	Levator labii superioris alaeque nasi Levator labii superioris Levator anguli oris Zygomaticus major Depressor labii inferioris Buccinator Incisivus labii superioris Incisivus labii inferioris
Gray's anatomy, 38 <sup>th</sup> ed. (1995)	Orbicularis oris	UL: PP left/right + PM left/right  LL: PP left/right + PM left/right  (n=8)	Levator anguli oris Zygomaticus major Depressor anguli oris Buccinator Incisivus labii superioris Incisivus labii inferioris
Gray's anatomy, 40 <sup>th</sup> ed. (2008)	Orbicularis oris	UL: PP left/right + PM left/right  LL: PP left/right + PM left/right  (n=8)	Platysma Depressor septi Levator labii superioris alaeque nasi Levator labii superioris Levator anguli oris Zygomaticus major Mentalis Depressor labii inferioris Depressor anguli oris Buccinator Incisivus labii superioris Incisivus labii inferioris

abbreviations: UL= upper lip

LL= lower lip

PM= Pars marginalis (marginal part)

PP= Pars peripheralis (peripheral part)



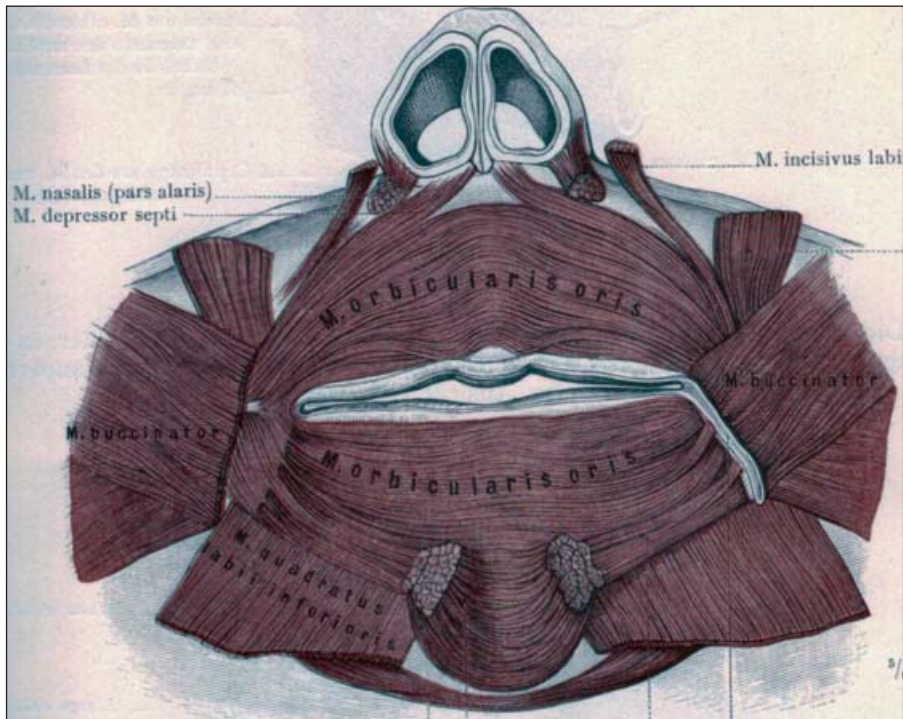


Fig. 7: Pars marginalis and Pars peripheralis of the OOM (Dalla Rosa/Toldt 1914)

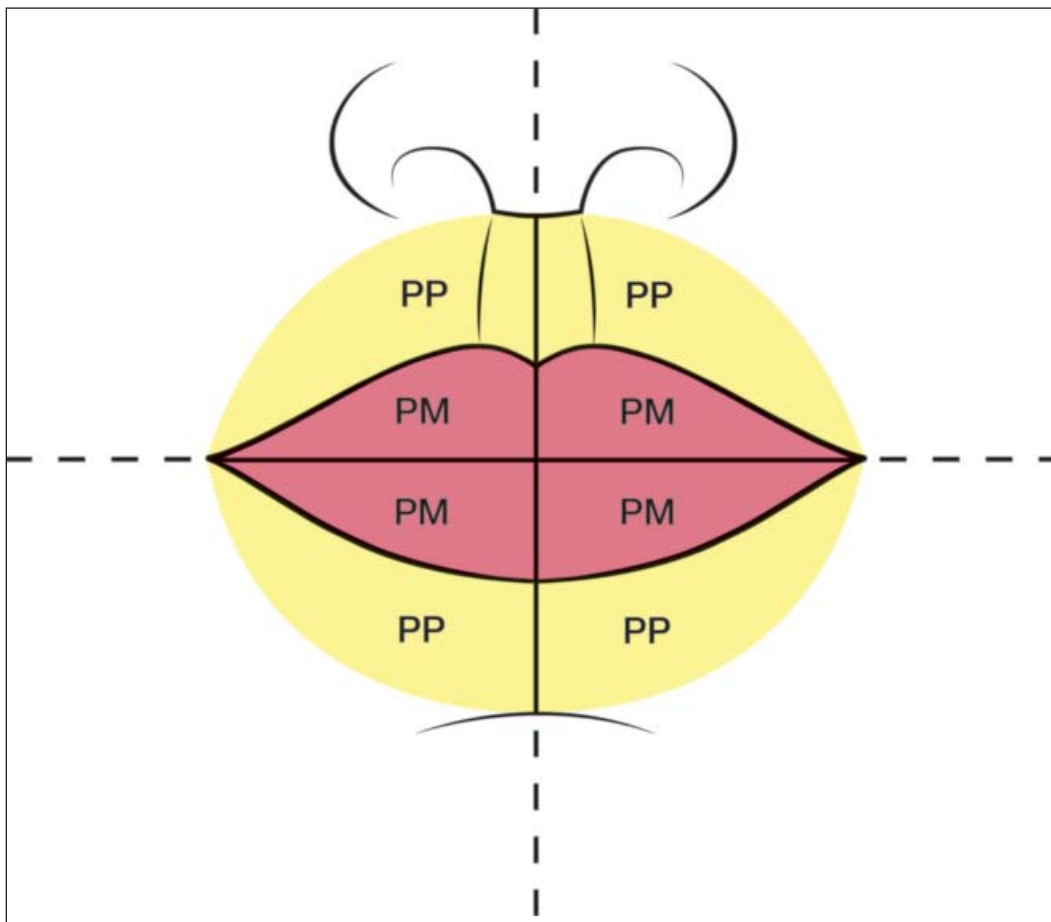


Fig. 8: Eight compartments of the OOM: four left-sided and four right-sided portions (Peeters 2018)

labii superioris alaeque nasi and Musculus levator labii superioris (proprius), the “Quadratus labii superioris” with its three heads (Caput angulare, Caput infraorbitale, Caput zygomaticum) is mentioned here. The Musculus levator anguli oris is called “Caninus” (descriptive terminology), the Musculus depressor anguli oris is called “Triangularis” (descriptive terminology). The Musculus zygomaticus major is simply named “Zygomaticus”, and the Musculus depressor labii inferioris is mostly referred to as “Quadratus labii inferioris”.

Another example are three different editions (1914, 1929, 1987) of the anatomical textbook “Rauber/Kopsch”<sup>14-16</sup>:

The 10<sup>th</sup> edition (1914<sup>14</sup>) and the 13<sup>th</sup> edition (1929<sup>15</sup>) do not differ in texts and illustrations. They use the same wording. The illustrations in the 20<sup>th</sup> edition (1987<sup>16</sup>) are identical with those in the 10<sup>th</sup><sup>14</sup> and 13<sup>th</sup><sup>15</sup> edition, but they have other texts: The 1987<sup>16</sup> edition uses more functional nomenclature (e.g. Musculus levator anguli oris, Musculus levator labii superioris alaeque nasi, Musculus levator labii superioris, Musculus depressor labii inferioris, Musculus depressor anguli oris), whereas the 10<sup>th</sup><sup>14</sup> and 13<sup>th</sup><sup>15</sup> edition mostly use topographic nomenclature (e.g. Musculus caninus, Musculus quadratus labii superioris, Musculus quadratus labii inferioris, Musculus triangularis). The texts do not contradict, but the 1987<sup>16</sup> edition is more detailed: For example, the description of the OOM includes the statements, that Musculus incisivus labii superioris/inferioris and Musculus depressor septi may be regarded as fibres of the OOM. The 1914<sup>14</sup> edition states that the OOM mostly contains “continuations of radiating muscles”, but there are also “independent bundles”. In the 1987<sup>16</sup> edition, the OOM consists of two muscle fibre bundles: the Pars marginalis around the oral fissure (hook-shaped as the blade of an ice hockey stick), and the Pars labialis: This is the peripheral part (like the shaft of an ice hockey stick) terminating cranially at the nasal septum and caudally in the chin groove. According to the actual scientific point of view<sup>1,2</sup>, this part is called Pars peripheralis.

### Clinical relevance

For routine clinical practice, the anatomy of the OOM is relevant in several aspects: The superficial layer (Pars superfi-

cialis) represents the evolutionary younger, secondary functions of the lips (articulation during running speech and while playing brass instruments, facial expressions, gestures and aesthetics). These functions are not essential for survival anymore. The deep layer with its sphincter (Pars peripheralis and Pars marginalis) represents the evolutionary older, primary function of the lips (closing the mouth for ingestion/catching food), which is essential for survival. This arrangement of layers is surgically relevant in cleft lips, injuries and excisions of lip tumors: The OOM should be sutured multilayered (if possible each layer separately) for accurate functions of the lips. These multilayered sutures are important with regard to aesthetic outcome. For plastic reconstruction of the philtrum (for example in congenital cleft lips), it is important to suture corresponding fibres of the different OOM bundles: Fibres of the healthy lip side should be “sutured to their corresponding units on the cleft side”<sup>30</sup> (1983). Nicolau<sup>30</sup> (1983) calls this technique “end-to-end-suture”.

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