

# The Third Part of the Masseter Muscle: Anatomical and Functional Aspects

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## ABSTRACT

**Introduction:** the masseter muscle is a powerful jaw elevator, traditionally described with two parts: superficial and deep. However, there are some anatomical works that describe the existence of three muscle parts or layers. Thus, the present study performed a literature review on classical textbooks on human anatomy and on PubMed regarding the anatomy and function of the masseter muscle, aiming to clarify the existence of a third layer as well as its functional aspects.

**Literature review:** the masseter muscle features a complex anatomy with several muscle and tendinous bands subdividing the muscle on various layers. The third part of this muscle (i.e. deep portion) has been described as fan-shaped with origin at the medial aspect of the zygomatic arch and insertion at the superior part of the mandibular ramus and coronoid process. In addition, this part is subdivided in anterior and posterior regions by the masseteric neurovascular bundle. The anatomical complexity of this muscle is reflected in a functional heterogeneity of its parts. There is evidence that different regions and/or parts of the masseter muscle can be activated differently during the execution of mandibular movements.

**Conclusion:** more functional studies need to be developed taking into account the anatomical complexity of this muscle and its division beyond the superficial and deep parts described in the current Anatomical Nomenclature, aiming at a better understanding of its functions.

**Keywords:** Masticatory muscles; Masseter muscle; Anatomy; Mandibular movement.

## Introduction

The masseter muscle is described in the current Anatomical Terminology with two overlapping parts, one superficial and one deep<sup>1</sup>, with the main function of elevating the mandible<sup>2-4</sup>.

However, some studies have shown a complex organization of this muscle with a succession of muscle and tendon bands in different directions<sup>5-10</sup>. In addition, the complex architecture and the existence of fibers in different directions explain the functional differences between the parts of this muscle described in several previous studies<sup>9,11-14</sup>.

Recently, Mezey *et al.*<sup>15</sup> demonstrated the existence of a third and distinct layer of the masseter muscle in humans, by means of macroscopic and radiological investigations. For the researchers, this was the first detailed anatomical description of this muscle part, with a suggested nomenclature of the “coronoid part” of the masseter muscle. The authors also suggested that this third part, due to the direction of its fibers, could act in the retrusion of the mandible.

In response to this study, Akita and Fukino<sup>16</sup> argued that muscle fibers between the temporal and masseter muscles have already been described in different ways in the literature: as being part of the temporal, masseter or an independent muscle bundle.

Another study also demonstrated that the attachment of the masseter to the coronoid process

and the presence of three parts or laminae of the masseter muscle had already been documented since the mid-18th century. Therefore, the findings of Mezey *et al.*<sup>15</sup>, despite contributing to a better understanding of these fibers, they do not represent an anatomical novelty<sup>17</sup>.

Hence, the present study performed a minireview on the anatomical and functional aspects of the masseter muscle in humans, aiming to clarify the anatomy and function of the third portion of this muscle.

## Review

### Third part of the masseter muscle: what is already known?

As shown on Table 1, the existence of three layers (or parts) of the masseter muscle have been already described in classical anatomical literature or in scientific papers.

The 38th edition of Gray's Anatomy describes the masseter muscle as a quadrangular-shaped muscle with three superposed layers: superficial, middle and deep. This book states that the superficial layer originates by a thick aponeurosis of the zygomatic process of maxillae and the two anterior thirds of the inferior margin of zygomatic arch, ending on the angle and inferior half of the lateral aspect of mandibular ramus. The middle layer originates on the medial surface of the two anterior thirds and the inferior margin of the

**Table 1.** The third part of the masseter muscle and insertion at the coronoid process of the mandible, according to classical anatomical textbooks and scientific papers.

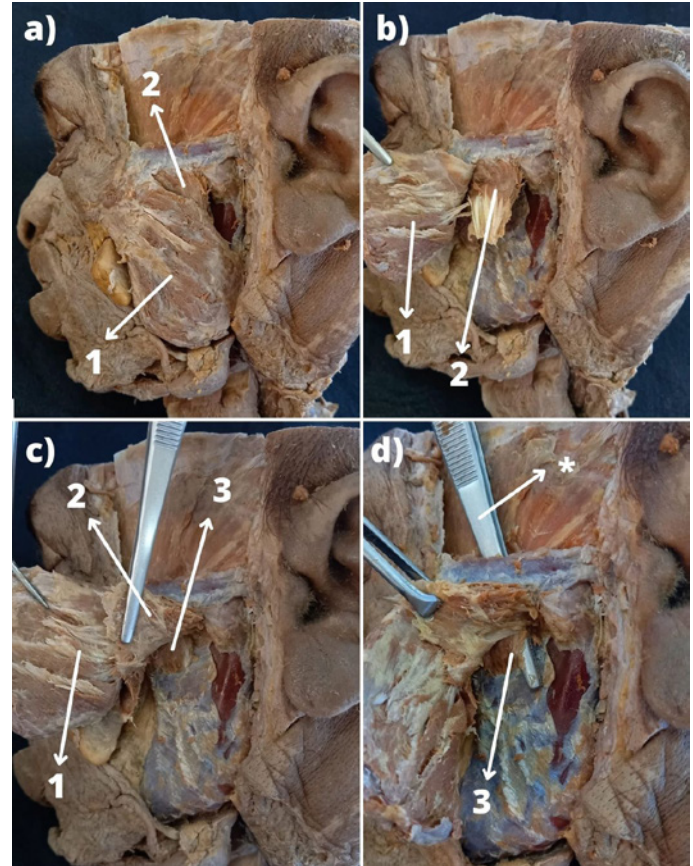
Study ID	Describes the third part of the masseter muscle?	Describes insertion at the coronoid process?
Warwick and Williams, 1979	X	X
Gardner, Gray and O’Rahilly, 1988	X	
Johnson and Moore, 1999	X	
Bransby-Zachary 1948 apud Jones <i>et al.</i> , 2003	X	X
Gaudy <i>et al.</i> 2000	X	
Brunel <i>et al.</i> , 2003	X	
Guerreschi <i>et al.</i> , 2011	X	
Mezey <i>et al.</i> , 2022	X	X
Testut, 1923		X
Sicher and Tandler, 1981		X
Goss, 1988		X
Dubrul, 1991		X
Alves and Cândido, 2009		X
Hiatt and Gartner, 2011		X

posterior third of the zygomatic arch and inserts on the middle third of the lateral aspect of the mandibular ramus. The deep layer originates on the medial surface of the zygomatic arch, attaching on the superior part of the mandibular ramus and coronoid process. They also state, on current Anatomical Terminology, the middle and deep layers constitute the deep part of the masseter muscle<sup>4</sup>. The figure 1 shows the arrangement, origins and insertions of the three portions of the masseter muscle.

Another classical book also describes the existence of three layers of the masseter muscle; however, it does not report its insertions or images and schematic drawings demonstrating the arrangement of its muscle fibers<sup>2</sup>.

Similarly, Johnson and Moore<sup>18</sup> reported three parts of the masseter muscle: superficial, middle and deep, with the latter inserted superiorly at the medial aspect of zygomatic arch and inferiorly to the superior portion of the mandibular ramus. These authors also report the mixture of middle and deep fibers of the temporal muscle, which may have a specific denomination of “zygomaticotemporal fibers”.

Bransby-Zachary (1948 apud Jones *et al.*<sup>19</sup>), by describing the submasseteric space, observed that the masseter muscle is comprised by three parts: superficial, middle and deep, all originating on the zygomatic arch. The superficial part runs to the inferior third of the mandibular ramus, mainly on



**Figure 1.** Dissection sequence of the masseter muscle. 1 = superficial part; 2 = medium part (deep part on current Anatomical Terminology); 3 = third part (constitute, with the medium portion, the deep portion on current Anatomical Terminology) inserting at the superior part of the mandibular ramus and at the base of the coronoid process; \* instrument separating the third portion of the masseter muscle from the temporal muscle.

the mandibular angle region. The middle part inserts throughout a curve line running superiorly and posteriorly, limited to the middle third of the lateral aspect of mandibular ramus. Regarding the deep part, it inserts on the lateral aspect of the coronoid process and superior third of the mandibular ramus. The authors elaborated a schematic drawing, which was reproduced by Jones *et al.*<sup>19</sup>, showing the regions of insertion of the three parts of the masseter muscle. Nevertheless, it is not shown the regions of origin and the course/arrangement of the muscle fibers.

Gaudy *et al.*<sup>6</sup> demonstrated that the masseter muscle has a complex architecture with a succession of alternating musculoaponeurotic layers, which can be divided into three very different parts: superficial, intermediate and deep. They also observed that the deep part is fan-shaped, being divided into anterior and posterior regions by the masseteric neurovascular bundle.

Another study by the same group of researchers provided a more accurate description of the layers and sublayers of the masseter muscle. The researchers described the existence of six layers, which can be grouped into superficial, intermediate and deep portions. The superficial part is subdivided into two musculoaponeurotic layers, extending from the

inferior margin of the zygomatic bone and its temporal process, with a robust tendinous layer, rarely extending beyond the zygomatic-temporal suture. Then the fibers descend towards the angle of the mandible. The intermediate layer is arranged at 90° in relation to the Frankfurt Horizontal Plane, starting from its most robust origin at the inferior margin of the zygomatic arch and ending in the inferior quarter of the lateral aspect of the ramus of the mandible. Finally, the deep layer is fan-shaped, with fibers oriented upwards and forwards, measuring approximately between 3 and 5 cm, lengthening and narrowing as it travels to the zygomatic arch. More anteriorly, it is formed by a single vertical layer and more posteriorly by three alternating muscle-aponeurotic layers<sup>5</sup>.

Guerreschi *et al.*<sup>7</sup> made a similar description of the masseter muscle. According to these researchers, the deep part of the muscle, in addition to being divided into anterior and posterior regions, separated by the masseteric neurovascular bundle, presents a subdivision of its posterior region into superficial, intermediate and deep layers. They also demonstrated that fibers from the deep part insert into the temporal fascia.

Recently, a study demonstrated the existence of three distinct parts of the masseter muscle<sup>15</sup>. According to the researchers, the third and deepest part originates at the medial surface of the zygomatic process of the temporal bone and, in some cases, at the deep layer of the temporal fascia, in the vicinities of its attachment on the zygomatic arch, and inserts at the base and posterior margin of the coronoid process of the mandible. Its fibers are parallel between each other and run diagonally (anteriorly, medially, and inferiorly). In addition, considering the course of the muscle fibers, the authors state that this layer may be involved in mandibular retrusion and stabilization of the coronoid process of the mandible.

As previously described in this minireview, the attachment to the coronoid process of the mandible can be attributed to the third part of the masseter muscle<sup>4,15,19</sup>. However, other anatomical textbooks, despite reporting the insertion of muscle fibers in the coronoid process, describe that this muscle is constituted only by two parts, superficial and deep, which is the traditional description<sup>3,20-24</sup>. By the understanding given in these books, the fibers with fixation in the coronoid process of the mandible are not individualized and constitute a portion of the deep part described in current Anatomical Terminology. Furthermore, as mentioned at the beginning of the present topic, there are also no images or figures that clearly demonstrate the attachments and the arrangement of muscle fibers on the coronoid process.

The third edition of the compendium of human anatomy by Testut<sup>3</sup> described the insertion of fibers of the masseter muscle on the coronoid process of the mandible. This book describes that fibers of the deep

part are inserted simultaneously on the posterior third and on the inferior margin of all medial surface of the zygomatic arch, and often difficult to isolate them completely, in the vicinities of the coronoid process, from the corresponding fibers of the temporal muscle. From this point on, fibers run diagonally forming an angle of 40° to 45° with the fibers from the deep layer and are then inserted on the lateral aspect of the mandibular ramus, from the area of insertion of the superficial layer to the base of the coronoid process<sup>3</sup>.

According to Sicher and Tandler<sup>24</sup>, the fibers of the deep layer of the masseter muscle originate on the medial surface of the zygomatic arch, between the zygomatic-temporal suture and the articular eminence, appearing anteriorly to the temporomandibular joint (TMJ). In addition, these fibers also attach at the deep layer of the temporal fascia, close to the superficial fibers of the temporal muscle. Running inferiorly, the deep part of the masseter muscle is covered by the superficial part, with a space between these portions. The insertion of the deep part of the masseter muscle extends to the lateral aspect (masseteric tuberosity), on the inferior third of posterior margin of mandibular ramus and on the coronoid process of the mandible.

The 29<sup>th</sup> edition of Gray's Anatomy describes that fibers of the deep layer originate on the posterior third of the inferior margin and on all medial aspect of zygomatic arch, running anteriorly and inferiorly to insert on the superior half of the lateral surface of the mandibular ramus and on the coronoid process<sup>22</sup>.

Other classical anatomical textbook applied to dental practice also describes a similar morphology of the masseter muscle. It is highlighted that the posterior origin of the superficial part never crosses the zygomatic-temporal suture. The deep portion is separated from the superficial portion only on the posterior region, where there is a fusion of both portions, anteriorly. The deep portion originates by means of fibers inserted on the medial surface of the posterior portion of zygomatic arch and on its inferior margin. They run downwards almost vertically and insert on the lateral aspect of the mandibular ramus, superiorly to the insertion of the superficial part and reaching the base of the coronoid process<sup>21</sup>.

Other textbooks with recent editions also report similar attachments of the deep part of the masseter muscle, with insertion on the base of the coronoid process<sup>20,23</sup>.

In addition, a textbook of anatomy applied to dental practice, often used and referenced on Brazil, does not describe the insertion of the fibers of the deep layer of masseter muscle on the coronoid process of mandible; however, it reports an interlacing of these fibers with fibers of the temporal muscle, which may be understood as a subliminal report of the insertion on the coronoid process<sup>25</sup>.

An important textbook of South Americans anatomists does not describe the insertion of this



muscle on the coronoid process of the mandible<sup>26</sup>. Nevertheless, it is worth mentioning that it describes that fibers from the posterior part of the deep layer may insert on the articular capsule of the TMJ. A similar description was also performed by Chopard<sup>27</sup>. According to this author, the most posterior fibers of the deep layer, in some anatomical preparations, may attach on the articular capsule and on the articular disc of TMJ. Testut<sup>3</sup> wrote that the deep layer is frequently reinforced by a bundle associated to the temporomandibular ligament, a capsular ligament that reinforces this joint.

**Functional considerations regarding the masseter muscle**

Table 2 summarizes the functional aspects of the masseter muscle. This muscle acts as a powerful jaw elevator, producing load, especially in the molar region<sup>2,9,20,22,23,28</sup>.

However, the anatomical complexity and difficulty of evaluating its deeper parts makes it difficult to describe the function of each part during different mandibular positions and movements. Furthermore, the existence of several muscle and tendon bands in different directions suggests that different parts of this muscle can be recruited separately and perform different actions<sup>9,11-14</sup>.

Most textbooks describe the function of the muscle as a whole, with no distinction between the three or two portions, which is the description in the current Anatomical Terminology<sup>1</sup>. In addition to the elevation function, classical works describe that the masseter can act in mandibular protrusion<sup>4,18,24</sup>; retrusion<sup>4,24</sup> and in latero-protrusion<sup>4</sup>.

Dubrul<sup>21</sup> describes that the fibers of the deep layer are directed onwards and downwards if the mandible is on protrusion. Thus, this part presents an important component of retrusion during the occlusion movement (a combination of elevation and retrusion).

A textbook in Portuguese language reports the function of the superficial portion on protrusion

and of the deep portion on mandibular retrusion; nevertheless, there is a mention that the forces of protrusion and retrusion annulate each other, resulting in elevation of the mandible, considering the parts working simultaneously altogether<sup>29</sup>.

Belser and Hannam<sup>28</sup> compared the electromyographic (EMG) activity of the superficial and deep parts of the masseter during clenching and chewing tasks. They demonstrated that the greatest activity of both parts occurred in the maximum clenching in the intercuspoid position with forces directed vertically, proving the elevating function of the masseter muscle. They also observed that during the movement with retrusive direction the average response of normalized EMG activity (%) of the fibers of the superficial part dropped from 95.6% in vertical effort to only 5.5% in retrusive effort; regarding the deep fibers, the response dropped from 94.4% to 47.5% for the same tests, which suggests a participation of this part in the retrusive elevation. In addition, they observed that in the unilateral chewing tests, the superficial part was highly active on the chewing side and significantly less active on the support (non-functional) side, in contrast to the deep part that showed a more uniform activity bilaterally.

Another study evaluated the displacement of an inferior incisal point in response to electrical stimulation of four different areas of the masseter muscle (deep part of the muscle and the anterior, middle and posterior regions of the superficial part) in four mandibular positions: rest position, 50% maximum mouth opening and right and left lateral excursions of 10 mm. The researchers demonstrated that stimulation of the superficial parts resulted in a primarily anterovertically directed movement, while stimulation of the deep masseter resulted in a primarily laterovertically directed response. In addition, simultaneous activation of the deep part of the right and left muscle in the resting position resulted in a movement with only a vertical component, while bilateral activation of the superficial part resulted in

**Table 2.** Functions of the masseter muscle, according to classical anatomical textbooks and scientific papers.

Study ID	Elevation	Protrusion	Laterality	Retrusion
Alves and Candido 2009	X			
Belser and Hannam 1986	X			X
Gardner, Gray and O’Rahilly, 1988	X			
Goss, 1988	X			
Hiatt and Gartner 2011	X			
Van Eijden, Blanksma and Brugman, 1993	X			
Johnson and Moore, 1999	X	X		
Sicher and Tandler, 1981	X	X		X
Warwick and Williams, 1979	X	X	X	X
Teixeira, Reher and Reher, 2010	X			

an anterovertical direction movement<sup>30</sup>. In this study, a retrusive action of the deep part was not observed. The researchers evaluated only one area of this part of the masseter muscle, with the electrode being introduced at a point 20 mm anteriorly to the lateral pole of the mandibular condyle in the resting position and 15 mm inferior to the zygomatic arch. According to studies with morphological evaluation, the anterior fibers present a more vertical direction, explaining the movement with a vertical component only. The posterior part exhibits oblique fibers and in a more complex arrangement<sup>5-7,15</sup>. We believe, therefore, that this muscular part was not stimulated in the study, justifying the absence of movements with vertical and retrusive direction.

Another study, similar to the previous one, evaluated the movement responses of the mandibular condyles to electrical stimulation of the same four areas of the masseter muscle. The researchers observed that the range of condylar movements on the stimulated and unstimulated side was greater after stimulation of the deep portion of this muscle compared to stimulation of the superficial portion<sup>14</sup>.

## Conclusion

According to the literature showed on previous topics, the three layers of the masseter muscle have

been described on classical textbooks of Human Anatomy and on articles of specialized literature, as well as its insertion on the coronoid process of the mandible. However, there are controversies regarding if these coronoid fibers constitute in fact a separate layer or if they are associated to the deep layer, according to the current Anatomical Terminology.

New studies should properly perform a sample size calculation, which will guarantee the representativeness of sample, and analyze different age ranges and ethnical groups. These results, by proving its frequency, will arouse the need for discussion regarding a reformulation of official Anatomical Terminology of the layers of the masseter muscle.

The anatomical complexity of the masseter muscle makes it difficult to record its function in detail. Thus, the anatomical understanding of the three parts of this muscle and the direction of its fibers should be considered in future functional studies, through EMG analysis and electrical stimulation. The insertion of electrodes in specific points of the parts of this muscle can clarify its functions during the most varied positions and mandibular movements, especially the possible retrusive function of the more posterior fibers of the deep part.

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