On the Mm. Dorsi Profundi (Mm. Dorsi Proprii) in Formosan Monkey.

Part III. Systema m. longissimi

By

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Received for Publication December 1, 1967

The Systema M. longissimi in Formosan monkey separated into the M. longissimus dorsi, M. longissimus cervicis and M. longissimus capitis.

This system has been investigated from the point of view of the statistical and comparative anatomy for the purpose of a certain the standard condition of origin, insertion, innervation, variation and its relation to other muscles.

Formally, YAMAGUCHI (1966) in this laboratory has described on the systema m. iliocostalis, which is part of the Mm. dorsi profundi, of the Formosan monkeys. Therefore, in this paper, the longissimus muscles group (Systema m. longissimi) will be described.

This muscle group occupied on the medial parts of the Mm. dorsi profundi and includes the M. longissimus dorsi, M. longissimus cervicis and M. longissimus capitis.

The material consisted of 41 cadaver (male 22, female 19) of adult Formosan monkey (Macaca cyclopis, Schwinhoe) selected at random from the Formalin fixed specimens which are preserved in this laboratory.

The inspection was conducted using magnifying lenses with an illumination attachment.

Findings and Consideration

The M. longissimus and M. iliocostalis are united and arise as a powerful muscle mass from the ilium and sacrum. The separation of these two parts occurs at the lumbar region.

This system can be separated into the M. longissimus dorsi, M. longissimus cervicis and the M. longissimus capitis. The separation and independence of these parts are greater than that of the M. iliocostalis.
1. **M. longissimus dorsi** (Fig. 1, 2)

The M. longissimus dorsi which arises from the Aponeurosis lumbodorsalis, ilium, sacrum and thoracic vertebrae, runs upward or medio-upward to insert into the cervical, thoracic and lumbar
Fig. 2 left ...... show the insertion of the m. longissimus dorsi on the lumbar vertebrae.
right ...... is open on the both side between mm. longissimi and systema m. transversospinalis.
vertebrae and the ribs. The Aponeurosis lumbo-dorsalis, from which one portion of this muscle arises, is composed primarily of aponeurosis which arises from the medial three fourths of the iliac crest, spinous processes and Lig. supraspinale between the eleventh thoracic vertebra to the seventh lumbar vertebra, median sacral crest and the Fascia coccyygea. Additional contributions to the formation of the Aponeurosis lumbo-dorsalis are made by tendons, that arise from the mamillary processes of the eleventh thoracic to seventh lumbar vertebrae (accessory origin'N[SHI]), and the articular processes and the intermedian crest of the sacrum, and which run upward and backward between the Systema mm. transversospinalum, M. longissimus and the M. extensor caudae lateralis to fuse with the main part of the above Aponeurosis lumbo-dorsalis at the posterior lateral angle of the Systema Mm. transversospinalum. The Aponeurosis lumbo-dorsalis, thus formed, runs upward and lateralward and a gradual transition to muscle fiber occurs. This aponeurotic area forms a triangle with the apex generally at the level of the spinous process of the seventh thoracic vertebra.

The upper limit of the portion arising from the spinous processes of the vertebrae was variable and there were cases in which the upper limit was at the level of the spinous process of the eleventh thoracic vertebra. (39%), spinous process of the twelfth thoracic vertebra(57%) and cases with the upper limit at the level of the spinous process of the first lumbar vertebra (4%) (table 4).

The aponeurosis, which arise from the mamillary processes of the eleventh thoracic vertebra to the second or third lumbar vertebra, are powerful and are not adjacent to each other, but those from the lower lumbar vertebrae become increasingly weaker and wider, uniting with each other to form a single thin layer which covers the lateral surface of the Systema mm. transversospinalum. This portion runs upward and backward to join the main part of the Aponeurosis lumbo-dorsalis. In the area on a line drawn perpendicular through a point 1–2cm medial from the lateral edge of the origin of the Aponeurosis lumbo-dorsalis from the iliac crest, one portion of the deep layer was reflected ventrally to form an additional lingual aponeurosis within the muscle mass which terminated at the level of the third lumbar vertebra. The muscle fibers formed from this area extend only to about the twelfth thoracic vertebra.

The portion arising from the ilium has origin from the area between the medial three fourths of the iliac crest to the medial edge of the ilium. This portion, like the part from the sacrum, arises muscularily and inserts into the lumbar region.

Frequently, fasciculi(additional origin) are noted from the transverse processes of the thoracic vertebra (88.7%). These arise from the transverse processes of the second to tenth thoracic vertebrae, particularly, the sixth to tenth thoracic vertebrae, by slender tendons
and, in rare cases, by a mixture or musculearly (table 1).

These fasciculi arise by two to six slips (processes) (table 2), most frequently by five continuous slips (table 3). The fasciculi are adjacent to each other and form a single compound body which ascends along the spine between the Systema mm. transversospinalum and the M.longissimus and passes over one to six vertebrae to insert into the transverse processes of the lower cervical vertebrae and thoracic vertebrae either after uniting with the main part of the M.longissimus dorsi or independently.

The muscle bundle arising from any transverse process always inserts by separating into two to five processes. When the origin is muscular or by a mixture, the width of the origin is wide and passes over one or two transverse processes to insert into the lower middle

| Table 1  Location and frequency of the additional origin. (M-longissimus dorsi) |
|----------------|-----------------------|-----------------------|
|               | Macaca cyclopis (Formosan monkey) | Macaca rhesus (Rhesus monkey) |
| material      |                        |                        |
| portion of the add. origin |                        |                        |
| II thoracic vertebra | 0.3% | 0% |
| III "          | 1.0% | 0% |
| IV "          | 3.3% | 1.0% |
| V "          | 10.0% | 6.0% |
| VI "          | 15.4% | 9.5% |
| VII "         | 18.0% | 14.0% |
| VIII "        | 18.7% | 17.0% |
| IX "          | 19.0% | 26.5% |
| X "          | 15.1% | 27.0% |

| Table 2  Cases and frequency of the additional origin on one side of the body (M. longissimus dorsi). |
|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| cases | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| frequency | 11.2% | 1.2% | 13.8% | 11.2% | 17.5% | 22.5% | 16.2% | 5.0% | 0% | 1.2% |
Table 3 Status of the additional origin

<table>
<thead>
<tr>
<th>origin (cases)</th>
<th>frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 1 Proc. transversus</td>
<td>13.8%</td>
</tr>
<tr>
<td>2 &quot;</td>
<td>10.0%</td>
</tr>
<tr>
<td>3 &quot;</td>
<td>15.0%</td>
</tr>
<tr>
<td>4 &quot;</td>
<td>10.0%</td>
</tr>
<tr>
<td>5 &quot;</td>
<td>28.8%</td>
</tr>
<tr>
<td>6 &quot;</td>
<td>17.5%</td>
</tr>
<tr>
<td>7 &quot;</td>
<td>3.8%</td>
</tr>
<tr>
<td>8 &quot;</td>
<td>0%</td>
</tr>
<tr>
<td>9 &quot;</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

edge of the transverse process.

When these fasciculi, which arise from the transverse process of the thoracic vertebra, remain separate from the main part of the M. longissimus, the Mm.intertransversarii also appear to separate and extend farther upward.

When the development of these fasciculi are poor and independent of the M.longissimus dorsi, they have been termed the Mm.intertransversarii dorsales by NISHI.

Next, inspection of the site and condition of the insertion of the M.longissimus dorsi shows that the insertion in the cervical region is by tendinous processes into the transverse processes of the second to seventh cervical vertebrae. These tendons of insertion are located lateral to the tendon of insertion of the M.longissimus capitis with which there is firm adhesion.

In the thoracic region, the processes of insertion are separated into two rows on the medial and lateral sides. The processes on the medial side insert into the lateral lower tip of the transverse processes of the first to eleventh thoracic vertebrae and the accessory process of the twelfth thoracic vertebra. In the upper thoracic region, this insertion is tendinous and in the remaining portion there is mixed insertion.

On the other hand, the processes of insertion on the lateral side attach by wide bands to the lower edge of all ribs except the first(71%)
or the second rib (29%) in the region between the medial part of the
costal origin of the Pars dorsalis of the M. iliocostalis and the vicinity
of the tubercle of the ribs.

These processes of insertion in the upper part are of lesser width
and are tendinous while those below the level of the fourth to fifth rib
become increasingly wider and of mixed nature with tendon on the
deep surface.

The only exception is the process to the twelfth rib which unites
with one of the processes of the Pars lumbalis of the M. iliocostalis to
form a powerful, wide process of insertion which is difficult to separate.

The insertion in the lumbar region is by powerful processes that
attach by tendon to the lower tip of the accessory processes of the first
to sixth lumbar vertebrae and by muscle to the roots of these vertebrae.
Moreover, muscle fibers from the deep layer of this muscle insert into
the posterior surface and lower edge of the costal processes of all
lumbar vertebrae.

The fasciculi that attach to the lower edge of the costal processes
become aponeurotic at a point 1–1.5 cm from the lateral edge of the
process. They are adhered to the Lig. lumbocostale and run
mediouward to the lateral lower edge of the costal process.

When this attachment is to the medial lower edge, it changes to
tendon at the level of the upper edge of the costal process immediately
below, and runs mediouward on top of the Mm. intertransversarii
laterales to the medial lower edge. Thus, the upper edge becomes
tendinous, and in addition, there is firm union with the upper edge.
Therefore, this area may be considered to be the Lig. intertransves-
rsarum and, if so, it would mean that the M. longissimus inserts into
this ligament.

The medial surface of the processes that insert into the accessory
processes is tendinous. The origin of the M. extensor caudae lateralis
from the accessory process is adhered to this region over a distance
of 1–2 cm. Therefore, the M. longissimus may be said to play an
accessory role in the formation of the M. extensor caudae.

However, the upper fasciculi of insertion in the lumbar region run
mediouward while the lower ones run at a lesser angle. The muscle
fibers to the seventh lumbar vertebra run almost horizontally and
attach only to the lateral lower tip of the lower edge of the costal
process.

A variation was noted in which a small fasciculus from the medial
side of the iliac crest ran almost perpendicularly in the deep layer of
the M. longissimus to the lateral side of the costal process of the fifth
lumbar vertebra where it inserted into the Lig. lumbocostale.

Another similar cases was noted in which a fasciculus attached
to the Lig. lumbocostale at the level of the fourth lumbar vertebra.
Nerve supply:

Of the lateral branches of the primary posterior divisions of the spinal nerve, the supply is by Th₁ to L₇. In addition, there were comparatively many cases in which C₈ also contributed (33%).

In the thoracic region, after emerging from the lateral side of the Mm.intertransversarii, they separate into two to three branches which enter into the belly of the muscle from the medial surface. In the lower thoracic region, however, they enter from the deep surface.

C₈ pierces the M.longissimus cervicis and enters from the medial surface. On emerging from between the vertebrae in the lumbar region it gives off a branch to this muscle. It then runs downward and lateralward between the processes of insertion into the accessory processes and other fasciculi in the deep portion to become a cutaneous branch after giving off a branch to the M.longissimus.

In man, the M.longissimus separates into three independent parts; the M.longissimus capitis, M.longissimus cervicis and M.longissimus dorsalis (NISHI, EISLER). Such separation into independent parts is not found in such anthropoid apes as Chimpanzee (VIRCHOW) or Gorilla (PLATTNER). In Formosan monkey however, cases in which these portions were inseparable were very rare (2.4%). The majority of cases showed definite separation into three parts as in Rhesus monkey and Semnopithecus of NISHI.

The upper level of the Aponeurosis lumbodorsalis at the spinous process is similar to that in Rhesus monkey of NISHI and is higher by one vertebral body than in man (table 4).

In other primates, however, the upper limit is reported to be the eleventh thoracic vertebra in Semnopithecus entellus (NISHI) and the tenth or ninth thoracic vertebra in Chimpanzee (VIRCHOW, PLATTNER) which is slightly higher than the condition in Formosan monkey.

Table 4  Relation of Aponeurosis lumbodorsalis to Proc.spinous.

<table>
<thead>
<tr>
<th>upper limit (Proc. spinous)</th>
<th>Macaca cyclopis (Formosan monkey)</th>
<th>Macaca rhesus (Rhesus monkey)</th>
<th>Japanese (Nishi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XI  thoracic vertebra</td>
<td>39%</td>
<td>28%</td>
<td>4%</td>
</tr>
<tr>
<td>XII</td>
<td>57%</td>
<td>64%</td>
<td>27%</td>
</tr>
<tr>
<td>I   lumbar vertebra</td>
<td>4%</td>
<td>8%</td>
<td>47%</td>
</tr>
<tr>
<td>II  &quot;</td>
<td></td>
<td></td>
<td>19%</td>
</tr>
<tr>
<td>III &quot;</td>
<td></td>
<td></td>
<td>3%</td>
</tr>
</tbody>
</table>
The fasciculi of origin from the transverse processes of the thoracic vertebrae have been called the Verstärkungsbündel (EISLER) or the Accessorische ursprung (NISHI). When it is poorly developed, it is considered to be the Mm. intertransversarii dorsales and when it is well developed it is considered to be an independent muscle and called the M.transversalis dorsi which in the upper part continues with the M.longissimus cervicis (NISHI).

Moreover, the frequency of the presence of these fasciculi in Formosan monkey was higher for those located inferiorly, similar to the condition in Rhesus monkey of NISHI (table 1). The rate of its absence (19%) was not much different from that in Formosan monkey (11%).

A review of the status of these fasciculi which arise from the transverse processes of the thoracic vertebrae in other primates shows that it arises from only the ninth thoracic vertebra in Erythrocebus patas (VIRCHOW), from the fourth to seventh thoracic vertebrae in Hylobates (PLATTNER), from the eighth to tenth thoracic vertebrae (VIRCHOW) or only the ninth thoracic vertebra in Chimpanzee (PLATTNER), and from the fourth to tenth thoracic vertebrae in Gorilla (PLATTNER). In man, it arises from the sixth to tenth thoracic vertebrae, most frequently from the ninth or tenth thoracic vertebrae (NISHI). Thus, these fasciculi presumably arise from the lower thoracic vertebra in other primates also.

As mentioned previously, the M. longissimus dorsi in Formosan monkey is separated into the medial and lateral portions at the insertion in the thoracic region. The medial portion inserts into the transverse processes of the thoracic vertebrae while the lateral portion inserts into the ribs. In the cervical region, there only is a medial insertion which attaches to the transverse processes between the second to seventh cervical vertebrae, as in Rhesus monkey (NISHI, HOWELL-STRAUS) and Erythrocebus patas (VIRCHOW).

VIRCHOW has occasionally considered the cervical insertion of this muscle in Chimpanzee separately as the Nackentypus. PLATTNER considers the insertion of the M.longissimus dorsi to be below the seventh cervical vertebra and that part which inserts into the cervical vertebra was included with the M.longissimus cervicis as its lateral superficial portion. Aside from whether such a classification is appropriate or not, insertion into the cervical region among the cases examined by VIRCHOW and PLATTNER included insertion into the transverse processes of the second to seventh cervical vertebrae (VIRCHOW) or the fifth to seventh cervical vertebrae (PLATTNER) in Chimpanzee and the second to fourth cervical vertebrae in Hylobates (PLATTNER). However, insertion into the cervical vertebrae is hardly ever noted in man and even cases that extend to the seventh cervical vertebra are rare (NISHI), most cases inserting into the transverse processes below the first thoracic vertebra (NISHI, EISLER).
Table 5  Upper limit of costal insertion of the M. longissimus dorsi

<table>
<thead>
<tr>
<th>material</th>
<th>Macaca cyclopis (Formosan monkey)</th>
<th>Macaca rhesus (Rhesus monkey) (Nishi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>II rib</td>
<td>71%</td>
<td>57%</td>
</tr>
<tr>
<td>III</td>
<td>26%</td>
<td>36%</td>
</tr>
<tr>
<td>IV</td>
<td>7%</td>
<td></td>
</tr>
</tbody>
</table>

The lateral portion, in other words the insertion into the rib, does not include the first rib. Most frequently the upper limit is the second rib which is the same as in Rhesus monkey (Nishi), but the frequency at which there is insertion into the upper ribs is higher in Formosan monkey (table 5). In other primates, the upper limit is the second rib in Erythrocebus patas and Semnopithecus entellus (Virchow, Nishi) the sixth rib in Hylobates, the third rib (Virchow) or the fifth rib (Plattner) in Chimpanzee and the fifth rib in Gorilla (Plattner). In man, it ranges from the first to seventh ribs, but most common is the third rib (27%), fourth rib (21%) and the fifth rib (25%) (Nishi) so that the upper limit in anthropoid apes and man appears to be lower than in such lower monkey as macaque or Semnopithecus.

2. M. longissimus cervicis (Fig. 1, 3)

This muscle is located adjacent to the medial side of the M. longissimus dorsi, and between it and the M. longissimus capitis. The former covers this muscle from the dorsal side. The origin is from the lateral superior articular surface of the cervical vertebrae and the transverse processes of the upper thoracic vertebra. It terminates into the transverse processes of the cervical vertebrae.

The origin in the cervical region is by a mixture of muscle and tendon. These muscle bundles that arise in the cervical region are covered on the dorsal side by the fasciculi that arise from the thoracic vertebrae below.

Of the portion that has origin in the thoracic region, the processes that arise from the transverse processes of the first and second thoracic vertebrae are a mixture, but there is no adhesion with the processes of origin of the M. longissimus capitis or the Systema mm. transversospinalum. Those from the transverse processes of the third and lower thoracic vertebrae are tendinous and are united with the M. longissimus capitis and Systema mm. transversospinalum to form a common tendon of origin. The fasciculi that arise from the upper
Table 6 Lower limit of the origin of the M.longissimus cervicis

<table>
<thead>
<tr>
<th>lower limit (Proc. transv.)</th>
<th>frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV thoracic vertebra</td>
<td>9.8%</td>
</tr>
<tr>
<td>V</td>
<td>41.4%</td>
</tr>
<tr>
<td>VI</td>
<td>42.7%</td>
</tr>
<tr>
<td>VII</td>
<td>6.1%</td>
</tr>
</tbody>
</table>

Thoracic vertebrae insert into the lower cervical vertebrae while those from the lower thoracic vertebrae insert into higher cervical vertebrae.

The upper limit of the origin in most cases is the lateral superior articular surface between the third and fourth cervical vertebrae (70%), but occasionally it may be between the fourth and fifth cervical vertebrae (30%).

On the other hand, the lower limit of the origin varies between the transverse processes of the fourth to seventh thoracic vertebrae, but most often it is the fifth or sixth thoracic vertebrae (table 6).

The insertion is the transverse processes of the second to sixth cervical vertebrae. The processes of insertion are all tendinous and covered on the lateral side by the tendon of insertion of the M. longissimus dorsi with which there is firm adhesion.

The so-called Atlasteil of Virchow was always noted in Formosan monkey. This muscle arose from the upper cervical vertebrae by muscle or by a mixture and ascends between the M.longissimus Cervies and the M.longissimus capitis to attach by short tendon into the central portion of the transverse process of the Atlas. Occasionally, a fasciculi from the upper edge of the tendon of insertion into the second cervical vertebra of the M.longissimus cervicis joined this muscle (8.5%).

The upper limit of the origin of the Atlasteil is always the lateral

Table 7 Lower limit of the origin of the "Atlasteil (Virchow)"

<table>
<thead>
<tr>
<th>lower limit</th>
<th>frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>joint between III and IV Cerv. Vert.</td>
<td>57.7%</td>
</tr>
<tr>
<td>&quot; IV and V</td>
<td>41.0%</td>
</tr>
<tr>
<td>&quot; V and VI</td>
<td>1.3%</td>
</tr>
</tbody>
</table>
superior articular surface between the second and third cervical vertebrae, but the lower limit is either the joint between the third and fourth cervical vertebrae or one joint lower (table 7).

The variations noted included the following:

a) The M. longissimus dorsi and M. longissimus cervicis are not only fused but an accessory origin from the first to tenth thoracic vertebrae is noted from which fasciculi run to both the M. longissimus cervicis and the M. longissimus dorsi so that the lower limit of the M. longissimus cervicis could not be determined.

b) A small fasciculus arising by tendon from the spinous process of the second thoracic vertebra ran upward and lateralward to continue into the dorsal region of the M. longissimus cervicis.

c) A small fasciculus that arose from the lateral superior articular surface between the second and third cervical vertebrae ascended between the M. longissimus capitis and the M. longissimus cervicis to spread out and continue into the dorsal surface of M. obliquus capitis superior.

d) An independent fasciculus from the articular region between the third to fifth cervical vertebrae ascended on the ventral side of the M. longissimus capitis to attach to the mastoid process at the lateral edge of the insertion of the M. obliquus capitis superior.

e) A small fasciculus separating from the main portion of the M. longissimus dorsi continued into the dorsal region of the M. longissimus cervicis on 3 sides.

**Nerve supply**

Innervation is by the lateral branches of the posterior primary divisions of the second to eighth cervical nerves which enter the muscle from the ventral side except for C₈ which enters from the lateral dorsal surface of the muscle.

The Atlasteil is usually supplied by C₂, C₃ and in rare cases by Th₁ (2.4%).

At the origin of this muscle in Formosan monkey muscle fibers arising from the articular surface of the third cervical vertebra joined this muscle, but there is no mention of such a condition in Rhesus monkey. The origin is simply mentioned to be the upper thoracic vertebrae involving the first to fifth thoracic vertebrae (HOWELL-STRAUS) or the first to seventh (eighth) thoracic vertebrae (NISHI).

Furthermore, the lower limit of the origin in other primates has been reported to be the fourth thoracic vertebra in Erythrocebus (VIRCHOW), the fifth (HOWELL-STRAUS) or the fifth to eighth thoracic vertebra in Rhesus monkey (NISHI), the second to fifth thoracic vertebra (KOHLBRUGGE) or either the fifth or sixth thoracic vertebra in Semnopithecus (NISHI),
Table 8. Lower limit of the origin of the M.longissimus cervicis

<table>
<thead>
<tr>
<th>Material</th>
<th>Macaca cyclopis (Formosan monkey)</th>
<th>Macaca rhesus (Rhesus monkey) (Nishi)</th>
<th>Japanese (Nishi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lower limit (Proc. transv.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV thoracic vertebra</td>
<td>9.8%</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>41.4%</td>
<td>6%</td>
<td>38%</td>
</tr>
<tr>
<td>VI</td>
<td>42.7%</td>
<td>41%</td>
<td>32%</td>
</tr>
<tr>
<td>VII</td>
<td>6.1%</td>
<td>42%</td>
<td>18%</td>
</tr>
<tr>
<td>VIII</td>
<td>11%</td>
<td></td>
<td>2%</td>
</tr>
<tr>
<td>IX</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

the fifth thoracic vertebra in Hylobates and Chimpanzee (Plattner) and the fourth thoracic vertebra in Gorilla. In man, it is the fourth to ninth thoracic vertebrae, most frequently the fifth or sixth thoracic vertebra (Nishi).

When the findings in my cases of Formosan monkey are compared with the study of the large number of Rhesus monkey by Nishi, the lower limit of origin in Formosan monkey very frequently is higher by one thoracic vertebra than in Rhesus monkey (table 8).

The upper limit of insertion in Rhesus monkey (Nishi) and Semnopithecus (Kohbrugge) is reportedly the second cervical vertebra, the same as in my Formosan monkey.

The so-called Atlasteil of Virchow which inserts into the transverse process of the Atlas was always found in Formosan monkey. This Atlasteil is frequently seen in other primates such as Rhesus monkey (Nishi), Erythrocebus patas, Chimpanzee (Virchow), Hylobates and Gorilla (Plattner), etc., and also in man (Eisler, Nishi).

The nerve supply in man involves C3(4) – Th2, but in Formosan monkey it usually is by C2–C8 with contribution by Th1 in only 2 cases. Therefore, the supply is by nerves more cranial than in man.

3. M. longissimus capitis (Fig. 1,3)

This muscle is located on the lateral side of the M. semispinalis capitis and on the medial side of the M. longissimus cervicis. The dorsal side is covered by the M. splenius.

This muscle arises from the articular processes of the last four or five cervical vertebrae and the transverse processes of the upper five or six thoracic vertebrae. There are cases in which the origin is
Fig. 3 Variations in m. longissimus capitis

*........ variation

M. longissimus capitis

M. obliquus capitis superior

Proc. mastoideus

M. obliquus capitis inferior

M. longissimus capitis

--- Protuberantia occipitalis externa

--- inskription

--- I thor. vert.

--- I thor. vert.

l. longissimus cervicis

*........ (to fascia lumbodorsalis)
limited to the upper part with the lower limit of the origin being the third thoracic vertebra (table 9).

In a considerable number of cases, there were additional small fasciculi from the spinous processes of the thoracic vertebrae (22%).

The origin is by several processes that immediately unite to form a single large muscle bundle which runs upward to insert into the posterior edge of the mastoid process by tendon. One portion of the middle part of the process of origin, in other words, the portion from the second thoracic vertebra (3.6%) or that from the third thoracic vertebra (1.2%) may be absent.

The origin in the cervical region is by a mixture of muscular and tendinous. The origin from the thoracic region is tendinous and a common tendon of origin is formed with the Systema mm. transversospinalum and the M. longissimus cervicis. The arrangement of the muscle fibers of this muscle is such that the fibers from the lower portion are located more superficially, becoming more deeper the higher the site of origin is.

At the insertion of this muscle into the mastoid process, a powerful tendinous process is formed which, in the majority of cases, is separated into two layers that overlap each other (61.0%). Between these layers runs the A. occipitalis (53.7%). Occasionally, it is separated into three layers (3.6%) but there may be entirely no separation in a considerable number of cases (35.4%) (table 10).

When this separation is present, the fasciculi that have origin from the upper portion become the deep layer while the fasciculi from the lower portion form the superficial layer. The former inserts slightly lower than the former.

It was mentioned earlier that small fasciculi arising from the

### Table 9 Upper and lower limit of the M. longissimus capitis

<table>
<thead>
<tr>
<th>lower and upper limit</th>
<th>frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>joint between III and IV cerv. vert.</td>
<td>67.1%</td>
</tr>
<tr>
<td>IV and V</td>
<td>32.9%</td>
</tr>
<tr>
<td>III thoracic vertebra (Proc. transv.)</td>
<td>7.3%</td>
</tr>
<tr>
<td>IV</td>
<td>17.1%</td>
</tr>
<tr>
<td>V</td>
<td>42.7%</td>
</tr>
<tr>
<td>VI</td>
<td>32.9%</td>
</tr>
</tbody>
</table>
spinous processes of the thoracic vertebrae continued into the dorsal part of this muscle at a considerably high frequency (22%). These fasciculi arise by tendinous processes about 0.2–0.5 cm wide from the spinous processes or the Lig. supraspinale of the second to fifth thoracic vertebrae. Frequently, they are adhered with the tendon of origin of the M. splenius and run lateralward and upward in the same direction as the muscle fibers of the M. splenius to continue into the posterior edge of the M. longissimus capitis. In rare cases, there were two such fasciculi on one side.

The variations noted included the following: A small fasciculus
arising from the fascia of the intrinsic muscle at the level of the fourth thoracic vertebra ran upward and lateralward to continue into the dorsal side of the M.longissimus capitis; a small fasciculus arising from the articular process between the fourth and fifth cervical vertebrae separated from the main portion of the M.longissimus capitis and ran upward on the deep side to terminate at the mastoid process below the tendon of insertion of the main portion; a small fasciculus separating from the medial surface of the M.longissimus capitis ascended perpendicularly to end at the superior nuchal line at about the middle of the insertion of this muscle and the M.semispinalis capitis. In addition, inscriptions were noted in 3 cases at the level of the third to fifth cervical vertebrae on about the medial half of the belly which run horizontally (Fig. 3).

Nerve supply

The supply is by the lateral branches of the primary posterior divisions of the second to fourth cervical nerves with contribution by C5 in a small number of cases (3.6%). C2 and C3 enter respectively from the medial surface of the muscle but occasionally these two may anastomose with each other before entering the muscle (2.4%). C4 enters the muscle from the lateral surface.

The lower limit of the origin of this muscle is the third thoracic vertebra in Erythrocebus patas (VIRCHOW), the fifth or fourth to fifth thoracic vertebra in Rhesus monkey (HOWELL-STRAUS, NISHI), the fourth thoracic vertebra in Semnopithecus entellus (NISHI), the third thoracic vertebra in Hylobates (PLATTNER), the first thoracic vertebra in Chimpanzee (VIRCHOW, PLATTNER) and the second thoracic vertebra in Gorilla (PLATTNER). Apparently, the lower limit in Formosan monkey is lower than in other primates.

The fasciculi from the spinous processes of the upper vertebrae noted in Formosan monkey has been mentioned in man by EISLER who regarded this as a variation of the M.splenius. In Formosan monkey however, the nerve supply was the same as the M.longissimus capitis so that I feel that this is a variation of the M.longissimus capitis.

The inscriptions noted in rare cases on the belly of the muscle have also been reported in Erythrocebus patas (VIRCHOW), Chimpanzee (VIRCHOW), Gorilla (PLATTNER), etc.

The nerve supply in man is reported to be C1 to C3 or C4 (EISLER), but contribution by C1 was not found in Formosan monkey.

SUMMARY

The Systema m.longissimi, which is part of the Mm.dorsi profundi, can be separated into the M.longissimus dorsi, M.longissimus cervicis
and the M. longissimus capitis.

1) The M. longissimus dorsi arises from the Aponeurosis lumbodorsalis, iliac crest, upper edge of the sacrum and the transverse processes of the thoracic vertebrae. In the cervical region, it inserts into the transverse process of the second to seventh cervical vertebrae. The insertion in the thoracic region is separated into two groups, the first group attaches to all thoracic vertebrae and the second group to the second to twelfth ribs. In the lumbar region, the insertion is into the accessory processes of the first to sixth lumbar vertebrae and the costal processes of all lumbar vertebrae.

The Aponeurosis lumbodorsalis is formed by the aponeurosis arising from the spinous process, the mamillary processes and Lig. upraspinale of the last one or two thoracic vertebrae and the upper seven lumbar vertebrae, the median and intermedian sacral crest, the iliac crest and Fascia coccygea.

The fasciculi which arise from the transverse processes of the thoracic vertebrae are accessory fasciculi which most frequently have origin from the seventh to ninth thoracic vertebrae and there is a tendency for two to six to be present continuously on one side.

The nerve supply is usually by Th1 to L7, but contribution by C8 is seen comparatively frequently.

2) The M. longissimus cervicis arises from an area ranging superiorly from the articular process between the third and fifth cervical vertebrae, and inferiorly from the transverse process of the fifth or sixth thoracic vertebrae. It inserts into the transverse processes of the second to sixth cervical vertebrae.

The so-called "Atlasteil" of Virchow was found in all cases.

The nerve supply in most cases is by C2 to C5 with innervation of the Atlasteil by C2 to C3. Occasionally, Th1 also contributed.

3) The M. longissimus capitis arises from the articular processes between the third to fifth cervical vertebrae and the transverse processes of the upper five or six thoracic vertebrae. It inserts into the mastoid process.

The insertion is tendinous and separates into two layers between which run the A. occipitalis in most cases.

A fasciculi arising from the spinous processes and the Lig. supraspinale of the second to fifth thoracic vertebrae were found at a considerable frequency.

The nerve supply is by C2 to C5 with contribution by C5 in rare cases.

My best thanks offered to Prof. J. SATOH for his helpful suggestions, criticism and direction.
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6) PLATTNER, F., 1923, Über die ventral innervierte und die genuine Rückenmuskulatur bei drei Anthropomorphen (Gorilla gina, Hylobates und Troglodytes niger). Morph. Jb., 52