

# Morphological Classification of the Depressor Supercilii Muscle Based on Shape, Orientation, and Attachment Site

## Clasificación Morfológica del Músculo Depresor Supercilia Según su Forma, Orientación y Punto de Inserción

Mi-Sun Hur<sup>1</sup>

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**HUR, M-S.** Morphological classification of the depressor supercilii muscle based on shape, orientation, and attachment site. *Int. J. Morphol.*, 44(2):632-637, 2026.

**SUMMARY:** The depressor supercilii muscle (DS) is a small but clinically relevant depressor of the glabellar region, whose morphology and independent existence remain debated. Precise knowledge of its variations is critical for optimizing botulinum toxin (BoNT) injections and surgical interventions. A total of 44 DS specimens from 22 embalmed Korean cadavers (10 males, 12 females; mean age, 72.1 years) were dissected. The DS was analyzed for overall shape, fiber orientation, and attachment sites, with classification into morphological subtypes. Bilateral symmetry was also assessed. Two major shapes were identified: wide fan-shaped (79.5%) and narrow band-shaped (20.5%). Fiber orientation was predominantly vertical (86.4%), with a minority displaying asymmetric (6.8%) or oblique (6.8%) trajectories toward the orbicularis oculi. Five insertion patterns were observed, ranging from exclusive eyebrow to exclusive glabellar attachment. Balanced dual insertion was the most frequent, with symmetrical patterns in 45.5% and asymmetrical patterns in 54.5% of cadavers. These findings support the DS as an anatomically distinct muscle exerting a primarily vertical downward pull on the medial eyebrow and glabella. The DS demonstrates consistent vertical orientation but variable morphology and attachment patterns, which may explain incomplete wrinkle reduction and asymmetry following standard BoNT injections. Recognition of DS variability highlights the need for individualized treatment strategies in both aesthetic and reconstructive practice.

**KEY WORDS:** Depressor supercilii muscle; Orbicularis oculi muscle; Glabella; Wrinkle; Botulinum toxin injection.

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## INTRODUCTION

The glabellar region is anatomically complex, where several small but clinically relevant muscles interact within a narrow space. The frontalis elevates the eyebrows, while the procerus, corrugator supercilii, and depressor supercilii muscle (DS) act to draw them downward, forming the expressive lines of the glabella (Kim *et al.*, 2016; Seo, 2017; Benedetto, 2018; Standring, 2020; Wan *et al.*, 2024).

The procerus contributes to horizontal wrinkles across the glabella, and the corrugator supercilii produces vertical or oblique lines by pulling the medial eyebrow inferomedially. Knize (2000) further described three medial eyebrow depressors—the oblique head of the corrugator supercilii, the DS, and the medial orbital portion of the orbicularis oculi muscle (OOc)—that together produce the oblique glabellar lines.

Among these muscles, the DS holds a particularly noteworthy position. Attaching directly to the medial end of the eyebrow, it exerts a nearly vertical downward pull, distinguishing it from its adjacent depressors. Yet, despite this unique role, the DS remains a subject of anatomical debate: some authors consider it merely the superomedial extension of the OOc, while others, supported by histological and dissection-based evidence, identify it as an independent muscle (Cook *et al.*, 2001).

Despite its small size, this muscle holds clinical relevance that should not be disregarded. Botulinum toxin (BoNT) injections into the glabellar region—common in both aesthetic and therapeutic practice—may diffuse into the DS, altering its function and leading to variable wrinkle reduction, eyebrow asymmetry, or other complications.

<sup>1</sup>Department of Anatomy, Daegu Catholic University School of Medicine, Daegu, South Korea.

FUNDING. This work was supported by research grants from Daegu Catholic University in 2025 (20255002).

Received: 2025-12-08 Accepted: 2026-01-31

While the procerus and corrugator supercilii muscles have been extensively studied (Yang *et al.*; Hur, 2017; Lee *et al.*; Park *et al.*, 2025), detailed investigations of the DS—its morphology, variations, and spatial relationships—remain limited (Cook *et al.*, 2001; Hur *et al.*, 2022).

The present study aimed to conduct a detailed morphological analysis of the DS, focusing on its shape, fiber orientation, and insertion sites—whether into the eyebrow, glabella, or both—and to classify these patterns while assessing bilateral symmetry. By examining its anatomical relationships with neighboring muscles such as the procerus and corrugator supercilii, this research aimed to clarify the functional role of the DS muscle in glabellar wrinkle formation and provide foundational anatomical data to guide safer and more effective BoNT interventions.

## MATERIAL AND METHOD

The DS was investigated in 44 specimens from embalmed adult Korean cadavers (10 males, 12 females; mean age, 72.1 years; age range, 40–94 years). All cadavers were legally donated to the Catholic Kwandong University College of Medicine, and the study was conducted in accordance with the Declaration of Helsinki.

Dissection of the upper face was performed to expose the DS, OOc, procerus, frontalis, and adjacent anatomical structures. The analysis focused on the orientation of the DS muscle fibers, their anatomical

relationships to adjacent muscles such as the OOc and procerus, and their attachment sites in the eyebrow and glabellar regions. To accurately identify the anatomical insertion of the DS into the eyebrow region, dissection was performed with the overlying eyebrow skin preserved. This approach allowed for clear visualization of the muscle fibers and their direct attachments to the subcutaneous tissues and dermis of the medial eyebrow. For consistency, all images were adjusted to the left facial orientation, allowing clearer observation of DS morphology.

## RESULTS

The DS was classified according to three criteria: overall shape, muscle fiber orientation, and attachment site (Figs. 1–3). This classification demonstrates considerable anatomical variability of the DS, which may have important implications for anatomical and clinical assessments of the glabellar region.

### Shape of the DS

- Type I: Wide fan-shaped ( $n = 35$  of 44 specimens, 79.5 %, Fig. 1A), in which the DS had a broad triangular configuration, with muscle fibers radiating widely from a relatively narrow origin.
- Type II: Narrow band-shaped ( $n = 9$ , 20.5 %, Fig. 1B), in which the DS exhibited a slender, ribbon-like morphology, with muscle fibers following a confined trajectory.

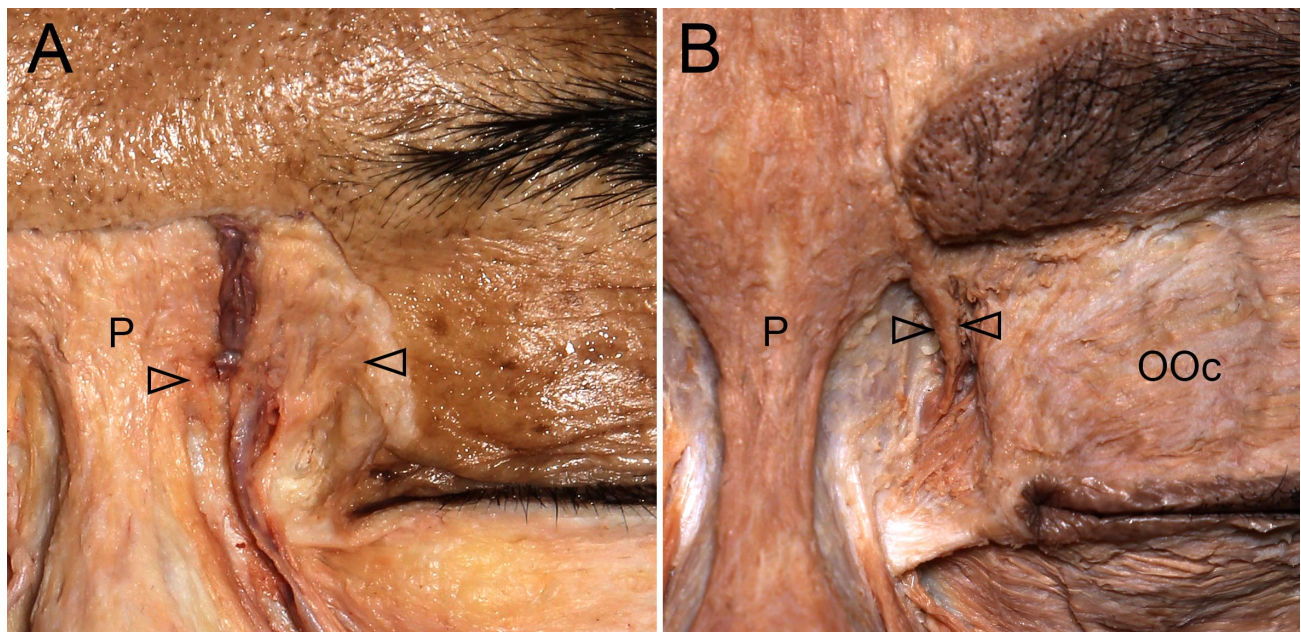


Fig. 1. Two morphological types of the DS (depressor supercilii) based on overall muscle shape (A) Wide fan-shaped type – The DS had a broad, triangular configuration with muscle fibers radiating outward from a relatively narrow origin. (B) Narrow band-shaped type – The DS appeared as a slender, ribbon-like band with muscle fibers running in a confined trajectory. OOc, orbicularis oculi; P, procerus.

### Muscle fiber orientation of the DS

- Type A: Vertically oriented type (n = 38, 86.4%, Fig. 2A). The DS fibers ascended almost straight in a vertical direction, forming a symmetric fan-shaped configuration.
- Type B: Asymmetrically oriented type (n = 3, 6.8%, Fig. 2B), in which while the majority of muscle fibers ascended vertically, the lateral fibers deviated superolaterally toward the medial portion of the OOc, resulting in an asymmetric triangular morphology.
- Type C: Obliquely oriented type (n = 3, 6.8%, Fig. 2C), in which most fibers ascended obliquely in a superolateral direction toward the OOc, showing a predominantly inclined trajectory rather than a vertical course.

### Attachment Site of the DS

- Type I: The eyebrow only (n = 7, 15.9 %, Fig. 3A), in

which all DS fibers ascended and inserted beneath the medial end of the eyebrow.

- Type II: Predominantly eyebrow (n = 9, 20.5 %, Fig. 3B), in which approximately two-thirds of the DS fibers inserted into the medial end of the eyebrow, with the remaining one-third attaching to the glabella.

- Type III: Balanced dual insertion (n = 13, 29.5 %, Fig. 3C), in which approximately half of the DS fibers attached to the medial end of the eyebrow and half to the glabella.

- Type IV: Predominantly glabella (n = 9, 20.5 %, Fig. 3D), in which approximately two-thirds of DS fibers inserted into the glabella, with the remaining one-third attaching to the medial end of the eyebrow.

- Type V: Glabella only (n = 6, 13.6 %, Fig. 3E), in which All DS fibers ascended and inserted to the glabella, medial to the eyebrow.

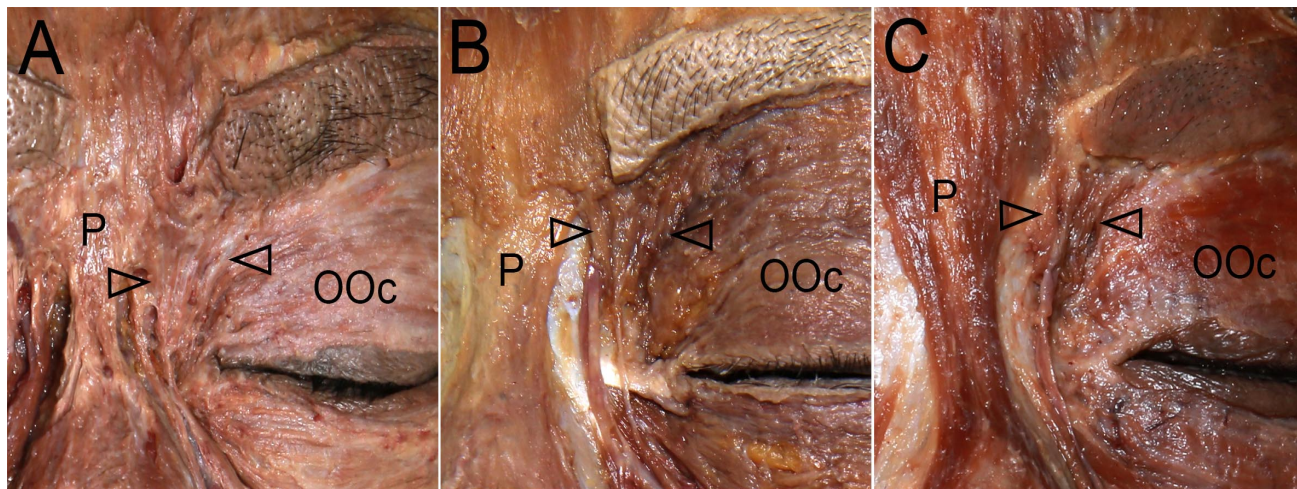


Fig. 2. Three types of fiber orientation in the DS (A) Vertically oriented type – The DS fibers ascend almost straight in a vertical direction, forming a symmetric fan-shaped configuration. (B) Asymmetrically oriented type – While the majority of fibers ascend vertically, the lateral fibers deviate superolaterally toward the medial portion of the orbicularis oculi, resulting in an asymmetric triangular morphology. (C) Obliquely oriented type – Most fibers ascend obliquely in a superolateral direction toward the orbicularis oculi, showing a predominantly inclined trajectory rather than a vertical course. OOc, orbicularis oculi; P, procerus.

### Symmetrical and asymmetrical insertion patterns of the DS

Among the 22 cadavers with bilateral DS muscles, 10 cadavers (45.5%) exhibited symmetrical insertion patterns, while the remaining 12 cadavers (54.5%) demonstrated asymmetrical patterns.

When the bilateral insertions were symmetrical, the specific insertion patterns varied considerably. In three cadavers (13.6%), approximately half of the DS muscle fibers were attached to the sub-medial end of the eyebrow,

and approximately the other half to the glabella. In three cadavers (13.6%), approximately one-third of the DS fibers were attached to the medial end of the eyebrow and the remaining approximately two-thirds to the glabella, whereas in three other cadavers (13.6%), approximately two-thirds were attached to the eyebrow and approximately one-third to the glabella. Additionally, exclusive eyebrow insertion (100%) was observed in one cadaver (4.5%).

A variety of asymmetrical insertion patterns of the DS were observed. In four cadavers (18.2%), one side

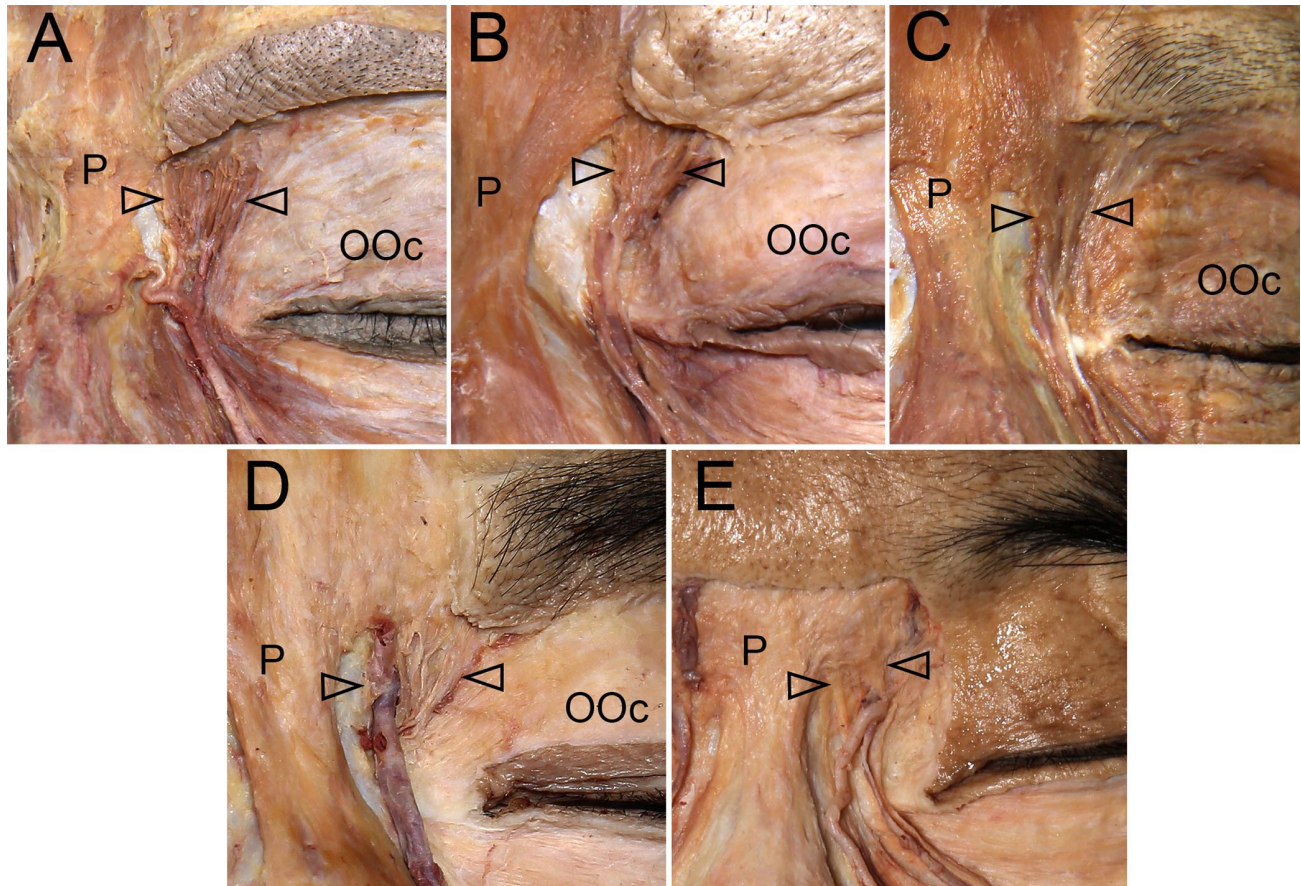


Fig. 3. Five types of attachment sites of the DS muscle to the eyebrow and glabellar region (A) Eyebrow only type – All DS fibers ascended and inserted beneath the medial end of the eyebrow. (B) Predominantly eyebrow type – Approximately two-thirds of the fibers inserted into the medial end of the eyebrow, while approximately one-third attached to the glabella. (C) Balanced dual insertion type – Approximately half of the fibers attached to the medial end of the eyebrow and half to the glabella. (D) Predominantly glabella type – Approximately two-thirds of the fibers inserted into the glabella, while one-third attached to the medial eyebrow. (E) Glabella only type – All DS fibers ascended and inserted to the glabella, medial to the eyebrow. OOc, orbicularis oculi; P, procerus.

showed an even distribution of fibers between the medial end of the eyebrow and the glabella, whereas the contralateral side demonstrated exclusive insertion at the medial end of the eyebrow. In two cadavers (9.1%), one side showed an equal distribution of fibers between the medial end of the eyebrow and the glabella, whereas the contralateral side exhibited exclusive insertion into the glabella. In another two cadavers (9.1%), one side demonstrated approximately one-third of the DS fibers were attached to the medial end of the eyebrow and the remaining approximately two-thirds to the glabella.

Of the remaining four cadavers, one exhibited equal fiber distribution between the medial end of the eyebrow and the glabella on one side, while the contralateral side showed a predominance of eyebrow insertion with two-thirds of the fibers attached beneath the eyebrow and one-third to the glabella. In another cadaver, one side demonstrated

exclusive eyebrow insertion, whereas the opposite side showed a predominance of glabellar insertion with two-thirds of the fibers attached to the glabella and one-third to the eyebrow. In a third cadaver, one side displayed exclusive glabellar insertion, while the contralateral side exhibited a predominance of eyebrow insertion with two-thirds of the fibers attached to the eyebrow and one-third to the glabella. In the final cadaver, one side showed exclusive eyebrow insertion, whereas the opposite side demonstrated a predominance of eyebrow insertion with two-thirds of the fibers attached to the eyebrow and one-third to the glabella.

## DISCUSSION

In the present study, the DS predominantly exhibited a vertical fiber orientation (86.4%), with only a minority of cases (13.6%) showing superolateral deviation toward the OOc. This supports the view that the DS acts independently

from the OOC, exerting a distinct vertical pull rather than acting as part of it. Morphologically, the DS most commonly appeared as a wide fan-shaped muscle. The most frequent attachment pattern was dual insertion into both the medial end of the eyebrow and the glabella, suggesting a role in the simultaneous vertical depression of both regions.

Cook *et al.* (2001), previously described the DS as a vertically oriented muscle overlapping with the origin of the corrugator supercilii. Our results corroborate the predominance of vertical orientation (86.4%) but, importantly, also reveal clear morphological variations in shape and attachment, with some fibers showing oblique trajectories toward the orbicularis oculi. These findings extend beyond observations of Cook *et al.* (2001), by suggesting that the DS is not merely an extension of the corrugator or the orbicularis oculi but rather an independent muscle with distinct anatomical and functional contributions to glabellar depression.

From a clinical aspect, anatomical variations of the DS may influence the outcomes of botulinum toxin (BoNT) treatment in the glabellar region. A wide fan-shaped DS with dual attachment may not be fully inactivated by standard injections targeting only the procerus and corrugator supercilii, leaving residual muscle activity and resulting in incomplete wrinkle reduction. Fiber orientation of the DS can also be relevant: a vertically oriented DS primarily contributes to glabellar frown lines, whereas oblique fibers directed toward the orbicularis oculi may additionally affect the medial canthal region, where untreated fibers could produce persistent wrinkles. The site of attachment further modifies the clinical effect. An eyebrow-only DS tends to influence eyebrow position, while a glabella-only DS responds more directly to midline injections. In cases of dual attachment, the DS can exert effects on both the eyebrow and glabella, requiring careful injection planning to achieve balanced and predictable results.

Injection technique is another important consideration. Wan *et al.* (2024), demonstrated that deeper injections into the periosteal layer are more effective for inactivating the fibers responsible for oblique glabellar lines, whereas vertical lines respond better to slightly more superficial injections. Clinical observations are consistent with these findings: targeted DS blockade can elevate the medial eyebrow and improve oblique glabellar wrinkles, particularly in cases where standard injections into the procerus and corrugator supercilii produce unwanted flattening of the glabella or excessive widening of the interbrow distance (Domínguez-Duarte, 2022). Together,

these results demonstrate the importance of considering DS morphology and its spatial relationships with adjacent muscles when designing individualized BoNT treatment strategies.

Macdonald *et al.* (1998), reported that the corrugator supercilii and procerus as the primary contributors to vertical and horizontal glabellar rhytids, respectively, but did not identify the DS as a distinct anatomical entity. This absence has contributed to debate regarding the independent existence and clinical relevance of the DS. In contrast, the present study provided clear morphological evidence supporting the DS as a separate muscle, demonstrating its variable shape, muscle fiber orientation, and attachment patterns. These findings suggest that inter-individual differences in DS anatomy could account for residual activity following botulinum toxin injections targeted only at the corrugator supercilii and procerus.

Consistent with these anatomical findings, Sanctis Pecora *et al.* (2021), reported that the One21 technique—an individualized approach that adjusts botulinum toxin injection sites and dosages to the specific muscular pattern involved, including the procerus, corrugator supercilii, and particularly the DS and frontalis—yielded superior outcomes compared with the standard 5-point method. In the standard group, the DS was recruited in approximately 60% of patients but was not directly targeted, which may have contributed to residual muscular activity or asymmetry. These clinical observations align with our morphological evidence and highlight the importance of incorporating DS targeting into anatomical mapping and injection planning, particularly in patients presenting with asymmetric glabellar lines or the involvement of additional muscle groups in addition to the procerus and corrugator supercilii.

Overall, our findings emphasize that the DS is an anatomically and functionally distinct muscle with a predominantly vertical action that contributes to the balance of glabellar and medial eyebrow movement. Further investigation into the extent of overlap between the DS, corrugator supercilii, and adjacent eyebrow structures would help clarify their spatial relationships and support more precise surgical and clinical interventions. The observed morphological variations of the DS, particularly in fiber orientation and attachment, have direct clinical relevance for botulinum toxin therapy and facial rejuvenation procedures. Accordingly, individualized anatomical assessment that accounts for DS variability and its interactions with surrounding muscles is essential for optimizing both aesthetic and reconstructive interventions in the glabellar region.

## ACKNOWLEDGMENTS

The authors express their deep gratitude to individuals who donated their bodies for scientific research, enabling advancements in anatomical studies.

**Institutional Review Board Statement.** Our study was exempted from requiring Institutional Review Board (IRB) approval, as evidenced by the exemption number CKU-21-01-0101. All specimens were handled in strict accordance with the ethical standards of the Declaration of Helsinki, ensuring that our methods were ethically sound. The cadaver donations were made under legal agreements that comply with both our institution's guidelines and national regulations on research ethics.

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**HUR, M-S.** Clasificación morfológica del músculo depresor superciliar según su forma, orientación y punto de inserción. *Int. J. Morphol.*, 44(2):632-637, 2026.

**RESUMEN:** El músculo depresor superciliar (DS) es un músculo pequeño pero clínicamente relevante de la región glabellar, cuya morfología y existencia independiente siguen siendo objeto de debate. El conocimiento preciso de sus variaciones es fundamental para optimizar las inyecciones de toxina botulínica (BoNT) y las intervenciones quirúrgicas. Se disecaron 44 muestras de DS procedentes de 22 cadáveres coreanos embalsamados (10 hombres, 12 mujeres; edad media: 72,1 años). Se analizó la forma general, la orientación de las fibras y los puntos de inserción del DS, clasificándolo en subtipos morfológicos. También se evaluó la simetría bilateral. Se identificaron dos formas principales: ancha en forma de abanico (79,5 %) y estrecha en forma de banda (20,5 %). La orientación de las fibras fue predominantemente vertical (86,4%), con una minoría que presentaba trayectorias asimétricas (6,8 %) u oblicuas (6,8 %) hacia el músculo orbicular del ojo. Se observaron cinco patrones de inserción, desde inserción exclusiva en la ceja hasta inserción exclusiva en la glabella. La inserción dual equilibrada fue la más frecuente, con patrones simétricos en el 45,5 % y asimétricos en el 54,5 % de los cadáveres. Estos hallazgos respaldan la idea de que el músculo depresor superciliar es un músculo anatómicamente distinto que ejerce una tracción vertical descendente principalmente sobre la ceja medial y la glabella. El DS demuestra una orientación vertical constante, pero una morfología y patrones de inserción variables, lo que podría explicar la reducción incompleta de arrugas y la asimetría tras las inyecciones estándar de toxina botulínica. El reconocimiento de la variabilidad del DS subraya la necesidad de estrategias de tratamiento individualizadas tanto en la práctica estética como reconstructiva.

**PALABRAS CLAVE:** Músculo depresor superciliar; Músculo orbicular del ojo; Glabella; Arruga; Inyección de toxina botulínica.

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Corresponding author:

Mi-Sun Hur, PhD

33, Duryugongwon-ro 17gil

Nam-gu

Department of Anatomy

Daegu Catholic University School of Medicine

Daegu

KOREA

E-mail: mshur@cu.ac.kr