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Anatomical Study With Clinical Significance of the Buccomandibular Space: A Complementary Ultrasonographic Study to Cadaveric Dissection

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ABSTRACT

The buccomandibular space is a potential space located within the oral and maxillofacial regions. This morphological study aimed to provide a detailed anatomical description and ultrasonographic examination of the buccomandibular space and its adjacent structures, to discuss its clinical significance—particularly in relation to pathological conditions such as the spread of odontogenic infections, complications associated with antiaging injectables, and tumor invasion—and to offer valuable insights into the understanding and management of lower face treatment and rejuvenation. Anatomical dissection was performed on 28 facial halves, including 10 from five embalmed and 18 from nine fresh-frozen Korean adult cadavers. An ultrasonographic study was conducted on 12 facial halves of six healthy Korean adult participants. In addition, targeted intraoral polycaprolactone filler injection into the buccomandibular space was performed on two fresh-frozen hemifaces to simulate the expansion of the potential space, followed by ultrasonographic validation and intraoral dissection to confirm the filler-occupied area. The buccomandibular space was bounded by six anatomical boundaries. Ultrasonographic examination at three reference points in the lower third of the face identified adjacent muscular and vascular structures. This study presented various methods for clarifying the boundaries and adjacent structures of the buccomandibular space. The detailed anatomical insights gained in our study can enhance the understanding of the buccomandibular space, including its clinical relevance and anatomical relationships with adjacent structures. These findings may also improve the interpretation of ultrasonographic imaging for healthcare professionals and students in both clinical and educational settings.

1 | Introduction

The buccomandibular space (BMS) is a potential space in the oral and maxillofacial regions filled with loose connective tissue and bounded by adjacent facial muscles and bones. This "new space of the face" was investigated and designated as the BMS in an intraoral cadaveric dissection study. The soft- and hard-tissue boundaries of the BMS have a notable anatomical relation to the mental nerve and its branches exiting the mental foramen of the mandible (Iwanaga, Kamura, et al. 2017; Inoue et al. 2024). Considering that the BMS is a deep-lying space in the lower face, immediately lateral to the mandibular

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body, it is necessary that the boundaries of the BMS, a loose connective tissue layer, can be more precisely delineated with additional anatomical detail.

Published scientific studies reporting medical imaging findings related to the BMS are extremely scarce. Ultrasonographic studies of potential spaces are well documented for educational purposes and are commonly used as preliminary diagnostic tools (Harris 1983; Azzoni et al. 2004; Brooks et al. 2004; Rambhia et al. 2017; So et al. 2017; Johnson et al. 2025). In this study, ultrasonographic examination of the BMS was introduced to demonstrate the normal appearance of the space and identify the simulated distended potential space using an injectable.

This potential space may expand because of tissue distention secondary to pathology, including inflammatory conditions, such as abscess formation resulting from odontogenic infection, complications of injectables, vascular lesions, and tumors (Flynn 2000; Khafif et al. 2005; Daramola et al. 2009; Miloro et al. 2022; Kugimoto et al. 2023). The mental nerve, an anatomical component of the BMS, can be involved in pathological processes affecting this space or iatrogenic injury from local anesthetic injections.

The purpose of this study was to provide a detailed anatomical description of the BMS through cadaveric dissection, ultrasonographic examination, and simulated filler-occupying procedures and to discuss its clinical significance in understanding pathological involvement in the BMS.

2 | Materials and Methods

This study was conducted in accordance with the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of Yonsei University Dental Hospital (IRB approval number: Redacted for Peer Review). The cadavers used in this study were donated to the Surgical Anatomy Education Center of Yonsei University College of Medicine. Informed consent was obtained from the donors and living participants for educational and research purposes. The faces of the cadavers showed no evident signs of previous trauma or surgical operations, including scars, adhesions, structural defects, or deformities.

2.1 | Anatomical Dissection and Ultrasonographic Scanning

2.1.1 | Anatomical Dissection

The primary purpose of the cadaveric dissection was to delineate the anatomical boundaries and neighboring structures of the BMS to support the interpretation of ultrasonography (US) and clinical simulation findings. Twenty-eight facial halves of embalmed and freshly frozen Korean adult cadavers were used in this study. Ten hemifaces of five embalmed Korean adult cadavers (four males and one female; mean age, 88.6 ± 3.1 years) and 18 hemifaces of nine fresh-frozen Korean adult cadavers (seven males; mean age, 83.8 ± 8.9 years) were dissected layer by layer. The landmarks used for the initial skin incision included the tragus, oral commissure, midpoint of the lower labial vermilion border, and gnathion. A skin incision was made along the tragus–lateral commissure line to the midpoint of the lower labial vermilion border, and a vertical incision was made inferior to the gnathion. Skin and subcutaneous tissues were then dissected.

2.1.2 | Ultrasonographic Scanning

US-based study was carried out on 12 facial halves of six healthy Korean adult participants (one man and five women; mean age, 32.7 ± 7.7 years) to identify the uninvolved appearance of the BMS. All the participants were placed in an upright sitting position. Reference points were marked on the face using a skin marker, and US gel was applied to the skin. The transducer was oriented horizontally at the landmark points. Three landmark points for the US examination were selected in the mandibular body region of the lower third of the face. These points lay along the otobasion inferius–mid-chin line, connecting the otobasion inferius to the point transecting half of the vertical line between the midpoint of the lower labial vermilion border and gnathion. The anterior (I), middle (II), and posterior (III) points were selected as the intersection points of the perpendicular lines originating from the medial canthus, mid-pupil, and lateral canthus, respectively (Figure 1).

2.2 | Clinical Simulation Following Filler Injection Into the BMS

Two freshly frozen hemifaces were used in the BMS-targeted filler injection study. The injections were performed on both hemifaces of a single fresh-frozen male cadaver aged 94. A two-dimensional US machine (SONIMAGE HS1, KONICA MINOLTA Inc., Tokyo, Japan) equipped with a high-frequency (15 MHz) linear transducer (L18-4) was used to obtain US images.

A total of 1.0 cc of polycaprolactone (PCL) filler (Lafullen filler, Samyang Holdings Co. Ltd.) was injected into the mandibular vestibule in the premolar region of each hemiface specimen to expand the potential space and simulate the spread of pathology into the BMS. The PCL filler was injected using a 21 G cannula once the entry point was created using a 21 G puncture needle. An intraoral incision was made along the mucogingival junction in the mandibular body from the canine to the molar regions, penetrating only the mucosal layer. The simulated filler-occupying space was also identified. The BMS-targeted filler injected into two freshly frozen hemiface specimens was also subjected to US examination to validate the space and adjacent structures before intraoral dissection.

The results were obtained in a descriptive manner from the borders of the BMS with adjacent tissues and documented using photographs and US images.

3 | Results

3.1 | Anatomical Boundaries and Contents of the BMS by Dissection and US Examination

BMS was defined using six boundaries in this study. The BMS was bounded anteriorly by the mentalis and incisivus labii inferioris (ILI), posteriorly by the anterior margin of the

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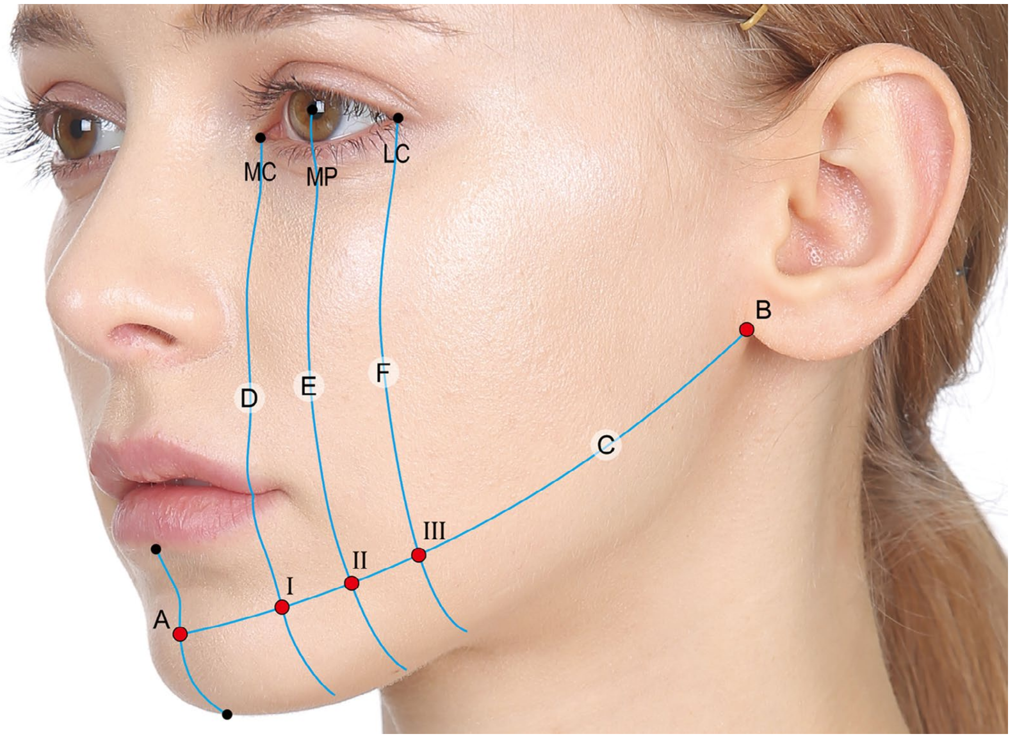

FIGURE 1 | Three landmark points (I, II, III) for ultrasonographic examination in the lower third of the face with reference lines. A, mid—chin, transecting half of the vertical line between the midpoint of the lower labial vermilion border and gnathion; B, otobasion inferius; C, otobasion inferius—mid—chin line (OCL); D, perpendicular line originating from the medial canthus (MCL); E, perpendicular line originating from the mid—pupil (MPL); F, perpendicular line originating from the lateral canthus (LCL); I, anterior landmark point on OCL—the intersection point of MCL; II, middle landmark point on OCL—the intersection point of MPL; III, posterior landmark point on OCL—the intersection point of LCL.

masseter, superiorly by the buccinator, inferiorly by the inferior border of the mandible where the depressor anguli oris (DAO) and depressor labii inferioris (DLI) originated, medially by the buccal aspect of the mandibular body with the periosteum, and laterally by the DAO and DLI in the anterior portion of the space and by the platysma in the posterior portion of the space (Figure 2). The platysma was identified in the lateral wall as the incision line of the inferior margin of the orbicularis oris (OOr) extended posteriorly to the anterior margin of the masseter, revealing the dissected area of the potential space more posteriorly. The broad lateral boundary of the BMS consisted of the muscle layers of the DLI and platysma. The mental nerve and its branches were identified as components of the BMS, exiting through the mental foramen in the medial aspect of the space (Figure 3). To address differences in specimen preservation, findings from embalmed and fresh-frozen cadavers were presented separately. While the general anatomical boundaries of the BMS were consistent between each group, fresh-frozen cadavers allowed for clearer visualization of the mental nerve and surrounding muscular structures. This was attributed to superior preservation of tissue pliability and natural tissue texture, which facilitated more accurate and detailed anatomical dissection.

The adjacent anatomical structures along the full length of the loose connective tissue layer of the uninvolved BMS were identified at three points (Figure 1) on the otobasion inferius–mid-chin line. The US examination at the anterior landmark point, detected the mentalis anteriorly, the buccal aspect of the mandible, the DLI, the DAO, subcutaneous tissue, and skin from the medial to lateral direction (Figure 4A). In Doppler mode, the horizontal labiomental artery (HLA) was detected deep to the DAO (Figure 4B). The HLA is a branch of the facial artery that courses horizontally through the mid-lower lip and supplies the lower lip mucosa. It is distinguished from the inferior labial artery by its origin rather than its distribution (Lee et al. 2015). The US examination at the middle landmark point detected the buccal aspect of the mandible medially, the DLI, the greater presence of the DAO, subcutaneous tissue, and skin laterally (Figure 4C). In Doppler mode, a branch of the facial artery was detected deep to the DAO (Figure 4D). The US examination at the posterior landmark point detected the buccal aspect of the mandible medially, the DAO, subcutaneous tissue, and skin laterally, and the masseter posteriorly (Figure 4E). In Doppler mode, the facial artery was observed at the anterior margin of the masseter (Figure 4F).

3.2 | Clinical Simulation With BMS-Targeted Filler Injection

Clinical simulation of the expansion of the potential space was successfully performed with a targeted PCL filler injection. The full volume (1.0 CC) of PCL filler injected intraorally, which was intended to distend the loose connective tissue, remained well contained within the described boundaries of the BMS. The simulated BMS with filler injection was also validated by US examination, which showed that the PCL filler was in the layer between the buccal aspect of the mandibular body and muscle layers of the DAO and DLI (Figure 5). To assist readers

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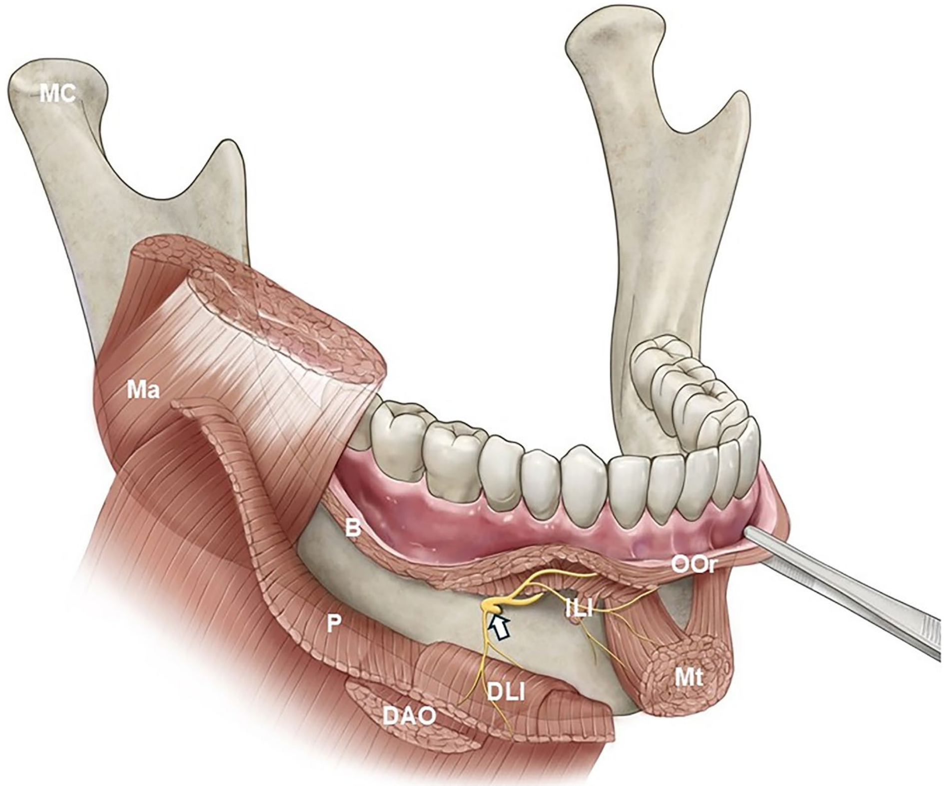

FIGURE 2 | Buccomandibular space with surrounding musculature. The mental nerve is indicated by a white arrow. B, buccinator muscle; DAO, depressor anguli oris muscle; DLI, depressor labii inferioris muscle; ILI, incisivus labii inferioris muscle; Ma, masseter muscle; Mc, mandibular condyle; Mt, mentalis muscle; OOr, orbicularis oris muscle; P, platysma muscle.

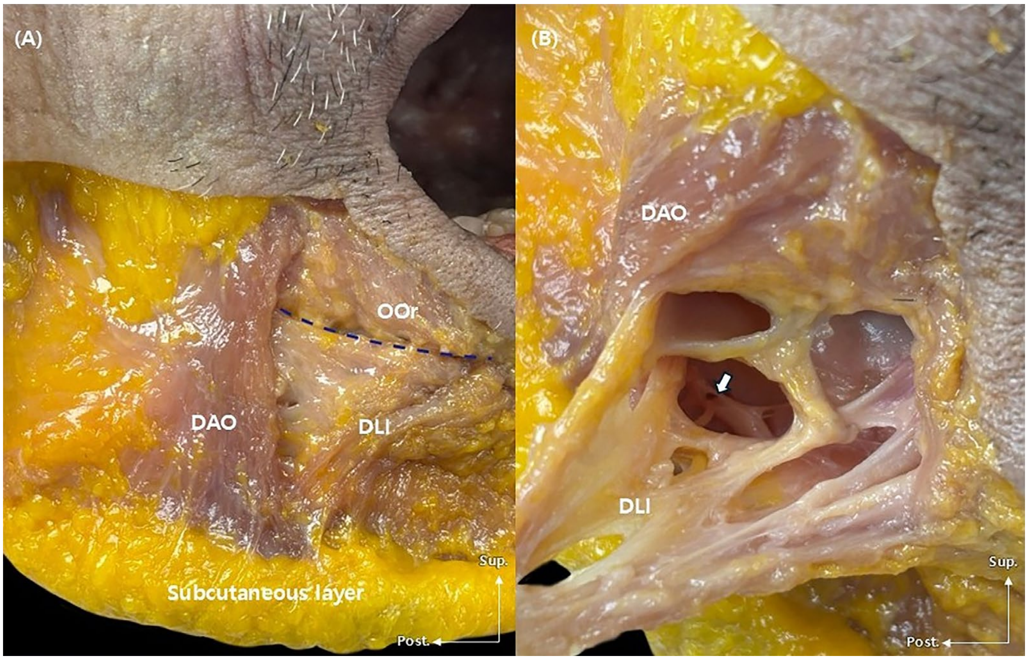

FIGURE 3 | Extraoral approach to access the buccomandibular space. (A) Musculature of the lateral boundary of the anterior portion of the buccomandibular space. (B) Direct view of the distended portion of the buccomandibular space with laterally retracted musculature. The incision line is marked with a dotted line. The mental nerve is indicated by a white arrow. DAO, depressor anguli oris muscle; DLI, depressor labii inferioris muscle; OOr, orbicularis oris muscle.

in spatially contextualizing the BMS relative to adjacent anatomical compartments, a schematic overview of the major facial spaces is provided (Figure 6).

4 | Discussion

The US-based study identified layers of adjacent muscles at

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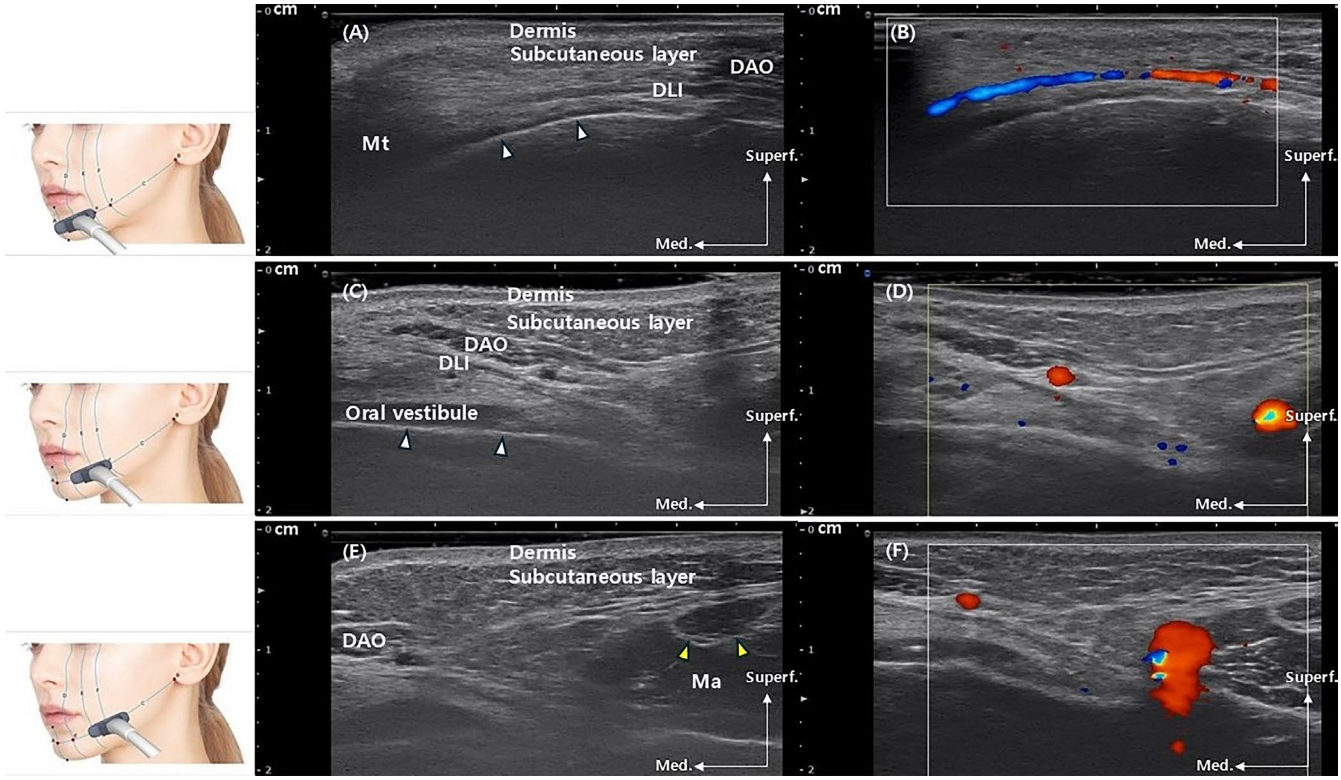

FIGURE 4 | Ultrasonographic images of adjacent structures of the buccomandibular space at three landmark points (I, II, III) in the lower third of the face described in Figure 1 (15 MHz linear transducer, scale unit: cm). (A) Ultrasonographic image at the anterior landmark point of the lower third of the face, point I. (B) Doppler image of the horizontal labiomental artery at the anterior landmark, point I. (C) Ultrasonographic image at the middle landmark, point II. (D) Doppler image of the facial artery at the middle landmark, point II. (E) Ultrasonographic image at the posterior landmark, point III. (F) Doppler image of the facial artery at the posterior landmark, point III. The buccal cortex of the mandibular body is marked with white arrowheads in ultrasonographic images at the anterior and the middle landmark points. The tendon of the masseter muscle is marked with yellow arrowheads in the ultrasonographic image at the posterior landmark point. DAO, depressor anguli oris muscle; DLI, depressor labii inferioris muscle; Ma, masseter muscle; Mt, mentalis muscle.

multiple points in the lower face in proximity to the presumed uninvolved BMS. It also indicated that multiple muscles formed the broad lateral wall of the BMS, consistent with findings from the meticulous layer-by-layer dissection of the expanded BMS located immediately lateral to the buccal aspect of the mandibular body. The musculature adjacent to the BMS was also described in a study by Hur et al. and Iwanaga et al., who examined the relationships among the mentalis, ILI, and OOr through intraoral cadaveric dissection (Hur et al. 2011; Iwanaga, He, et al. 2017).

In the present study, the BMS boundaries defined by Iwanaga et al. were modified based on precise anatomical findings and detailed descriptions, specifically concerning the superior, lateral, and inferior borders. The superior boundary of the BMS was identified as the inferior (alveolar) part of the buccinator in our dissection study on both embalmed and fresh-frozen cadavers, which was consistent with the results of the simulated study with targeted filler injection into the space. The lateral boundary of the BMS was revealed as a broad wall with multiple muscles, including the DAO and DLI, comprising the anterior portion of the lateral wall and the platysma encasing the lateral wall of the space posteriorly. The inferior border of the mandibular body, where the DAO and DLI originated, was evidently the inferior part of the BMS, which was directly visualized with the tented dissected area.

The results of the simulated filler injection study also supported the modification of the inferior boundary of the BMS to the inferior border of the mandibular body by showing that the inferior portion of the three-dimensional filler occupant was well contained at the inferior border of the mandible with the help of the lateral wall of multiple muscles. The results regarding the anterior and posterior boundaries of the BMS in our study agree with those of a previous study. The subjective finding of minimal resistance to syringe advancement with insignificant resistance to PCL filler injection into the presumed BMS site may support the characteristic of an easily penetrable tissue layer within the potential space. This characteristic of the BMS contributes to its transformation into a vulnerable space under pathological conditions.

Because the BMS becomes appreciable under pathological conditions, its contents, including the mental nerve, can be affected. Barrett and Buckley reported that selective anesthesia of trigeminal branches may result from mechanical pressure due to expanding odontogenic infections and possibly from microorganism-induced neural degeneration (Barrett and Buckley 1986). As a primary fascial space of the mandible, the BMS is directly involved in early-stage odontogenic infections, along with the buccal, submental, sublingual, and submandibular spaces (Figure 6). If untreated, infections can spread to

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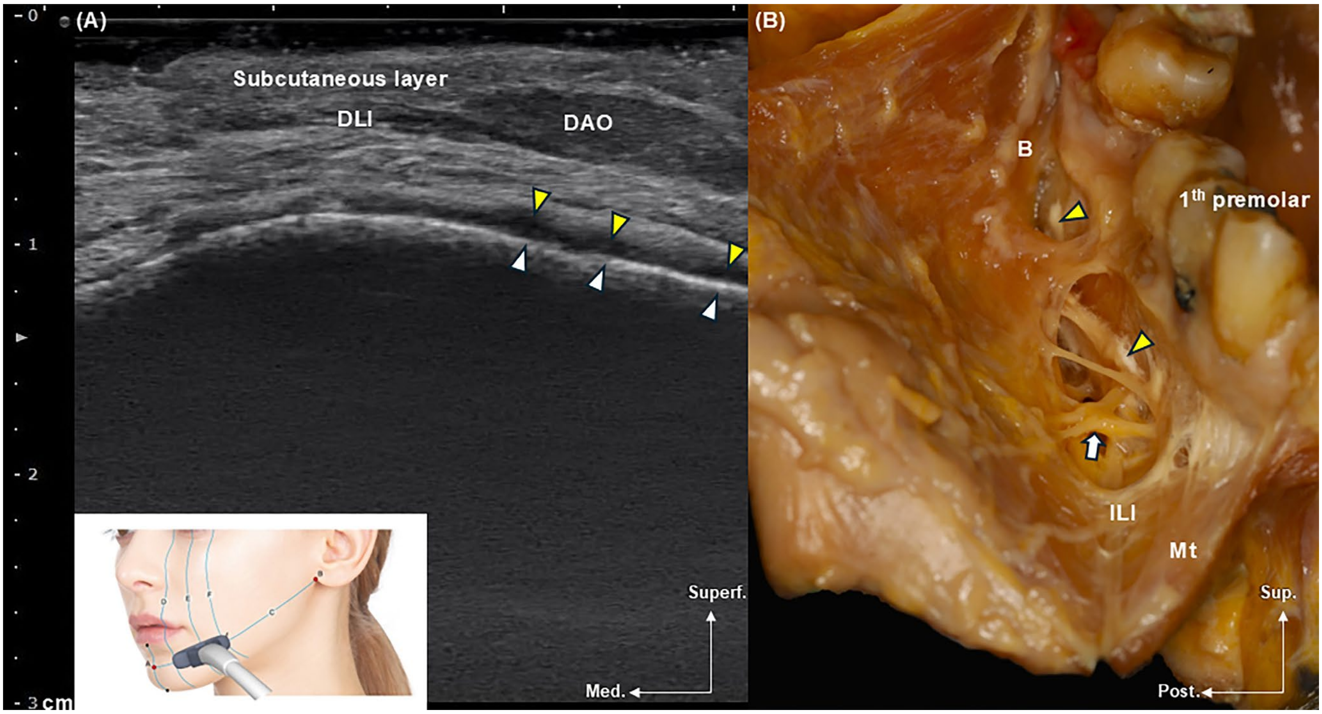

FIGURE 5 | Ultrasonographic image of adjacent structures of the buccomandibular space (BMS) with BMS-targeted polycaprolactone filler injection and its corresponding fresh-frozen specimen. (A) Ultrasonographic image at the middle landmark point of the lower third of the face, point II described in Figure 1. The buccal aspect of the mandibular body is marked with white arrowheads, and the injected polycaprolactone filler is marked with yellow arrowheads. (B) Intraorally dissected fresh-frozen specimen following filler injection and ultrasonography. The mental nerve is indicated by a white arrow, and the injected polycaprolactone filler expanding the buccomandibular space is marked with yellow arrowheads. B, buccinator muscle; DAO, depressor anguli oris muscle; DLI, depressor labii inferioris muscle; ILI, incisivus labii inferioris muscle; Mt, mentalis muscle.

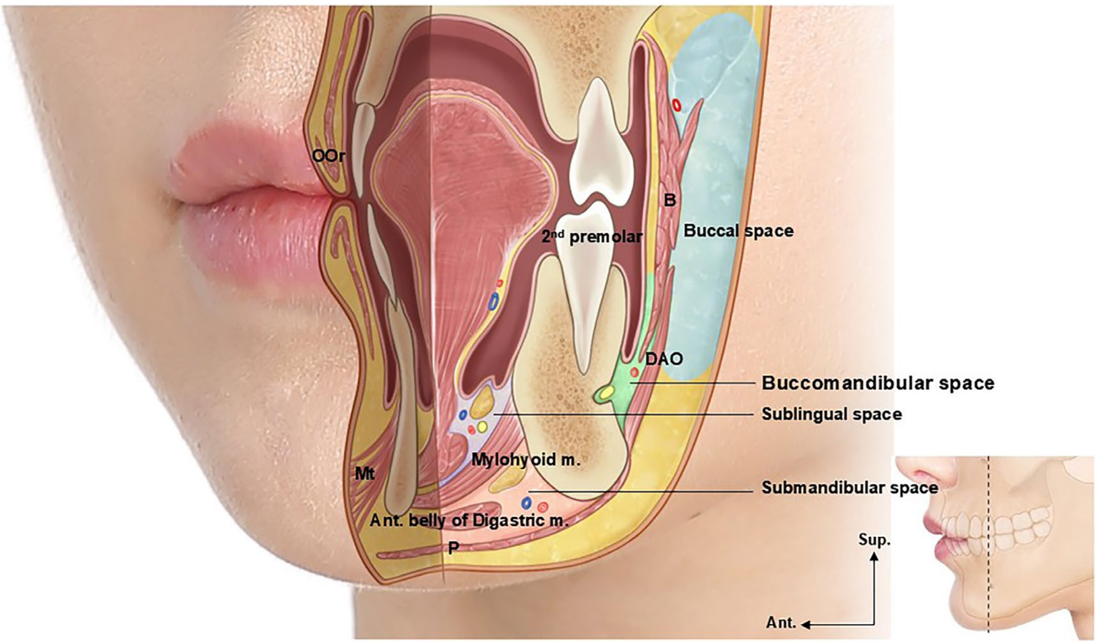

FIGURE 6 | Schematic illustration of anatomical spaces in the lower face, including the buccomandibular space, presented as a coronal section view along the dotted vertical line. B, buccinator muscle; DAO, depressor anguli oris muscle; Mt, mentalis muscle; OOr, orbicularis oris muscle; P, platysma muscle.

secondary spaces, compromising the airway and leading to life-threatening complications. Timely diagnosis and urgent intervention are essential to prevent such consequences (Flynn 2000; Daramola et al. 2009; Miloro et al. 2022). US is increasingly used in emergency medicine (EM) to evaluate facial swelling, and familiarity with the US appearance of the BMS, both in healthy

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and infected states, aids in early detection and effective management (Nelson and Chason 2008; Oeppen et al. 2010; Abdelsalam et al. 2019).

The formation of the labiomandibular fold with aging primarily results from the descent of the buccal fat pad and progressive deepening of the prejowl sulcus. To effectively reduce these age-related changes, filler injection techniques should consider both volumetric restoration and anatomical support. Injecting a sufficient amount of filler from deep to superficial layers adjacent to the DAO can help lift and smooth the affected region (Kim et al. 2023). In such cases, utilizing the potential space beneath the DAO—referred to as the BMS—provides a strategic advantage. This space allows for safe, deep placement of filler that supports the lower face, contributing to a more natural rejuvenation outcome.

Possible iatrogenic infectious etiologies include the injectables procedures. Abscesses, cellulitis, noninflammatory nodules, and foreign body granulomas are the most common filler-related complications (Bailey et al. 2011; Abduljabbar and Basendwh 2016; Mundada et al. 2017). This cautious practice, with an understanding of the potential space near the injection site of interest, can prevent wrongful deep filler injections, thereby expanding the fascial plane.

The findings of this study should be considered in light of several limitations that warrant future investigation. Our study was conducted predominantly on men. In addition, the exposure duration of the freshly frozen cadavers was not documented, potentially compromising specimen integrity. Despite these constraints, the study employed multiple complementary methods—including layer-by-layer dissection, US examination, and targeted filler injection—to delineate the boundaries and adjacent structures of the BMS. The anatomical insights gained may enhance understanding of the BMS and its clinical relevance, improve interpretation of US images, and support both clinical applications and anatomical education. Furthermore, given the marked age difference between healthy adult participants (mean age, 32.7 ± 7.7 years) and cadaveric specimens (mean age, 86.0 ± 8.9 years), direct comparisons between the groups should be interpreted with caution. Age-related morphological changes in soft tissues and muscle composition of the lower face may affect the anatomical characteristics observed in each group.

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Ethics Statement

The study was conducted in accordance with the guidelines of the Declaration of Helsinki and was approved by the Institutional Review Board of Yonsei University Health System, Severance Hospital (IRB no. 2-2023-0050).

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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