The Utility of Ultrasound in the Evaluation of Submental Fullness in Aging Necks

Grigoriy Mashkevich, MD; Jeff Wang, MD; Jeffrey Rawnsley, MD; Gregory S. Keller, MD

Objectives: To evaluate the submental region of the aging neck with high-frequency ultrasound and to assess the relative contribution of its various components to the appearance of age-related soft-tissue ptosis.

Methods: Ten patients with submental soft-tissue excess were recruited from the senior author’s (G.S.K.) private practice. The subcutaneous fat compartment, the subplatysmal fat compartment, and the anterior bellies of the digastric muscles were imaged with high-frequency ultrasound and measured in the cephalocaudal dimension. Pseudoherniation of subplatysmal fat, judged in relation to the inferior surface of the digastric muscles, was also assessed from acquired images.

Results: A clear delineation of submental anatomy was obtained with ultrasound in all patients (N = 10, 100%). Hypertrophied digastric muscles (n = 1, 10%) and excessive subplatysmal fat (n = 5, 50%) adversely contributed to the appearance of submental fullness in 6 patients (60%). These findings would not have been predicted with the same degree of accuracy from the physical examination alone.

Conclusions: High-frequency ultrasound provides useful imaging of the submental region and its components. Deeply situated subplatysmal fat and anterior bellies of the digastric muscles, both of which may be difficult to assess on physical examination, can be readily evaluated with ultrasound. When sufficiently enlarged and ptotic, deep tissues of the submental space necessitate an open submentoplasty to restore a youthful neck contour. Preoperative ultrasonography can assist with anatomical imaging of the submental space and help in planning a targeted operative intervention in patients with submental soft-tissue excess.

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Institutional review board approval was obtained at Santa Barbara Cottage Hospital, Santa Barbara, California (protocol 07-58). Ten patients with a wide range of submental soft-tissue excess were recruited from the senior author’s (G.S.K.) private practice and enrolled in the study. Informed consent was obtained for all patients, along with standard aging face photographs in the frontal, three-quarter, and lateral views.

Neck ultrasound was performed with a 14-MHz probe on a commercially available ultrasound system (Acuson Sequoia C512; Siemens AG, Erlangen, Germany). The submental region was scanned transversely in a caudocephalad direction at a midway point between the chin and the hyoid bone. The lateral borders of the region were limited at the digastric muscles. To avoid compression of the submental structures, the ultrasound probe was gently pressed on the neck skin until complete contact was made along its entire length. This was confirmed by the lack of air gaps between the probe and the skin on the ultrasound monitor. No further pressure was applied in order to avoid distortion and compression of submental compartments. This protocol was strictly followed for all ultrasound images obtained in this study.

Size measurements were obtained from the acquired images for the subcutaneous fat compartment (measured between the dermis and the anterior fascial layer of the platysma muscle), the subplatysmal fat compartment (measured between the posterior fascial layer of the platysma muscle and the fascia of the mylohyoid muscle), and the anterior bellies of the digastric muscles (Figure 2, patients 1-10). All images were electronically stored, and the patient data were entered into an Excel spreadsheet.

A total of 10 female subjects (age range, 42-75 years; median age, 56 years) were enrolled in the study. Physical examination and ultrasound findings for all patients are summarized in the Table. In all patients, the platysma muscle was readily identified on ultrasound, based on the highly echogenic band of surrounding fascia. Anatomically, this corresponded to the superficial cervical fascia, which envelops the platysma muscle on both surfaces. Visualization of the platysma muscle allowed precise subdivision of the submental space into the subcutaneous and subplatysmal fat compartments, which, along with the anterior bellies of the digastric muscles, were measured in the transverse (or cephalocaudal) dimension (Table). The relative protrusion (or pseudoherniation) of the subplatysmal fat was judged based on the location of the platysma muscle in the midline and its relation to the inferior edge of the digastric muscles situated just laterally. This positioning was studied in all patients (Figure 2, arrows), and 5 of the 10 patients showed pseudoherniation of subplatysmal fat (Figure 2, patients 1, 5, 7, 8, and 10).

Digastric muscle hypertrophy was discovered in 1 patient in whom the platysma muscle was situated deep (or cephalic) to the inferior surface of the digastric muscles (Figure 2, patient 3). The hypertrophy was attributable to a near-complete absence of subplatysmal fat (0.13 cm vs 0.48 cm, which was the mean for the study group; \( P = 0.04 \)) and to “relative” enlargement of the surrounding digastric muscles. Absolute values for digastric muscle hypertrophy could not be detected in this study because of the small sample size and the absence of accompanying cephalometric data.

Visual features that are associated with a pleasing neck contour include a mentocervical angle of 80° to 95° and a clearly discernible mandibular rim that stretches from the mentum to the angle. In the aging submental region, unattractive contour changes arise as a result of several processes that lead to the development of midline soft-tissue ptosis. These processes include connective tissue weakening and adipose hypertrophy, both of which result from a combination of congenitally driven and acquired factors. In the midline, loosening of the superficial cervical fascia, with a concomitant diastasis of medial platysmal edges, leads to pseudoherniation of subplatysmal fat. Ensuing ptosis of this compartment adversely contributes to the observed submental volume increase and to blunting of the mentocervical angle. Other regional changes, such as jowling, bone resorption at the gonial angle, and chin ptosis, further accentuate the degree of submental fullness.

Excessive submental soft tissue poses a challenging dilemma for the surgeon, who must decide whether to perform an open or closed submentoplasty (eg, liposuc-
This decision, in addition to individual surgeon preferences, hinges on the findings of the physical examination of the neck. Visual inspection and tactile feedback during submental palpation can provide useful information about the underlying anatomy. For instance, firmness on palpation may imply tightness of the hyomandibular ligament, low hyoid, hypertrophied digastric muscles, or the presence of subcutaneous fat deposits, which can be poorly responsive to liposuction.

In certain patients, however, physical examination of the submental area yields limited information. This is especially true in patients with heavy necks, in whom palpation provides a less accurate assessment of the underlying anatomy. Particularly difficult is the evaluation of deep submental structures, such as subplatysmal fat and digastrics. However, knowing the extent of their contribution to submental fullness is essential in making the decision about which type of submentoplasty to perform. In cases in which the subplatysmal fat and the anterior digastric muscles are sufficiently enlarged, a subplatysmal lipectomy and/or digastric reduction via an open approach (through a submental crease incision) form an effective strategy in restoring a youthful submental contour. It is clear that pseudoherniated subplatysmal fat and hypertrophied digastric muscles represent important causes for failure when a less extensive surgery is undertaken (e.g., liposuction).

An inability to accurately estimate the size of the subplatysmal fat and the digastric muscles may also lead to performing unnecessary open submentoplasties, in an attempt to explore and alter structures under direct visualization. Another strategy that has been used in patients with equivocal examination findings is neck liposuction with a lateral pull SMAS (superficial musculoaponeurotic system) rhytidectomy. In the senior author’s surgical revision experience, this approach, in a setting of enlarged subplatysmal fat and digastric muscles, commonly leads to persistence, as well as early recurrence, of submental ptosis.

Figure 2. Ultrasound results. Frontal views, lateral views, and submental ultrasound scans of the 10 study patients. Note pseudoherniation of the subplatysmal fat in patients 1, 5, 7, 8, and 10 and the relative digastric hypertrophy in patient 3. Arrows indicate platysma muscle; D, digastric muscle; and M, mylohyoid muscle.
High-frequency ultrasound can provide the level of anatomical detail necessary for an accurate assessment of the entire submental region, including its deep components. Several studies have documented successful application of this imaging modality for the delineation of the soft tissues of the head and neck.2-5

<table>
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<tr>
<th>Patient No./ Age, y</th>
<th>Neck Type</th>
<th>Bands</th>
<th>Jowls</th>
<th>Chin Ptosis</th>
<th>Anatomy Clear on US</th>
<th>SubP Fat Positiona</th>
<th>SubC Fat, cm</th>
<th>SubP Fat, cm</th>
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Abbreviations: Avg, average; Dig, digastic muscle; N, no; SubC, subcutaneous; SubP, subplatysmal; Y, yes.

aPosition of the platysmal sling in relation to the inferior surface of the digastic muscles. Over indicates inferior, designating fat pseudoherniation; under, superior or cephalic.
phy relies on variations of acoustic and reflective properties of adjacent tissues, thereby generating differential echo patterns. The soft tissues of the submental region, including fat, superficial cervical fascia, and muscle, provide an excellent spectrum of tissues for ultrasound imaging.

The location of the platysma muscle is easy to identify on ultrasound (Figure 2, arrows). Sound waves strongly reflect from the superficial cervical fascia, which envelops the platysma muscle on both surfaces. Also, the platysma muscle forms an anatomical boundary between the subcutaneous and the subplatysmal fat compartments, allowing straightforward identification and measurement of both.

Among the 10 patients who were enrolled in this study, 2 general patterns of cervical fat distribution were noted. In patients with a diffuse pattern, heavy submental as well as lateral adipose deposits were present, obscuring the mandibular rim in its entirety, from the mentum to the angle (Figure 2, patients 5-8). Three of these 4 patients (75%) exhibited pseudoherniation of subplatysmal fat on ultrasound. This finding corroborates the presumption that these patients suffer from global adipose tissue hypertrophy, which in turn involves all compartments of the submental region. In fact, this group of patients may be considered at a high risk for subplatysmal fat pseudoherniation and might need more extensive lipocontouring (ie, open submentoplasty with resection of subplatysmal fat) at baseline.

In contrast, patients with a central pattern exhibited asymmetrically greater deposits of adipose tissue in the submental region (Figure 2, patients 1-4, 9, and 10). These 6 patients retained their mandibular contour, and 3 of the 6 patients had relatively thin necks and only a mild degree of submental fullness (Figure 2, patients 2, 3, and 9). One of these 3 patients (Figure 2, patient 3) had a clear finding of digastric hypertrophy. As noted in the “Results” section, this observation was based on the near-complete absence of adjacent subplatysmal fat and not on the absolute size value of the digastic muscles. The design of this study could not yield absolute values for digastric hypertrophy, which would require a much larger cohort of patients with accompanying cephalometric data.

Various surgical approaches, including liposuction, supraplatysmal lipectomy with medial platysma plication, and even direct excision of supraplatysmal submental tissues and overlying skin, have been described for the management of the submental area of the aging neck. Some authors recommend a conservative excision of central (subplatysmal) fat in the midline, while others advocate routine submental fat removal with corset platysmaplasty.

Modified inverting corset platysmaplasty—the preferred surgical technique of the senior author— involves an invagination of medial platysmal edges into the subplatysmal compartment after excision of subplatysmal fat (based on corset platysmaplasty as originally described by Feldman). This technique eliminates a potential dead space and prevents the cobra neck deformity. In the present study, corset platysmaplasty with subplatysmal fat excision would be the recommended approach for patients exhibiting subplatysmal fat pseudoherniation on ultrasound (Figure 2, patients 1, 3, 7, 8, and 10). In these patients, isolated reconstitution of the muscle sling without the removal of subplatysmal fat would most likely result in residual submental fullness after surgery. In addition, the platysmal suture line would theoretically be at a higher risk of dehisence from tying medial platysmal edges over a greater volume of adipose tissue (unresected bulging subplatysmal fat).

Digastric muscle hypertrophy represents another challenging cause of submental ptosis. Connell and Shamoun recognized the importance of digastric contribution in their series of 21 patients. They performed an intraoperative assessment of digastric hypertrophy with neck flexion, seeking a residual submental bulge after supraplatysmal lipectomy. Patients with this finding underwent a tangential excision of the muscle, with removal of 70% to 90% from the inferior border. In the present study, only a single patient was identified with digastric hypertrophy (Figure 2, patient 3) who would clearly benefit from digastric reduction.

High-frequency ultrasound can assist in the preoperative evaluation of aging necks and is especially well suited for necks with equivocal physical examination findings. Based on the findings of ultrasound imaging and discovered variations in individual anatomy, a simplified surgical plan can be followed. Moreover, measurements derived from ultrasound images can be potentially applied to alter patient photographs in a 1:1 ratio. This may further assist with the decision as to which submental structure(s) to address during a submentoplasty.

In conclusion, subcutaneous fat, subplatysmal fat, and anterior digastric muscles can each potentially contribute to the development of fullness in the submental region. High-frequency ultrasound can accurately image these structures, which may otherwise be difficult to assess by physical examination alone. Ultrasonography appears especially useful for the deeper situated subplatysmal fat and digastric muscles. In cases involving digastric hypertrophy and/or excessive subplatysmal fat, a more extensive operation may be anticipated, planned, and discussed with the patients in advance.

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Artwork, Figures 1, 2, 3A-C, 4, 5A-C were created using Adobe Photoshop CS3 software (Adobe Systems Incorporated, San Jose, Calif). The images were imported into Adobe Illustrator CS3 software (Adobe Systems Incorporated, San Jose, Calif) and cropped for publication. The images were then applied to alter patient photographs in a 1:1 ratio. This may further assist with the decision as to which submental structure(s) to address during a submentoplasty.

Figure 3. Suggested surgical management of the submental region based on findings derived from submental ultrasound (US). *Absent platysmal bands on physical examination.
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Author Contributions: Study concept and design: Mashkevich and Keller. Acquisition of data: Mashkevich, Wang, and Keller. Analysis and interpretation of data: Mashkevich, Wang, Rawnsley, and Keller. Drafting of the manuscript: Mashkevich, Wang, and Keller. Critical revision of the manuscript for important intellectual content: Mashkevich, Rawnsley, and Keller. Administrative, technical, and material support: Mashkevich, Wang, and Keller. Study supervision: Rawnsley and Keller.

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REFERENCES


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