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Abstract

Introduction. Ultrasonographic assessment of facial structures is a new branch of imaging diagnostics. Its rapid development is driven by technological advancements in ultrasound equipment, as well as the wide interest in reconstructive surgery, including procedures in the field of aesthetic medicine. The multitude of procedures performed necessitates the search for methods to enhance their safety and efficacy. Complications following procedures require protocols for rapid diagnosis. A critical postoperative complication is the closure or partial compression of a vessel supplying a specific region of the face, which can result in skin necrosis and, in particular cases, loss of vision. Even with a good knowledge of facial anatomy and professional experience, adverse events can occur. Ultrasonographic assessment of vessels and surrounding structures, mainly muscular, is crucial to improve the safety of the discussed procedures. Available publications do not comprehensively address the topic of evaluating facial mimic muscles and vessels in the central part of the face.

Aims and objectives. The primary objective of this study was to characterize the ultrasonographic anatomy of the face, with particular emphasis on mimic muscles and vessels. The components of the study included: presenting the ultrasonographic anatomy of the face, selected mimic muscles and arteries; calculating the mean thickness and distance from the epidermis of selected muscles; calculating the mean width and distance from the epidermis of selected arteries; determining the peak-systolic velocity (PSV) and end-diastolic velocity (EDV) of selected arteries; determining the resistance index (RI) and pulsatility index (PI) of arteries; assessing the relationship between selected parameters and individual patient characteristics (age, BMI); comparing anatomical variability within the face based on gender; comparing sides of the face in terms of symmetry of examined muscle and artery parameters; evaluating the simultaneous influence of age, gender, BMI, and side of the face on ultrasound parameters of examined facial structures.

Materials and methods. 127 volunteers aged 21-40 years, of both genders, were examined. The study included 10 paired mimic muscles (frontal belly of the occipitofrontalis muscle, procerus muscle, corrugator supercilii muscle, orbicularis oculi muscle, levator anguli oris muscle, levator labii superioris muscle, depressor anguli oris muscle, depressor labii inferioris muscle, zygomaticus major muscle, mentalis muscle) and 1 unpaired muscle (orbicularis oris muscle). The smaller zygomaticus and risorius muscles were excluded from the staudy. Seven arteries were included in the study (supratrochlear artery, supraorbital artery, infraorbital artery, angular artery, facial artery, superior labial artery, inferior labial artery). The ultrasound

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examination was performed using a Samsung RS80 system with a linear LA4-18B transducer. Both halves of the face were examined in each volunteer. The thickness and distance of the muscles from the epidermis, width and distance of the arteries from the epidermis, the flow velocities in the arteries, and the resistance and pulsatility indices were evaluated. Additionally, the weight, height, and gender of the volunteers were recorded. Statistical analysis of the determined parameters was then performed.

Results. The examined muscles and arteries were well imaged by ultrasonography. Based on statistical analysis, mean values of muscle thickness and distance from the epidermis, artery width and distance from the epidermis, peak systolic velocities (PSV), end-diastolic velocities (EDV), and mean resistance (RI) and pulsatility indices (PI) were determined. In subsequent analyses were assessed the influence of age, BMI, gender, and side of the face on the examined parameters. No age influence was demonstrated, confirming the proper selection of the study group. A positive correlation between BMI and the distance of muscles and arteries from the epidermis was shown. Differences in the observed values of the studied parameters were found between the group of women and men. These differences pertain to both distributions and medians. Only in the case of the distance of the facial artery from the epidermis a higher value of the parameter was observed in the group of women. In other cases where differences were found, men had thicker and deeper muscles, wider and deeper arteries, as well as higher values of PSV, EDV, RI, and PI. Asymmetry was demonstrated in all considered structures, which applied to all examined parameters. In the final statistical analysis, the influence of all examined variables on the parameters of anatomical structures was assessed. Relationships concerning BMI, gender, and side influence on particular anatomical structures of the face were demonstrated. However, age was not a predictive variable in none of the fitted models.

Conclusions. Ultrasonography is an effective method for assessing anatomical structures of the face. It allows for the collection of measurements of muscle thickness and distance from the epidermis. It enables the assessment of arteries in terms of width, depth, blood flow velocities, and resistance and pulsatility indices. It is a safe diagnostic method. Facial anatomy exhibits significant variability depending on BMI, between genders, and within one individual's face sides. Facial ultrasonography as a diagnostic method can be useful in preparing patients for facial reconstruction procedures, aesthetic medicine procedures, or plastic surgery. It can serve as a tool for intraoperative monitoring. It is a method for the rapid assessment of postoperative complications.