ORIGINAL ARTICLE

Orijinal Araştırma

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Geliş tarihi / *Received* : May 22, 2025
Kabul Tarihi / *Accepted* : July 07, 2025

Bu makalede yapılacak atıf
Cite this article as
Çimen T, Yaşar F.
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Akd Dent J 2025;4(2): 83-88

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Evaluation of the Parotid Gland with Ultrasonography of Patients with Type 2 Diabetes

Tip 2 Diyabeti Olan Hastaların Parotis Bezlerinin Ultrasonografi ile Değerlendirilmesi

ABSTRACT

Objective

The aim of this study was to evaluate the parotid gland thickness of patients with type 2 diabetes by ultrasonography.

Material and Methods

A total of 50 patients were examined twice by 1 observer at 2 week intervals. During ultrasonographic examination of both parotid glands, the probe was moved in transverse (craniocaudal) and longitudinal (anteroposterior) directions while the patient's teeth were occluded. During the measurements, the patient lay on a flat surface with their head resting on a pillow.

Results

In the control group, the right parotid glands were significantly thicker than the left parotid glands ($p = 0.023$). However, there was no significant difference in parotid gland thickness between the right and left sides in patients with type 2 diabetes ($p = 0.275$). There was also no significant difference in parotid gland thicknesses between patients with type 2 diabetes and the control group ($P > 0.05$).

Conclusion

Ultrasonography may be a prospective diagnostic test for detecting and monitoring the impact of systemic diseases on the soft tissues of the head and neck, but more research is needed.

Key Words

Parotid gland, Type 2 diabetes mellitus, Ultrasound

DOI: 10.62268/add.1704134

ÖZ

Amaç

Bu çalışmanın amacı tip 2 diyabeti olan hastaların parotis bezi kalınlıklarını ultrasonografi ile değerlendirmektir.

Gereç ve Yöntemler

Toplam 50 hasta iki haftalık aralıklarla bir gözlemci tarafından iki kez muayene edilmiştir. Her iki parotis bezinin ultrasonografik incelemesi sırasında prob, hastanın dişleri okluzyondayken transvers (kraniokaudal) ve longitudinal (anteroposterior) yönlerde hareket ettirilmiştir. Ölçümler sırasında hasta, başı bir yastığa dayalı olarak düz bir zeminde yatmıştır.

Bulgular

Kontrol grubunda, sağ parotis bezleri sol parotis bezlerinden anlamlı derecede daha kalındı ($p = 0.023$). Ancak, tip 2 diyabetli hastalarda sağ ve sol taraflar arasında parotis bezi kalınlığı açısından anlamlı bir fark yoktu ($p = 0.275$). Tip 2 diyabetli hastalar ile kontrol grubu arasında da parotis bezi kalınlığı açısından anlamlı bir fark yoktu ($P > 0.05$).

Sonuç

Ultrasonografi, sistemik hastalıkların baş ve boyun yumuşak dokuları üzerindeki etkisini tespit etmek ve izlemek için ileriye dönük bir tanı testi olabilir, ancak daha fazla araştırmaya ihtiyaç vardır.

Anahtar Sözcükler

Parotis bezi, Tip 2 diabetes mellitus, Ultrason

INTRODUCTION

The parotid gland is the largest salivary gland. It releases saliva from the parotid canal into the oral cavity to facilitate chewing and swallowing. The parotid gland weighs an average of 25 g and is shaped like a reverse pyramid, with a yellowish-grey colour. It is located under the meatus acusticus externus, between the mandibular ramus, the sternocleidomastoid muscles, and the mastoid processes (in the retromandibular fossa) (1).

Type 2 diabetes is the most common metabolic disease. In developed countries, 5-10% of the population has type 2 diabetes. Diagnosed cases of diabetes worldwide are primarily caused by type 1 (5-10%), type 2 (90-95%) and other types (2-3%). In many countries, diabetes is the fifth leading cause of death. The prevalence of diabetes increases with age (2).

The duration of the disease and the degree of metabolic control are key factors in the development of oral complications and salivary gland growth, rather than the type of diabetes. In cases associated with long-term diabetes, acinar atrophy and sialadenosis-related fatty infiltration may occur (3,4). The complication rate and severity increase with disease severity, and the onset and progression of diabetes mellitus are associated with severe and persistent hyperglycaemia (5).

Ultrasonography (USG) is a radiological diagnostic method used to examine soft tissues. It provides morphological information and enables liquid-solid separation. This method uses sound waves (ultrasound) with a frequency much higher than the upper limit of human hearing. Ultrasound can be used to detect lesions in the parotid gland. It can safely distinguish between solid and cystic lesions and demonstrate diffuse enlargement or focal diseases in the parotid gland (6).

USG is also an inexpensive imaging method that does not require ionising radiation (7). High-frequency sound waves pass through tissue and interact with it in various ways. These interactions take the form of absorption, refraction, scattering and reflection. The basic principle of USG is reflection. The reflection ratio is determined by the difference in the resistance of different media to sound transmission. The reflection of the sound bundle depends on the incidence angle, impedance and surface of the examined tissue, as well as the relationship between the reflective surface and the sound waves. In diagnostic radiology, 3-7.5 MHz ultrasound is generally used (8).

There is still lack of clinical examination of parotid gland thickness in the type 2 diabetic patient using USG in the literature. The present study aimed to investigate whether there are any differences in parotid gland thickness between patients with type 2 diabetes and those without systemic disease, using ultrasound examinations.

MATERIAL and METHODS

The permission for the study was taken Selcuk University Local Ethics Committee (protocol no: 2015-06) and it has been performed in compliance with Decleration of Helsinki.

A total of 50 female patients, who were admitted to Selcuk University Faculty of Dentistry Department of Oral and Maxillofacial Radiology, were included. Only female patients who met our criteria were included in the study. This was done to reduce the surface tension that could affect the measurement when ultrasonography is performed on the head and neck region in males with beards. In addition, the parotid gland was selected for the present study because it is the largest salivary gland in the head and neck region. This made access to the gland easier with ultrasound and enabled us to standardise reproducible measurements. The parotid glands of 25 female patients with type 2 diabetes were evaluated bilaterally in the present study. The control group comprised the bilateral parotid glands of 25 female patients with no systemic disease and aged between 40 and 60. Only patients with type 2 diabetes were included in the study, as the growth and development of the salivary glands can affect measurements in patients with type 1 diabetes, which usually occurs in childhood. According to the

inclusion criteria, the following patients were excluded from the study: *(1)* those who were 20% or more above their ideal body weight, *(2)* those with a history of head and/or neck radiotherapy, *(3)* those with salivary gland pathologies (acute or chronic inflammation of the salivary glands and tumours), and *(4)* those with immune system diseases affecting the salivary glands, such as Sjögren's syndrome.

Ultrasound protocol

Ultrasonographic examinations were performed by using the linear probe with the DC-N2 ultrasound device (MINDRAY, Bio-Medical Electronics Co. Ltd, Shenzhen, China) The parotid gland was evaluated using a 7.5 MHz linear probe, and its thickness was determined.

While taking the measurements, the patient lay down on a flat surface with his/her their head on a pillow. Their neck was turned to the opposite side to the area to be measured. If necessary, a pillow or towel was placed under the patient's shoulders (Fig. 1).

Figure 1. Positioning of the patient before to measurement.

The patients were measured twice, with a two-week interval between each measurement. The thickness of the parotid gland was measured for the first time during the initial examination of the patients. The second set of measurements was taken at the follow-up appointment, two weeks later. The mean of these measurements was used for statistical analysis, with those showing a large difference in size excluded from the study.

During ultrasonographic examination of both parotid glands, the probe was moved in a craniocaudal (transversal) and anteroposterior (longitudinal) direction while the patient was in occlusion. The size of the salivary glands was evaluated. While measuring the size of the salivary glands, their homogeneity and echogenicity were also evaluated for any pathology. Participants with salivary gland pathology were excluded from the study. A large amount of gel was used under the probe to minimise surface tension. The thickness of the parotid gland was determined by measuring the distance between the midpoint of the anteroposterior width of the deep lobe and the deepest part of the gland, in order to standardise the ultrasonographic image.

Ultrasonographic images were taken from both sides of the parotid glands. The measurements were taken using a feature on the ultrasound device that allows measurements to be taken between 2 points. The measurement accuracy was 0.1 cm.

Statistically analysis

The data obtained during the study were evaluated using SPSS Statistics 17.0 (SPSS Inc., Chicago, USA). Tables of the statistical results were created. As there was agreement between the first and second measurements, the first and second data sets were averaged and these averages were used for the remaining statistical analysis. Kolmogorov-Smirnov and Shapiro-Wilk tests were used to analyse the data, and it was found that they did not show normal distribution. Mann-Whitney U and Wilcoxon W non-parametric tests were used since the data did not show a normal distribution.

RESULTS

The present study evaluated 50 patients. The average age of the control group was 48.40, compared to 49.88 for patients with diabetes. Totally 100 parotid glands were examined. The control group and the diabetic group were examined to determine whether there were any differences in the thickness of the right and left parotid glands between the first and second measurements. The mean right and left parotid gland thickness of the control group was 1.59 ± 0.00 cm and 1.60 ± 0.00 cm, respectively. The mean right and left parotid gland thickness of the diabetic group was 1.60 ± 0.01 cm and 1.60 ± 0.01 cm, respectively (Tab. 1).

Non-parametric tests performed on the averages of the first and second measurements revealed no significant difference in parotid gland thickness between the control group and diabetic patients ($P > 0.05$).

DISCUSSION

Salivary gland imaging currently includes plain radiography, sialography, ultrasound, computed tomography, magnetic resonance imaging, salivary gland scintigraphy and fluorine-18-labelled fluorodeoxyglucose positron emission tomography. Ultrasound is often the first imaging modality used in the evaluation of salivary gland disease due to its simplicity, lack of irradiation and low cost compared to other methods. Ultrasound can visualise

Table 1. Descriptive statistical data table

	N	Minimum	Maximum	Mean	Std. Deviation
Diabetic group, age	25	40	60	49.88	5.659
Control group, age	25	40	57	48.40	5.196
Control group, right parotid thickness	25	1.58	1.61	1.5992	.00954
Control, left parotid thickness	25	1.58	1.62	1.6036	.00860
Diabetic group, right parotid thickness	25	1.57	1.62	1.6024	.01422
Diabetic group, left parotid thickness	25	1.58	1.62	1.6004	.01274

pathological changes in salivary glands, such as abscesses, tumours and systemic diseases (9,10). For this reason, we evaluated the parotid gland using ultrasound.

The cause of parotid gland enlargement in patients with diabetes remains unclear. The first researchers to study this topic believed that expansion of the parotid gland resulted from compensatory hyperplasia of the endocrine function in response to a decrease in insulin levels (11).

There are few studies in the literature examining the effects of diabetes mellitus on the submandibular and parotid glands (12-18). These studies included the parotid gland and most of the examinations were cytological. Two studies used computed tomography and three studies used USG. According to these USG studies Ozturk *et al.* (17) found that the size, volume and shear-wave elastography values of both submandibular and parotid glands were higher in the patients with diabetes group than in the control group. Kaya *et al.* (18) found that the volume and dimensions of the submandibular glands were significantly greater in the type 2 diabetes mellitus group. In a study by Gupta *et al.* (15) patients with type 2 diabetes mellitus and known HbA1c values, as well as 50 healthy controls, were examined for dimensional changes in the parotid glands using USG. The study reported that dimensional measurements were higher in the patient group than in the control group, and that the size of the parotid glands increased concurrently with rising HbA1c levels in the patient group. Unlike these studies, our study found no difference in parotid gland thickness between diabetic patients and the control group.

Some studies have examined only the parotid gland, while others have examined both the parotid and submandibular glands. The parotid gland was selected for the present study because it is the largest salivary gland in the head and neck region. This made access to the gland easier with ultrasound and enabled us to standardise reproducible measurements.

In addition, only female patients were included in the present study. This was done to reduce the surface tension that could affect the measurement when ultrasonography is performed on the head and neck region in males with beards. Further studies can also include male patients who we believe will not affect ultrasonographic applications.
Diabetes mellitus is the aetiological factor of sialadenosis, which is characterised by the enlargement of both parotid glands in the absence of inflammation or neoplasia (19-21). It affects the parotid gland and other large and minor salivary glands (15). Type 2 diabetes mellitus (non-insulin dependent) typically affects overweight or obese individuals over the age of 40 (1). Therefore, we determined the age range as 40-60 in our the present study.

In the past, many researchers reported a relationship between enlargement of the parotid gland and type 2 diabetes (22,23). According to the study by Sleman *et al.* (23) the duration of the disease and the degree of metabolic control play a more important role in oral complications and salivary gland enlargement in diabetes mellitus than the type (1 or 2).

However, in the present study, only patients with type 2 diabetes were included, as the growth and development of the salivary glands can affect measurements in patients with type 1 diabetes, which usually occurs in childhood. In future studies, study groups can be evaluated separately as those with type 1 diabetes and those with type 2 diabetes.

Finally there are few limitations of this study. We would also like to examine male patients. However, it is not possible to provide low surface tension due to beard in many male patients. But, further studies can also include male patients who we believe will not affect ultrasonographic applications. In addition, the submandibular salivary gland and patients with type 1 diabetes can be evaluated in future studies by increasing the sample numbers. In addition, the number of patients could be increased.

CONCLUSION

There is no difference between the ultrasonographic parotid gland thicknesses and echogenicity in patients having type 2 diabetes when compared with control group. Right parotid glands were thicker than left parotid glands in control group. The detailed evaluation of the patients by ultrasound gave us the opportunity of ultrasonic examination of the head and neck region especially soft tissue related pathology. USG is an effective imaging technique that can be used to investigate the effects of diabetes on the parotid salivary glands.

Author contribution statement

Concept: T.Ç., F.Y.; Design: T.Ç., F.Y.; Supervision: T.Ç., F.Y.; Resources: T.Ç., F.Y.; Materials: T.Ç., F.Y.; Data Collection and/or Processing: T.Ç., F.Y.; Analysis and/or Interpretation: T.Ç., F.Y.; Literature Search: T.Ç., F.Y.; Writing Manuscript: T.Ç., F.Y.; Critical Review: T.Ç., F.Y.

Conflict of interest

The authors declare no conflict of interests.

Funding/support

The study was supported by Selçuk University Scientific Research Project Unit.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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