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Evaluation of the Factors Causing Type 2 Diabetes Mellitus on Age of Onset in the İstanbul Kartal Region

İstanbul Kartal Bölgesi'nde Tip 2 Diabetes Mellitusun Başlangıç Yaşını Belirleyen Faktörlerin Değerlendirilmesi

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Abstract

Objective: We planned to investigate the age of onset of type 2 diabetes mellitus (T2DM) in our region and the factors affecting it in the İstanbul Kartal Region.

Methods: Age at diagnosis, body mass index, exercise, alcohol consumption, smoking, and co-morbidity anamnesis were taken from 566 T2DM patients who applied to our hospital. Factors related to diabetes were questioned in these cases.

Results: The mean age of onset for all cases was 50.01±10.50 years, whereas the age at diagnosis was 49.20 years in females and 51.40 years in males. The mean age at diagnosis is 47.11±9.56 (p=0.001) years in women with maternal T2DM, and it decreased to 45.89±9.57 years in women with paternal T2DM (p=0.001). In males, the mean age at diagnosis was 54.16±11.10 years in the absence of maternal T2DM, whereas it decreased to 47.93±9.58 years in the maternal T2DM (p=0.001). The presence of T2DM on the paternal side in men did not affect the age at diagnosis. In addition, a positive correlation was found between the number of pregnancies and age at diagnosis (p=0.001). Obesity, educational status, exercise, nutritional status, smoking, and marital status did not affect the age of onset.

Conclusion: Our study showed that female gender and family history decreased the age of onset of T2DM, whereas the total number of pregnancies increased the age at diagnosis. Our study results suggest that T2DM screening should be performed earlier in women and/or those with a family history of T2DM.

Keywords: Type 2 diabetes mellitus, diagnostic age, body mass index, family history

Öz

Amaç: Bölgemizde tip 2 diabetes mellitusun (T2DM) başlangıç yaşını ve bunu etkileyen faktörleri araştırmayı planladık.

Yöntem: Hastanemize başvuran 566 T2DM olgusunun tanı yaşı, yaş ve cinsiyetleri, beden kitle indeksleri, egzersiz, alkol, sigara, eşlik eden hastalık anamnezi, eğitim durumu, medeni hali, hepatosteatoz öyküsü, prediyabet, bozulmuş açlık glukozu öyküsü, beslenme öyküsü kaydedilmiştir. Kadın hastalara ek olarak toplam gebelik sayısı, iri bebek doğurma öyküsü (4000 gr ve üzeri), gestasyonel DM öyküsü ve polikistik over sendromu öyküsü sorgulanmıştır.

Bulgular: Tüm olguların ortalama başlangıç yaşı 50,01±10,50 iken, kadınlarda tanı yaşı 49,20 erkeklerde ise 51,40 bulundu. Anne tarafı akrabalarında T2DM olan kadınlarda ortalama tanı yaşı 47,11±9,56 (p=0,001), baba tarafı akrabalarında T2DM olan kadınlarda tanı yaşı 45,89±9,57'ye inmektedir (p=0.001). Erkeklerde ise anne tarafında T2DM olmadığında ortalama tanı yaşı 54,16±11,10 iken, anne tarafında T2DM tanısı olması halinde DM yaşı 47,93±9,58'e inmektedir (p=0,001). Erkeklerde baba tarafında T2DM varlığı tanı yaşını etkilememektedir. Ayrıca gebelik sayısı ile DM yaşı arasında pozitif ilişki de tespit edilmiştir (p=0,001). Türk toplumunda obezite, eğitim durumu, egzersiz, beslenme durumu, sigara kullanımı, medeni durum başlangıç yaşını etkilememektedir.

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Öz

Sonuç: Çalışmamız kadın cinsiyet ve aile öyküsünün T2DM başlangıç yaşını azalttığını, toplam gebelik sayısının ise tanı yaşını artırdığını göstermiştir. Kadınlarda ve/veya aile T2DM tanı öyküsü olanlarda T2DM taramalarının daha erken yapılması gerekliliğini çalışma sonuçlarımız düşündürtmektedir.

Anahtar Kelimeler: Tip 2 diabetes mellitus, tanı yaşı, vücut kitle indeksi, aile öyküsü

Introduction

The prevalence of type 2 diabetes mellitus (T2DM) has increased rapidly in the 1990s and early 2000s[1], and it is estimated that more than 400 million people are affected worldwide[2]. T2DM has been diagnosed at younger ages over time[3]. Aging population, low physical activity, obesity, and increased urbanization rates increase the prevalence of T2DM. It is thought that obesity is the main reason for the increase in T2DM, and it increases the incidence of T2DM by 70-90%[4]. Family history, age, obesity, and immobility are observed in individuals at high risk for T2DM. Family history is related not only to genetic factors but also to the familial acquisition of diet and exercise habits. Women with a history of gestational diabetes mellitus and their children are at risk for T2DM in the future. Insulin resistance and impaired glucose tolerance increase the risk of T2DM. Current interventions to prevent and delay T2DM are those that aim to change the environmental risk factors such as reducing obesity and promoting physical activity. Knowing the risk factors for the development of T2DM encourages screening, early diagnosis, and treatment as well as treatment in high-risk populations to reduce both microvascular and macrovascular complications[5].

Study Objective

We planned to investigate the age of onset of diabetes in the Turkish society who live in the İstanbul Kartal Region and which factors most affect the age of onset of the disease.

Materials and Methods

Five hundred sixty-six T2DM cases consecutively admitted to the internal medicine outpatient clinic were included in the study. T2DM cases that we were following with the diagnosis of T2DM or newly diagnosed T2DM were included in the study if consent was obtained. Cases followed for T1DM history, DM developed because of steroid use, and gestational DM were not included in our prospective and randomized study. Patients who were mentally competent to answer the questions were included in the study, and patients with dementia were excluded. Age at diagnosis, age and gender of the patients, body mass index, exercise (30 minutes of walking 5 days a week and equivalent exercise), alcohol consumption, smoking, history of co-morbidity, educational status, marital status, history of hepatosteatosis, history of prediabetes, and nutritional status were recorded. In addition, the total number of pregnancies, history of giving birth to a large baby (4000 gr and above), history of gestational DM, and polycystic ovary syndrome were questioned in women. All patients were asked about their birth weight, and due to insufficient response, birth weight questioning, which may affect the development of T2DM, was excluded from the scope of the study and canceled.

Ethical committee approval was obtained for University of Health Sciences Turkey, Kartal Dr. Lütfi Kırdar City Hospital (decision no: 2021/514/216/6).

Statistical Analysis

The Number Cruncher Statistical System (NCSS) 2007 (Kaysville, Utah, USA) program was used for statistical analysis. Descriptive statistical methods (mean, standard deviation, median, frequency, percentage, minimum, and maximum) were used to evaluate the study data. The conformity of the quantitative data to the normal distribution was tested using the Shapiro-Wilk test and graphical examinations. The independent groups t-test was used for the comparison of the normally distributed quantitative variables between the two groups. One-Way Analysis of Variance and binary evaluations with Bonferroni correction were used for comparisons between groups of more than two normally distributed quantitative variables. Spearman correlation analysis was used to evaluate the relationships between the quantitative variables. Statistical significance was set as $p<0.05$.

Results

The study was conducted with a total of 566 cases, 63.3% (n=358) female, and 36.7% (n=208) male, in the internal medicine outpatient clinic between January and March 2022. The ages of the cases ranged from 27 to 88 years, and the mean age was 59.40±10.06 years (Table 1).

Table 1. Distribution of descriptive features		
		n (%)
Gender	Female	358 (63.3)
	Male	208 (36.7)
Age (year)	Mean ± SD	59.40±10.06
	Median (min-max)	59 (27-88)
Age of onset of DM (year)	Mean ± SD	50.01±10.50
	Median (min-maks)	50 (6-83)
Height (m)	Mean ± SD	1.63±0.08
	Median (min-max)	1.6 (1.4-1.9)
Weight (kg)	Mean ± SD	82.39±14.65
	Median (min-max)	80 (48-140)
BMI (kg/m^2)	Mean ± SD	30.97±5.57
	Median (min-max)	30.1 (17.7-49.5)
Educational status	Primary school	442 (78.2)
	Secondary school	39 (6.9)
	High school	54 (9.6)
	University	30 (5.3)
Marital status	Single	77 (13.6)
	Married	489 (86.4)
Exercise	No	380 (67.5)
	Yes	183 (32.5)
Alcohol	No	548 (96.8)
	Yes	18 (3.2)
Smoking	No	480 (84.8)
	Yes	86 (15.2)
Co-morbidity	No	124 (21.9)
	Yes	442 (78.1)
	Asthma	14 (3.2)
	HT	266 (60.2)
	HL	133 (30.1)
	Hypothyroidism	43 (9.7)
	CAD	70 (15.8)
	COPD	18 (4.1)
	CRF	9 (2.0)
	CVA	5 (1.1)
	Malignancy	9 (2.0)
	RA	6 (1.4)
	Other	10 (2.3)
Maternal diabetes	No	274 (48.4)
	Yes	292 (51.6)
Paternal diabetes	No	353 (62.4)
	Yes	213 (37.6)
No of pregnancy (n=358)	Mean ± SD	4.25±2.70
	Median (min-max)	4 (0-20)
LGA history (n=358)	No	206 (57.5)
	Yes	152 (42.5)
Gestational DM (n=358)	No	325 (90.8)
	Yes	33 (9.2)
PCOS (n=358)	No	290 (81.0)
	Yes	68 (19.0)
Hepatosteatosis	No	309 (54.6)
	Yes	257 (45.4)
Prediabetes	No	406 (71.7)
	Yes	160 (28.3)
Healthy diet	No	291 (51.4)
	Yes	275 (48.6)

SD: Standard deviation, DM: Diabetes mellitus, BMI: Body mass index, HT: Hypertension, CRF: Chronic renal failure, HL: Hyperlipidemia, SVO: Cerebrovascular accident, CAD: Coronary artery disease, RA: Rheumatoid arthritis, COPD: Chronic obstructive pulmonary disease, PCOS: Polycystic ovary syndrome, LGA: Large for a gestational age infant

The BMI measurements of the patients ranged from 17.7 kg/m^2 to 49.5 kg/m^2, and the mean BMI measurement was determined 30.97±5.57 kg/m^2.

When the educational status was examined, 78.2% (n=442) of the cases were primary school, 6.9% (n=39) secondary school, 9.6% (n=54) high school, and 5.3% (n=30) university graduates.

While 13.6% (n=77) of the participants in the study were single, 86.4% (n=489) were married. 32.5% (n=183) of the cases performed exercises.

Alcohol use was reported in 3.2% (n=18) (average consumption 30 gr/week) and smoking in 15.2% (n=86) (average use 1 pack/day).

There was at least one comorbidity in 78.1% (n=442) of patients. 60.2% (n=266) of the patients with additional disease had hypertension (HT), 30.1% (n=133) hyperlipidemia (HL), 15.8% (n=70) coronary artery disease (CAD), 9.7% (n=43) hypothyroidism, 4.1% (n=18) chronic obstructive pulmonary disease (COPD), 3.2% (n=14) asthma, 2% (n=9) chronic renal failure (CRF), 2% (n=9) malignancy, 1.1% (n=5) cerebrovascular accident (CVA), 1.4% (n=6) rheumatoid arthritis (RA), and 2.3% (n=10) other comorbidities.

The age at the diagnosis of DM in the cases ranged from 27 to 83 years, with a mean age of 50.01±10.50 years, and the average age for males was 51.48 years and 49.26 years for females.

T2DM was present in the mother in 51.6% (n=292), and in father in 37.6% (n=213) of cases. The number of pregnancies (live birth + still birth +abortion) of the cases ranged from 0 to 20, and the average number of pregnancies was 4.25±2.70. 42.5% (n=152) of the cases had a history of large for gestational age infant. 9.2% (n=33) of the women participating in the study had a history of gestational DM. 19% (n=68) of the women participating in the study had a history of PCOS. Fatty liver disease was present in 45.4% (n=257) of the cases. 28.3% (n=160) of the participants had prediabetes before being diagnosed with DM. 48.6% (n=275) of the participants in the study had a healthy and balanced diet (Table 2).

Table 2. Relationship between the age of onset of DM and BMI and number of pregnancies

		Age of onset of DM
BMI (kg/m²)	r	-0.079
	p	**0.062**
No of pregnancy	r	0.258
	p	**0.001****

r: Spearman correlation coefficient, **: p<0.01, DM: Diabetes mellitus, BMI: Body mass index

A statistically significant and weak correlation was found between the age of onset of DM and the number of pregnancies (the age of onset of DM increased with an increase in the number of pregnancies) (r=0.258; p=0.001; p<0.01).

No statistically significant correlation was found between the age of onset of DM in the cases and their BMI measurements (p>0.05) (Table 3).

The age of onset of DM in women was found to be significantly lower than men (p=0.021; p<0.05).

There was no statistically significant difference between the age of onset of DM in men and women according to their marital status, education, exercise, and healthy diet (p>0.05) (Table 4).

While the mean age of onset was 51.86±9.93 years in women without a history of maternal diabetes, the mean age of onset decreased to 47.11±9.56 years in the presence of maternal diabetes. The age of onset of DM in women with maternal diabetes was found to be significantly lower than that in those without (p=0.001; p<0.01).

While the mean age of onset was 51.53±10.02 years in women without a history of paternal diabetes, it decreased to 45.89±9.57 years with a history of paternal diabetes. The age of onset of DM in women with paternal diabetes was found to be significantly lower than that in those without (p=0.001; p<0.01).

Table 3. Evaluation of age of onset of DM according to descriptive features

		Age of onset of DM		p
		Mean ± SD	**Median (min-max)**	
Gender	Female	49.23±10.21	49 (23-79)	[a]**0.021***
	Male	51.34±10.87	50 (6-83)	
Marital status	Single	51.36±11.74	52 (27-75)	[a]**0.223**
	Married	49.79±10.29	50 (6-83)	
Educational school	Primary school	50.46±10.67	50 (6-83)	[b]**0.192**
	Secondary school	48.72±8.67	48 (33-69)	
	High school	48.56±9.21	48 (29-71)	
	University	47.1±11.58	47 (27-71)	
Exercise	No	50.07±10.63	50 (6-83)	[a]**0.917**
	Yes	49.97±10.26	50 (27-78)	
Healthy diet	No	49.85±10.46	50 (23-79)	[a]**0.718**
	Yes	50.17±10.55	50 (6-83)	

[a]: Student's t-test, [b]: One-Way ANOVA test, *: p<0.05, SD: Standard deviation, DM: Diabetes mellitus

Table 4. Evaluation of the age of onset of DM according to the existence of maternal and paternal DM in women

		Age of onset of DM		p
		Mean ± SD	Median (min-max)	
Maternal diabetes (in women)	No	51.86±9.93	50 (27-78)	[a]0.001**
	Yes	47.11±9.56	47 (23-79)	
Paternal diabetes (in women)	No	51.53±10.02	50 (27-79)	[a]0.001**
	Yes	45.89±9.57	46 (23-75)	
Maternal diabetes (in men)	No	54.16±11.10	54 (6-83)	[a]0.001**
	Yes	47.93±9.58	48 (27-71)	
Paternal diabetes (in men)	No	51.84±10.82	51 (6-77)	[a]0.341
	Yes	50.30±11.00	50 (27-83)	

[a]: Student's t-test, **: p<0.01, DM: Diabetes mellitus, SD: Standard deviation

While the mean age of onset was 54.16±11.10 years in men without a history of maternal diabetes, it decreased to 47.93±9.58 years with the history of maternal diabetes. The age of onset of DM in women with maternal diabetes was found to be significantly lower than that in those without (p=0.001; p<0.01).

While the mean age of onset was 51.84±10.82 years in men without a history of paternal diabetes, it decreased to 50.30±11.00 years with the history of paternal diabetes. There was no statistically significant difference in the age of onset of DM in men according to the presence of paternal diabetes (p>0.05).

Discussion

Individuals diagnosed with T2DM have drastic reductions in life expectancy. If an individual is diagnosed at the age of 40, it is predicted that 11.6 life-years will be lost in men and 14.3 life-years in women[6]. Individuals diagnosed with T2DM at a young age have a higher incidence of obesity and higher HbA1c levels than those diagnosed at an older age. Their glycemic regulation also worsens faster. This supports the idea that early-onset T2DM may be a more pathogenic condition than late-onset disease[7]. All these findings show how important early onset age is in T2DM. In our study, there was no relationship between early onset age and BMI, and the mean BMI of the patients in our study was 30.1 kg/m^2. Since Turks in general and thus diabetic patients in our study are obese, and Turkey is the first in Europe for obesity in the World Health Organization 2022 report[8], our results cannot be generalized to the universe due to the small number of cases.

63.3% (n=358) of our cases were female and 36.7% (n=208) were male. At the same time, T2DM in women were diagnosed with DM on average 2.22 years earlier. Lifestyle, environment, socio-economic status, and biological and cultural differences affect the susceptibility and development of diabetes. There are serious differences in gender ratios between countries. The high tendency of obesity in women is also a factor in this. It is an essential biological factor that plays a key role in the regulation of metabolic homeostasis and causes vulnerability to the emergence, clinical presentation, and management of T2DM[9]. We believe that factors such as obesity, immobility, sex hormones and their postmenopausal changes, differences in body fat ratio and distribution between sexes, differences in muscle mass, and immobilization are effective in the gender distribution, which is almost F/M 2/1, and women being diagnosed earlier with DM. In addition, according to our observations in our country, the rate of admission to a health institution is higher for women than for men. This may lead to a later diagnosis in men.

Although the prevalence of T2DM is higher in men, there are more elderly women than elderly men all over the world. In a large cohort study, the prevalence of T2DM was 10.5%; 9.6% in men and 11.2% in women. It was reported in this study that the cases were mostly in the age range of 46-60 years[10]. Koopman et al.[11] showed that in the USA in 2000, the average age at diagnosis decreased from 52 to 46years. In the TURDEP-II data, the prevalence of T2DM in our population was 13.7%, which was slightly lower in men than in women. In the TURDEP-I study published in 1998, the diagnosis of T2DM was frequently made between the ages of 45 and 49 years, while the age of onset was reduced to 40 and 44 years in TURDEP-II in 2010[12]. In the years from TURDEP-I to TURDEP-II, the age at diagnosis of T2DM decreased by 5 years in our country. However, a more up-to-date age at diagnosis is not available for the Turkish population. The mean age at diagnosis for DM was 50 years.

In their study involving 2825 patients with T2DM, Svensson et al.[13] detected a parental history of T2DM in 34% of the cases and showed that the prevalence of diagnosis under 40 years of age was higher in those with a parental history. Parental history suggests that there may be more severe pancreatic beta-cell dysfunction at the time of diagnosis[13]. In our study, the DM family history of all cases was analyzed separately as maternal and paternal. It was observed that 51.6% (n=292) of the cases had maternal diabetes and 37.6% (n=213) had paternal diabetes. We showed that the presence of maternal and paternal DM in women showed a statistically significantly lower age at diagnosis, whereas in men, maternal DM decreased the age at diagnosis, whereas paternal DM did not affect the age at diagnosis. These results may be related to genetic transmission. Moreover, considering that the history of consanguineous T2DM does not affect the age of onset in males, the results of our study suggest that T2DM lineage transmission may be related to the X chromosome, a sex chromosome. Simultaneously, it also makes us think that the effect of parents, especially the mother, on the development of diet habits may affect DM susceptibility and age of onset. Our study is the only one examining the effect of maternal and paternal family history on age at diagnosis in men and women.

In a cross-sectional study of 5115 people in the Danish T2DM cohort, it was shown that daily smoking frequency was more common in those diagnosed with T2DM under the age of 45 years and that these cases did not have any exercise habits[14]. In our study, however, no relationship was found between exercise habits and the age of DM. No evaluation was made on the effects of age on T2DM diagnosis because only 15.2% of our patients were smoking and 3.2% were using alcohol.

Geiss et al.[15] showed that the incidence of DM is higher among those with a high school education and below than among those with a university education. In our study, no significant relationship was shown between education level and age of DM. The cases in our study do not have a balanced distribution in terms of educational status, and only 5.3% of all cases received a university education. Although our study, in which the individuals of Turkish society with T2DM are evaluated cross-sectionally, reflects the education level of that age group perfectly for our society, we think that different results can be obtained in terms of education level distribution in different societies. The result is generalizable to Turkish society and not to the universe.

A study on male diabetic cases showed a 16% higher risk of developing DM in single men than in married ones[16], and there is no other study investigating the status of women or the effect of marital status on diabetes age. However, in our study, we did not find a relationship between marital status and age at diagnosis of DM in female and male diabetics. Our study is the only one examining this situation.

In addition, contrary to our expectations, a weak positive correlation was observed between the total number of pregnancies and the age of onset of diabetes in female diabetics in our study. In a Danish birth cohort, the risk of diabetes diagnosis increased with parity[17]. This study was a risk assessment study, while our study examined the effect of the total number of pregnancies on the age at diagnosis and was the only study in which the effect of the current situation on the age at diagnosis of T2DM was examined. Insulin sensitivity decreases during pregnancy due to the activation of some hormones such as placental lactogen, estrogen, leptin, progesterone, prolactin, cortisol, and adiponectin. It has been reported that the decrease in insulin sensitivity due to all these hormones plays a central role in the pathophysiology of gestational diabetes[18]. While the total fertility rate was 1.7 in our country as of 2021[19], the mean number of pregnancies in pre/postmenopausal women was 4.25 in our study. Since our society is fertile in that age group, this may have resulted in this way. We believe that the effect of parity and the total number of pregnancies on the age at diagnosis of T2DM will be less, and a comparative evaluation may yield more accurate results with a group of multiparous women. When we make predictions about the socio-cultural levels of our cases based on their education levels, it is seen that all segments of society are not represented homogeneously and at a similar level. In addition, we believe that the susceptibility to diabetes will be affected by the change in the socio-cultural level, the change in nutrition-exercise-diet habits, the differentiation of healthy food access opportunities, and the change in birth-pregnancy rates. Although our study, which included randomized cases, reflects the perfect educational and cultural distribution of diabetic cases in our society, we do not think that our current data can be generalized due to the number of births and cultural reasons, due to the socio-cultural misrepresentation of all segments in our society at equal levels. We believe that better results can be obtained in countries with a more balanced class distribution, such as Central and Western Europe, and with social data where there is no significant difference between income level, education level, and socio-cultural classes.

Because of all our evaluations, we have concluded that factors that may affect the age of DM include female gender and maternal diabetes. Our study is the only study in the literature that comprehensively examines the effect of factors on the age of DM onset.

Study Limitations

With a study to be conducted in a population balanced in terms of educational status, more results could be obtained regarding the effect of education status on the age of DM. Likewise, due to the fact that our society is obese, a study to be conducted in a society that is more balanced in terms of weight and BMI will more accurately reflect the relationship between BMI and age of onset of D at diagnosis. Because alcohol consumption for religious reasons is very low in our country, the effect of alcohol consumption could not be evaluated in our study. The limitations of our study are the fact that elderly patients do not know whether they have a history of gestational diabetes and/or did not have the necessary medical follow-up or treatment because they do not have any clinical follow-up, their prediabetes history is not sufficiently known, and the subjective responses we received about exercises.

Conclusion

The mean age of onset of DM in our study was 50 years, and women were diagnosed with T2DM 2.2 years earlier at the age of 49.2 years, which is statistically significant. A history of both maternal and paternal T2DM significantly reduces the age at diagnosis in women. In males, although a history of maternal T2DM significantly reduces the age at diagnosis, the effect of a history of paternal T2DM on the age of onset was not demonstrated in our study. This situation made us think that there is a possibility that there may be a connection between sex chromosome X and age at diagnosis. Contrary to our expectations, the age at diagnosis increased as the number of pregnancies increased. This may have resulted in this way because of the high fertility rate in women in the age group diagnosed with DM in our society. No relationship could be established between BMI, smoking, nutritional status, exercise status, educational status, marital status, and age at diagnosis of DM. In conclusion, female gender and especially maternal family history are the most important factors in lowering the age of T2 onset.

As of 2022, the age at onset has been determined to be 50 years in the Turkish population, and our study results suggest that T2DM screening should be increased a few years before this age, especially in women and those with a family history. In outpatient clinic conditions, not only fasting plasma glucose, HbA1c level, postprandial blood glucose, and even oral glucose tolerance tests can be useful in early diagnosis.

Ethics

Ethics Committee Approval: Ethical committee approval was obtained for University of Health Sciences Turkey, Kartal Dr. Lütfi Kırdar City Hospital (decision no: 2021/514/216/6).

Informed Consent: Informed consent was obtained.

Authorship Contributions

Surgical and Medical Practices: Z.K., S.A., Concept: Z.K., H.Ç.T., Design: Z.K., H.Ç.T., Data Collection or Processing: Z.K., S.A., Analysis or Interpretation: Z.K., S.A., Literature Search: Z.K., S.A., Writing: Z.K., H.Ç.T.

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