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Evaluation of Bruxism's Effects on Sleep Quality

Bruksizmin Uyku Kalitesi Üzerine Olan Etkilerinin Değerlendirilmesi

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ABSTRACT Objective: Bruxism is an involuntary movement and non-functional habit, which causes intraoral soft and hard tissue pathologies and is characterized with teeth grinding and clenching. It is considered that the growth and the pathogenesis of bruxism are affected by multifactorial parameters. The study aimed to evaluate sleep quality and bruxism's effects on sleep quality of sleep bruxism (SB) patients, by using objective and subjective methods. **Material and Methods:** In this study, two subgroups in the form of normal subjects and SB patients were created for each sex, among 20 females and 20 males. Pittsburgh Sleep Quality Index (PSQI) and actigraphy were applied to all participants. Actigraphy device was affixed to the participants' non-dominant wrist for two nights. The Student t-test and the Mann-Whitney U test were used for statistical analysis. **Results:** According to the PSQI method, a subjective method relying on patients' statements, the SB patients stated that they had lower sleep quality compared to the normal subjects. During the application of the objective method of actigraphy on females, it was identified that there was no significant difference among the normal subjects and the SB patients in terms of parameters such as sleep latency, sleep efficiency, total time in bed, total sleep time, wake after sleep onset, number of awakenings, average awakening, fragmentation index, sleep fragmentation index, body mass index. It was identified that the movement index was higher for the females having bruxism compared to the normal subjects, and such difference was statistically significant. During the application of actigraphy on males, it was concluded that there was no statistically significant difference among the normal subjects and the SB patients relating to any sleep parameters. **Conclusion:** Pursuant to the PSQI index results, the SB patients declared that they had lower sleep quality than the normal subjects. The results of this study carried out by using the objective method of actigraphy, however, showed that there was no significant difference in terms of the sleep quality of the normal subjects and the SB patients.

Keywords: Bruxism; sleep quality; actigraphy; Pittsburgh Sleep Quality Index

ÖZET Amaç: Bruksizm; istem dışı, fonksiyonel olmayan, ağız içi sert ve yumuşak dokularda patolojilere yol açan, diş gıcırdatma veya sıkma biçimindeki alışkanlıklardır. Bruksizmin oluşumunun ve patogenezinin multifaktöriyel olduğu düşünülmektedir. Bu çalışmanın amacı objektif ve subjektif yöntemleri kullanarak uyku bruksizmli bireylerde, hastaların uyku kalitesini ve bruksizmin uyku kalitesine olan etkilerini değerlendirmektir. **Gereç ve Yöntemler:** Bu çalışmaya, her cinsiyette sağlıklı ve bruksizmli şeklinde alt gruplar oluşturarak, 20 kadın ve 20 erkek birey dâhil edildi. Tüm katılımcılara Pittsburgh Uyku Kalitesi İndeksi (PUKİ) ve aktigrafi uygulaması yapıldı. Aktigrafi cihazı 2 gece boyunca katılımcının non-dominant el bileğine takılmıştır. İstatistik analizde Student t-testi ve Mann-Whitney U testi kullanılmıştır. **Bulgular:** PUKİ'ye göre uyku bruksizmi olan bireyler sağlıklı olanlara oranla daha kötü uyku kalitesine sahip olduklarını belirtmektedir. Kadınlarda aktigrafi uygulamasında uyku latansı, uyku etkinliği, yatakta geçirilen toplam süre, toplam uyku süresi, uyku başlangıcından sonra uyanma, uyanma sayısı, ortalama uyanık kalma süresi, fragmantasyon indeksi, uyku fragmantasyon indeksi ve vücut- kitle indeksi parametreleri açısından uyku bruksizmli ve sağlıklı bireyler arasında karşılaştırma yapıldığında istatistik olarak anlamlı fark bulunamamıştır. Hareket indeksinin bruksizmli kadınlarda, sağlıklı kadınlara göre daha yüksek olduğu ve bu farkın istatistik olarak anlamlı olduğu görülmüştür. Erkeklerde aktigrafi uygulamasında tüm uyku parametreleri açısından bruksizmli ve sağlıklı bireyler arasında karşılaştırma yapıldığında istatistik olarak anlamlı fark bulunamamıştır. **Sonuç:** PUKİ sonuçlarına göre, bruksizmli hastalar sağlıklı bireylere oranlara daha düşük uyku kalitesine sahip olduklarını beyan etmiştir. Öte yandan, objektif bir yöntem olan aktigrafi metodu kullanılarak yapılan değerlendirmeye göre ise, sağlıklı ve bruksizmli bireyler arasında uyku kalitesi bakımından anlamlı bir fark bulunamamıştır.

Anahtar Kelimeler: Bruksizm; uyku kalitesi; aktigrafi; Pittsburgh Uyku Kalitesi İndeksi

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Oral parafunctions can be defined as habits which are not related to stomatognathic system's normal functions such as chew, speech, swallow and respiration. Habits which the chewing system components are affected, e.g., teeth clenching and/or gnashing during sleep (which is defined nocturnal bruxism) and unconscious teeth clenching during wakefulness (i.e., diurnal bruxism) are one of the oral parafunctions.[1] The term of bruxism typically means mandibular and maxillary teeth's non-physiological contact causing teeth clench or gnash.[2] This parafunctional habit is derived from the Greek originated word Brygmos meaning teeth grinding. In the literature, Marie and Pietkiewicz first defined bruxism in 1907 with their work titled "La Bruksomanie".[3] Bruxism takes place in the International Classification of Sleep Disorders (ICSD) list and is the third most frequent type of sleep disorders, following sleep talking and snoring.[4] Bruxism's typical symptoms are; abrasion in stiff parts of tooth, cracking, and even breaking, of tooth prosthesis and arthralgia and existence of teeth having sensitivity while biting.[2] Bruxism can be divided into two groups which are sleep bruxism (SB) and vigilance bruxism. From a phenomenological perspective, there are significant differences between these two groups.

Diurnal bruxism is a semi-voluntary locking in activity which is affected by stress and anxiety while nocturnal bruxism is a stereotyped movement disorder during sleep and a kind of parasomnia.[5] Bruxism's etiology is still unclear. It is, however, certain that there is not only one factor causing bruxism.[6] The latest evidence supports the hypothesis that bruxism occurs centrally with the effects of autonomic stimulation and brain stimulation or vigilance.[7] The prevalence of SB is at the highest level in childhood period and approximately 14-20%. It becomes stabilized at the rate of 8-12% in youngsters and adults, and decreases to 3% regardless of gender.[8] International Classification of Sleep Disorders has stated that 85-90% of the aggregate population experience grinding/clenching of their teeth at least for once in their lives, yet this becomes clinical for only 5% of that population.[9]

Biological function of sleep is still one of the most major mysteries of all times. On the other hand, for thousands of years, it is known that sleep is necessary and sleep disorders lead to certain significant short-term and long-term results. From a scientific perspective, sleep is considered based on behavioral patterns during sleep and physiological changes related to electrical currents of brain.[10] The main theories concerning the purpose of sleep can be divided into three categories: (i) energy metabolism related, stating that sleep is needed to restore energy resources of the body, (ii) inflammation/threat related, stating that staying awake initiates defense reactions in the body, and (iii) neural plasticity related, stating the restoration of synaptic homeostasis, underlying learning and memory functions, requires sleep.[11]

In adults, sleep continues for 3-6 cycles with 60-90 minutes' intervals and includes 2 main phases: 1) non-REM sleep (also called as silent sleep) including unsound sleep (phase 1 and phase 2) and sound sleep (phase 3 and phase 4); 2) REM sleep (also called as active or paradoxical sleep). Many SB episodes (60-80%) occur during non-REM sleep.[12]

This study's purpose was to evaluate sleep quality of individuals having bruxism and bruxism's effects on sleep quality.

MATERIAL AND METHODS

This study was performed at Süleyman Demirel University, Dentistry Faculty, Oral and Maxillofacial Surgery Department. The study followed the Declaration of Helsinki on medical protocol and ethics, and it was approved by the Clinical Research Ethics Committee of Süleyman Demirel University Faculty of Medicine with the decision no. 216 and dated 04/11/2015. The research was planned as a prospective and controlled clinical study. In the research, 20 females, (10 SB patients and 10 normal subjects) and 20 males (10 males with bruxism and 10 healthy males) were included.

All participants were selected according to the following criteria:

1. No neurologic disorder,
2. No use of sleeping pills,
3. No pregnancy/suspicion of pregnancy,

4. No use of total or partial moving dental prosthesis,

5. No use of antidepressant medicine,

6. No previous use of oral splint due to bruxism,

7. Being at the age of 18-60,

8. Systematically being healthy,

9. Carrying out the responsibilities as a volunteer.

Participants who did not satisfy the above criteria were excluded from this study.

The diagnosis criteria introduced by the American Academy of Sleep Medicine was used to identify SB during the participants' clinical examination. The individuals having one or more of such diagnoses were included in the SB groups.[13] Two main sleep quality measuring methods were applied in our study:

1. Pittsburgh Sleep Quality Index (PSQI)

2. Actigraphy

PSQI is a survey retrospectively measuring sleep quality and disorder in the last 1 month's period, where high scores show weak sleep quality and the total score ranges between 0-21, with self-assessment character.[14] PSQI is a survey evaluating sleep quality based on questions covering 7 main topics that are subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disorders, use of sleeping pill and daytime functions.[15] The Turkish translation of this survey was used in the study.

In the research, an Actigraph GT3XP-BTLE monitor (Actigraph LLC, Pensacola FL, USA), an accelerometer with 3 axes, was used to assess sleep quality on an accelerate basis, whereas PSQI was used for subjective assessment.

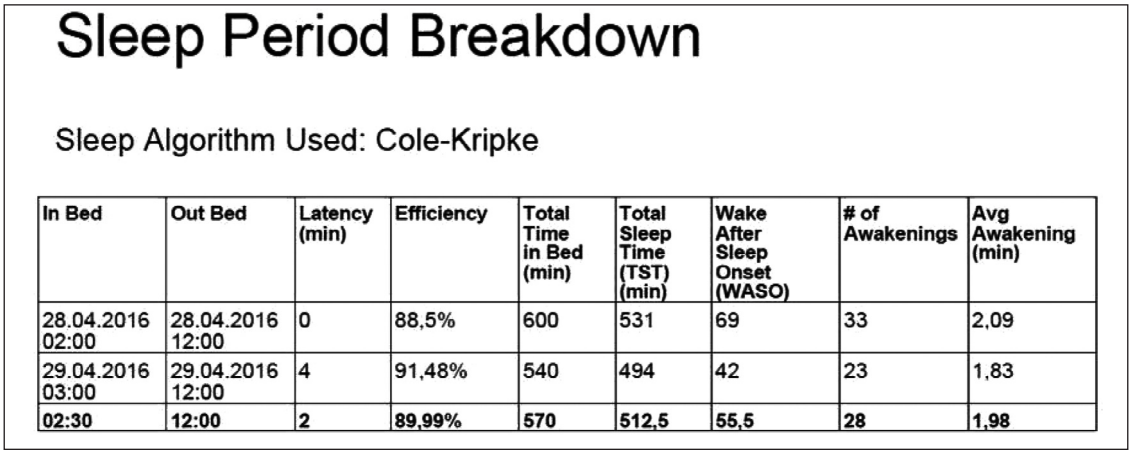
Actigraphy has been used for more than 25 years to evaluate sleep/vigilance behavior.[16] It is a non-invasive, objective imaging device evaluating sleep/vigilance patterns which is based on transaction record. Such an ecologic and non-invasive technology is cheap and an alternative to the golden standard "polysomnography" and it enables to objectively monitor sleep/vigilance rhythm at home. Actigraphy devices (actigraph) can be affixed to wrist, ankle or hip and gather information about body movements. Actigraphy does not require specialized technicians. The device is beneficial for studies covering special groups such as babies, children, old people and patients having psychiatric disorder while it gives an opportunity to make long-term records.[17] It has been understood that actigraphy has sensitivity of 78% and 99% for evaluating sleep and vigilance cycles, compared to polysomnography.[18]

In our research, the participants were requested to wear actigraphy device on their non-dominant wrists for two nights during their sleep (the use of actigraphy-Figure 1) and keep a sleep diary. A volunteer form was also signed by the participants.

The participants were informed that they had to record the time at which they got into bed to sleep and they woke up in their sleep diaries, and they were told about the use of the device in detail. The participants were requested to return the device so that the data recorded could be uploaded onto a computer for the purposes of scoring and analysis. 6.13.2 version of ActiLife 6 data analysis software was used to evaluate and to score the data acquired through actigraphy. At the configuration stage of the device, sample collecting speed was identified as 30 Hz. 60 second epoch, and Cole-Kripke algorithm was used to analyze the sleep quality (Figure 2).

Before starting the analysis, it was checked whether all characteristics satisfied the preliminary conditions for homogeneity of variances and normal distribution respectively by Levene and Anderson-Darling tests; and if the preliminary conditions were satisfied, the Student t-test was used but if not, the Mann-Whitney U test was applied.

FIGURE 1: The use of actigraphy.



Sleep Period Breakdown

Sleep Algorithm Used: Cole-Kripke

In Bed	Out Bed	Latency (min)	Efficiency	Total Time in Bed (min)	Total Sleep Time (TST) (min)	Wake After Sleep Onset (WASO)	# of Awakenings	Avg Awakening (min)
28.04.2016 02:00	28.04.2016 12:00	0	88,5%	600	531	69	33	2,09
29.04.2016 03:00	29.04.2016 12:00	4	91,48%	540	494	42	23	1,83
02:30	12:00	2	89,99%	570	512,5	55,5	28	1,98

FIGURE 2: The picture shows the analysis of sleep quality of one of the participants, measured with actigraphy.

RESULTS

The study was conducted with 40 volunteers, composed of 10 healthy females and 10 females having bruxism, 10 healthy males and 10 males with bruxism. The age average was 28.6 in the healthy males while it was 27.3 in the males having bruxism. The age average was 25.8 in the healthy females whereas it was 28.4 in the females having bruxism.

Parameters such as sleep latency, sleep efficiency, total time in bed, total sleep time, wake after sleep onset, number of awakenings, average awakening, fragmentation index, movement index, sleep fragmentation index and body mass index were used in actigraphically evaluating the sleep quality. For the analysis of the sleep quality based on the survey, the analysis was made by using parameters such as sleep efficiency and total score. The results are set forth in the tables.

PITTSBURGH SLEEP QUALITY INDEX

The survey results are indicated in the Table 1. Upon the analysis based on the survey with the males in terms of sleep efficiency characteristics, it was understood that the difference between the males having bruxism and the healthy ones in terms of their average sleep efficiency was not statistically significant, yet the healthy males' average sleep efficiency was higher than the males with bruxism ($p>0.05$).

According to the analysis based on the survey with the females in terms of sleep efficiency characteristics, the difference was statistically important ($p<0.05$).

Based on the analysis in terms of total score of the survey in both males and females, it was found out that the difference between the average of the SB patients and the normal subjects was statistically important ($p<0.05$).

When we assess the survey results, it shows that the SB patients have lower sleep quality compared to the normal subjects.

ACTIGRAPHY

The results of actigraphy application are indicated in Table 2. It was understood that there was no signifi-

TABLE 1: Pittsburgh Sleep Quality Index results.

Parameters of PSQI	Gender	No bruxism	Having bruxism	Significance (p value)
Sleep efficiency (%)	Male	94.604±0.738	90.17±1.62	0.0639
	Female	95.56±0.62	92.83±0.98	0.030
Total score	Male	4.00±0.49	6.40±0.90	0.031
	Female	2.800±0.389	5.80±0.94	0.0097

TABLE 2: The results of actigraphy application.

Parameters of actigraphy	Gender	No bruxism	Having bruxism	Significance (p value)
Sleep latency (minute)	Male	5.05±1.6	5.25±1.4	0.926
	Female	2.00±0.71	2.35±0.85	0.756
Sleep efficiency (%)	Male	90.16±0.99	89.09±0.83	0.422
	Female	92.96±0.87	91.68±1.1	0.372
Total time in bed (min)	Male	432.9±24	440.8±25	0.822
	Female	429.40±7.54	434.0±26.2	0.7618
Total sleep time (TST) (min)	Male	389.4±20	393.7±23	0.890
	Female	399.6±9.6	396.5±21	0.895
Wake after sleep onset (min)	Male	38.5±4.9	41.8±3.8	0.597
	Female	27.8±3.8	35.1±5.9	0.305
#of awakenings	Male	19.65±2.3	17.60±2.2	0.528
	Female	12.45±1.8	15.70±2.0	0.239
Avg awakening (min)	Male	1.923±0.13	2.61±0.38	0.105
	Female	2.40 ±0.35	2.171 ±0.20	0.581
Movement index	Male	12.49±0.64	12.41±0.88	0.937
	Female	9.59±0.65	12.58±0.90	0.015
Fragmentation index	Male	13.41±1.5	13.18±1.7	0.922
	Female	10.18±2.5	9.64±2.7	0.883
Sleep fragmentation index	Male	25.91±1.9	25.59±1.9	0.908
	Female	19.77±2.9	22.22±3.0	0.563
Body-mass index (kg/m²)	Male	24.06±0.67	25.40±1.4	0.408
	Female	20.63±0.96	22.52±0.84	0.157

cant statistical difference among the males having bruxism and the healthy ones based on the comparison in terms of actigraphy parameters such as sleep latency, sleep efficiency, total time in bed, total sleep time, wake after sleep onset, number of awakenings, average awakening, movement index, fragmentation index, sleep fragmentation index and body mass index ($p>0.05$).

It was identified that there was no significant statistical difference among the females having bruxism and the healthy ones based on comparison made in terms of actigraphy parameters such as sleep latency, sleep efficiency, total time spent in bed, total sleep duration, awakening after start of sleep, number of awakenings, average awakening, fragmentation index, sleep fragmentation index and body mass index ($p>0.05$).

It was observed that the movement index of the females having bruxism was higher than the healthy ones and such difference was statistically reasonable ($p<0.05$). These results may imply that the females having bruxism sleep more restlessly. On the other hand, based on the respective findings, it was seen that there was no difference between the females having bruxism and the healthy individuals in terms of sleep efficiencies and continuity although the females suffering from bruxism acted more during their sleep.

DISCUSSION

In the literature, the number of studies evaluating the sleep quality of SB patients is quite low. In this study, two parameters were used to assess the patients' sleep quality. In the literature, generally, either subjective or objective analyses have been applied and participants have not been categorized depending on their gender. This study aimed to assess separately each gender with different physiological, anatomical, chemical features and sleep structure and to compare the results of both the subjective method of PSQI and the objective method of actigraphy.

PITTSBURGH SLEEP QUALITY INDEX

In their research, Ohlmann et al. made an evaluation of associations between sleep bruxism, chronic stress, and sleep quality. The researchers used PSQI to evaluate the sleep quality. They found out that there was no difference between bruxers and non-bruxers when compared for sleep quality.[19] The findings regarding the subjective sleep quality in our study is not compliant with this study.

Serra Negra et al. used PSQI to measure the sleep quality in their study. They reported that low sleep quality was a highly significant factor for the SB patients during day and night.[20] Our study is compliant with the findings regarding the subjective sleep quality in this study.

Dias et al. used PSQI to evaluate the participants' sleep quality in their study. The study aimed to understand the relation among SB, low sleep quality and degenerative changes in temporomandibular joint. Consequently, they reported that the participants declared low sleep quality.[21] The findings regarding the subjective sleep quality in our study is consistent with this study.

Schmitter et al. used PSQI to analyze the characteristics of myofascial pain in orofacial zone related to sleep, on individuals having temporomandibular joint and a control group composed by them. They concluded that the sleep quality decreased whereas SB and the prevalence of facial ache increased for those having temporomandibular joint disorder.[22] The findings regarding the subjective sleep quality in our study is conistent with this study.

Shokry and et al. used PSQI method by also making a survey including additional questions to assess the relation between bruxism based on self-report and sleep patterns. They found out that weak sleep pattern was a significant determinant in the individuals with bruxism.[23] Our study has similar results with the findings of this study regarding the subjective sleep quality.

In this study, we have also used the PSQI method to assess the sleep quality. It was identified that there was a significant difference in terms of sleep scoring between the SB patients and the normal subjects, including both males and females. Our study showed that the SB patients experienced a lower sleep quality compared to the normal subjects. In general, the findings regarding the subjective sleep quality in our study is compliant with the literature's current findings.

ACTIGRAPHY APPLICATION

In a study, Ahlberg et al. made the participants use Bite-Strip, a disposable EMG device to identify the SB patients. The study included participants of 101 employees working at a publishing company either by shifts or shiftlessly and having week-end for two days. The researchers requested the participants to wear Actiwatch on their non-dominant wrists for seven days on a nightly basis. They observed that those with acute bruxism slept less than the normal subjects during business days while they slept a bit more on non-working hours compared to the normal subjects. It was concluded that the fragmentation index level increased parallel to the bruxism acuteness and there was a consistent relation between bruxism and sleep efficiency that could be identified at home with an affordable device.[24] This study is, however, not conistent with the findings in our study as the results obtained through the objective method of actigraphy indicated that there was, in fact, no significant difference in terms of sleep efficiency among the SB patients and the normal subjects.

In their study, Sjöholm et al. aimed to compare masseteric muscle activity in a control group composed of 23 patients suffering from bruxism and 6 normal subjects. They stated that phasic and mixed type masseter contraction was seen in the control group; yet rhythmic chin movements were more specific in the SB patients. They also reported that there was no significant difference between the SB patients and the normal subjects in terms of time period spent in bed and total sleep duration. Besides, distribution of sleep phases, sleep latency and REM latency were similar between the two groups.[25] The findings of this study are similar to the results in our study.

In another study, Lavigne et al. observed that the SB patients also had good sleep when they made a polysomnographic assessment, the "gold standard" procedure to diagnose most sleep disorders, of all

sleep variables in the SB patients and the normal subjects, who were at the same age group. They reported that there was no significant difference when macro and micro sleeping structure of the SB patients was compared to the normal subjects. They further concluded that the individuals with bruxism had not complained about sleeping disorder; in fact, their partners in bed and parents were complaining since their sleep was interrupted due to sounds of teeth grinding.[26] The findings regarding the subjective sleep quality in our study is conistent with this study which was carried out by polysomnographic assessment which is deemed the "gold standard" procedure in this regard.

In our study, it was observed that the movement index of the females with bruxism was higher than the normal subjects and such difference was statistically reasonable ($p<0.05$). These results may imply that the females having bruxism slept more restlessly. On the other hand, based on the respective findings, it was seen that there was no significant difference between the females having bruxism and the normal subjects in terms of sleep efficiencies and continuity although the females suffering from bruxism acted more during their sleep. Besides, in their study, Zhang et al. aimed to prove that SB patients, irrespective of their gender, showed a higher incidence of leg movements than the normal subjects. By applying polysomnographic method, they found out that most SB episodes might not have been isolated events, but rather a part of a series of movements second to changes in arousal level.[27] Further research is, however, required to make a certain conclusion in this regard.

In today's literature, the number of studies evaluating sleep quality of SB patients is quite limited. In the literature, when comparing SB patients and control groups composed of those at similar age group, it has been generally observed that SB patients have a normal sleeping structure.[25,28,29]

In general, individuals suffering from bruxism have a good sleep. In such a case, the main complainants of bad sleep are those sharing the same rooms with SB patients due to sounds of their teeth. While scoring based on the general rules, it has been understood that sleep had continuity and there was no sleep fragmentation.[30]

Our study also supports that pursuant to the objective method of actigraphy, there is no significant difference between SB patients and healthy individuals in terms of their sleeping structure.

In order to make a certain conclusion that bruxism patients have similar sleep quality with healthy individuals, more controlled clinical studies including actigraphic or polysomnographic assessments, with more participants are required.

CONCLUSION

In this study, it has been seen that the bruxism patients declared that they had a lower sleep quality compared to the healthy individuals in terms of the subjective evaluation. The objective evaluation, however, showed that there was no significant difference between the bruxism patients and the healthy individuals regarding their sleep quality. In fact, bruxism is an oral habit and does not decrease the sleep quality of bruxism patients. Today, there is no efficient treatment method healing or stopping bruxism. To eliminate bruxism's destructive effects, one should examine and treat each patient individually.

LIMITATIONS OF THE STUDY

The relationship between sleep quality and bruxism was characterized in the study. There are some limitations associated with the study. Accordingly, the number of SB patients is relatively small and they should have worn the device for more days. Further studies are required to exam a larger group of SB patients.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and/or family members of the scientific and medical committee members or mem-

bers of the potential conflicts of interest, counseling, expertise, working conditions, shareholding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Hasan Rıfat Koyuncuoğlu;* ***Design:*** *Hasan Rıfat Koyuncuoğlu;* ***Control/Supervision:*** *Gülperi Koçer, Hasan Rıfat Koyuncuoğlu;* ***Data Collection and/or Processing:*** *Hatice Dönmez Semiz;* ***Analysis and/or Interpretation:*** *Hatice Dönmez Semiz, Gülperi Koçer;* ***Literature Review:*** *Hatice Dönmez Semiz;* ***Writing the Article:*** *Hatice Dönmez Semiz, Gülperi Koçer;* ***Critical Review:*** *Gülperi Koçer, Hasan Rıfat Koyuncuoğlu;* ***References and Fundings:*** *Hatice Dönmez Semiz;* ***Materials:*** *Hatice Dönmez Semiz.*

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