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ORIGINAL ARTICLE

Comparison between laser and transobturator tape therapy in the treatment of stress urinary incontinence and role of overweight in treatment: a prospective observational study

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Abstract

Introduction and hypothesis Stress urinary incontinence (SUI) is treated with transobturator tape (TOT) sling procedures, but problems arise with artificial mesh in certain instances. Hence, non-invasive laser therapy may be useful under such circumstances. The current study was aimed at comparing the effects of these two treatments and at checking their applicability in various body mass index (BMI) groups.

Methods Seventy-nine patients, who were clinically diagnosed with SUI, were divided into two groups, those who preferred TOT and those who preferred the transvaginal fractional micro-ablative CO_2 laser system. The SUI symptoms and International Consultation on Incontinence Questionnaire Short Form (ICIQ-SF) scores of the patients were determined before and at the 12th month after the treatment. General linear model, Stuart–Maxwell, and Bonferroni correction for pairwise comparison analyses were performed to compare the efficacy of the treatment type.

Results The ICIQ-SF score decreased by 56.8% for laser therapy and 43.5% for TOT therapy (mean ± SE = 5.97 ± 0.16 and 5.09 ± 0.14 respectively). Laser therapy had a better effect on ICIQ-SF than TOT therapy (η2p: 0.176, $p_{time*group} < 0.001$). Regardless of the types of treatment, the ICIQ-SF scores of healthy-weight participants decreased more than those of overweight participants (η2p:0.050, $p_{time*group} = 0.045$). In the TOT group, healthy-weight participants were more than twice as likely to recover fully from SUI symptoms as overweight participants, 1 year after the treatment. In the laser group, the majority of healthy-weight participants (88.8%) did not report any SUI symptoms after the treatment.

Conclusions The efficacy of laser therapy for urinary incontinence was confirmed. Furthermore, it was observed that being overweight may be a risk factor for the failure of laser therapy.

Keywords Stress urinary incontinence · Transvaginal fractional micro-ablative CO_2 laser system · Quality of life · Overweight

Introduction

Stress urinary incontinence (SUI) and obesity are conditions that reduce the quality of life and negatively affect physical, mental, social, and sexual health. SUI is a serious problem that causes urinary leakage in scenarios of increased abdominal pressure, such as coughing. SUI is thought to affect 25–45% of all women and can result in depression and social isolation [1].

In Western societies and the developing world, it was determined that 105 million adults were affected by obesity in 1975, whereas this figure reached 641 million in 2014. If this trend continues, one billion people globally, including 1 in 5 women and 1 in 7 men, will be living with obesity by 2030 [2].

In the literature, obesity was associated with an increase in the prevalence and severity of SUI. A 10% increase in SUI is predicted for every 5 units of increase in BMI [3]. Accordingly, the prevalence of SUI is reported to be approximately 70% among women with BMI ≥ 40 kg/m^2. It is now a known

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fact that there is a significant decrease in urinary incontinence attacks with a 5–10% loss of body weight [4].

According to the International Continence Society (ICS), physiotherapy management as a conservative treatment in the treatment of SUI is recommended as the first-line approach [5]. Moreover, weight loss should be considered as the initial therapy for incontinence in overweight and obese women [6]. In cases of SUI, it is recommended to prefer non-invasive treatments such as pelvic floor physical therapy as they have minimal side effects for the patient/health system and pose low risks and high potential rewards for patients [7].

One of the most effective methods among the preferred surgical techniques for SUI is the mid-urethral sling procedure [8]. In recent years, this procedure has been used to support the bladder neck and urethra with a synthetic material called polypropylene mesh tape as a mid-urethral sling, including transobturator tape (TOT) and transvaginal tape (TVT). Although effective results are obtained with TOT, there is a risk of long-term complications owing to the artificial nature of the tape [9].

Fractional micro-ablative laser therapy was identified as a potential nonsurgical alternative treatment for SUI [10]. The subclinical thermal tissue effect of the laser beam triggers the healing of human dermal fibroblasts and stimulates de novo collagen and elastin synthesis. Thus, it results in a thicker vaginal epithelium with a larger diameter and glycogen-rich epithelial cells [11]. Within this framework, this study is aimed at comparing the effects of TOT and laser therapies on SUI symptoms and severity and to examine the role of BMI in the success of the treatment in patients with SUI.

Materials and methods

Study population

This is a prospective, observational study on women with SUI symptoms who were treated with TOT and transvaginal fractional CO_2 laser. Between 2020 and 2021, patients who were evaluated at the obstetrics and gynecology outpatient clinic of a private hospital, who did not respond to conservative treatments and who had bothersome SUI were invited to participate in the study. The study covered women who were 18 years or older, with a clinical and urodynamic diagnosis of SUI. Moreover, the inclusion criteria for participation in the study covered normal cell cytology, negative urine culture, and no injuries or bleeding in the vaginal canal, introitus, and vestibule. The diagnosis was based on a standardized stress provocation test (cough test) in supine and standing positions with a full bladder (300 ml) [12] and a pad weight of ≥5 g in a 1-h test under standardized conditions [13]. The urodynamic assessment was conducted using a Duet Logic (Medtronic, Düsseldorf, Germany) with a microtip catheter [14]. Women who had any neurological disease, insulin-dependent diabetes mellitus, active urinary tract infection, undiagnosed or abnormal vaginal bleeding, hematuria, or pregnancy were excluded from the study.

The study received Human Research Ethics approval from Diyarbakır Gazi Yasargil Training and Research Hospital Clinical Research Ethics Committee (Approved No: 2022–02-18). All participants provided informed and written consent. Additionally, the participants were not compensated for their participation.

International Consultation on Incontinence Questionnaire Short Form

The International Consultation on Incontinence Questionnaire Short Form (ICIQ-SF) is a scale that can be used to assess the prevalence, frequency, amount, and perceived causes of urinary incontinence and the effect of urinary incontinence on quality of life in all groups, men, women, young or old. The scale was developed by Avery et al. [15] to assess urinary incontinence and its effect on the quality of life. The scores that can be obtained from the scale range from 0 to 21, and higher scores indicate an increase in the severity of missing out and a greater impact on quality of life. The total score was used for the analyses in this study. The severity of urinary incontinence was classified as very severe SUI if the total ICIQ-SF score was between 19 and 21, severe for 13–18, moderate for 6–12, mild for 1–5, and no leakage for 0 [15]. A Turkish validity and reliability study of the scale was performed by Çetinel et al. [16]. In the current study, the ICIQ-SF scale was conducted with the patients before the treatment and 1 year after the treatment.

Surgical procedure and group assignment

Patients admitted to the obstetrics and gynecology department of a private hospital were informed about both TOT and laser treatment systems and the choice was left to the patients. Furthermore, the patients were informed about the risks and benefits of treatment. Forty-four of the patients preferred the TOT method whereas 35 preferred the laser method.

Patients who preferred the laser method underwent three treatments at 4- to 6-week intervals. Patients who came for treatment were pre-treated with topical anesthetic cream at the vestibule level. After 10 min, they were treated with a transvaginal fractional micro-ablative CO_2 laser system (MonaLisa Touch, SmartXide2 V2LR; DEKA, Calenzano, Italy) using the following settings: power 40 W, dwell time 1,000 ms, DOT spacing 700 mm, SmartStak parameter 3, and D-pulse mode. The laser beam was emitted from a

vaginal probe at a 90° angle that was gently inserted up to the level of the bladder neck, then rotated and retracted to ensure treatment of the anterior lower third of the vagina and external urethral meatus [17].

The TOT procedure was performed under lumbar anesthesia using the Monarc transobturator sling system or the Obtryx II Transobturator Mid-Urethral Sling System [18]. The intervention was performed in the lithotomy position. The ramus pubis and obturator internus muscles were identified with the index finger of the opposite hand without performing a vaginal incision. During the contralateral push of the bladder with the help of the metal probe, the prepared mesh carrier was placed with the needle, avoiding damaging the bladder from the inside out, by advancing appropriately on both sides toward the retropubic space. The same procedure was conducted for the opposite side, so that the needles met 1.5 cm below the urethral meatus. At this point, a 0.5-cm cut was made, and the needle points were taken outside. The synthetic sling material was attached to the needles, and the needles were backed out. A sufficient sling stretch was provided. The patients were discharged the same day. Urination trials were performed from the first postoperative day. The bladder was filled with normal urine and a volume corresponding to the maximum voiding volume and the residual volume was estimated by ultrasonography, checking for any failure during three consecutive voids.

Anthropometric measurements and sociodemographic characteristics

After the participants had been included in the study, their height and body weight were measured by a dietician. The body weight and body height were obtained while the participants were wearing lightweight clothing and no shoes. Body height was measured using a portable stadiometer with an accuracy of 0.1 cm. Body mass index (BMI) was calculated as body mass/height squared (kg/m^2) and participants were categorized as underweight/normal weight (BMI = 18.5–24.9 kg/m^2) and overweight/obese (BMI ≥25.0 kg/m^2) following international cut-off points. Participants were asked to report their age, smoking status, and number of births.

Statistical analysis

G*power software (version 3.1.9.7) was used to calculate the sample size. The primary hypothesis of the study was to investigate the change in the 1-year ICIQ-SF level of TOT and laser treatment protocols. In a recent study [14], the effect size was calculated by entering the mean and standard deviation data of the changes in the 1-year ICIQ-SF score of the participants, who received laser and TOT treatments. The effect size was determined as 0.897 (large effect size), and the sample size was determined as 34 people for each group, with a power of 95% and a 0.05 margin of error.

Data were analyzed using IBM SPSS software (version 21.0) and the R studio package (version R-4.2.2). The data were expressed as descriptives and frequencies. Numeric values were expressed as mean and standard deviation. The independent *t* test was used to compare the quantitative data of both groups whereas Pearson's Chi-squared test was conducted for categorical data. General Linear Model analysis was performed to determine the effect of both treatment groups on dependent quantitative variables. The interaction effect of $p_{group \times time}$ and partial eta squared values are presented to compare the effects of treatment groups. The effect size was estimated using partial eta square (η2p), classified as small ($0.01 < \eta2p < 0.06$), medium ($0.06 \leq \eta2p < 0.14$), or large ($\eta2p \geq 0.14$). Bonferroni correction test was used in pairwise comparisons to observe the effect of BMI in treatment groups. The mean difference, standard error, and 95% confidence interval values are presented in pairwise comparison analysis. Moreover, the Stuart–Maxwell test was used to test the statistical significance of the changes in the severity of ICIQ-SF and SUI symptoms after the treatment groups had been classified according to BMI. The results were evaluated within the 95% confidence interval, and $p < 0.05$ was bilaterally considered statistically significant [19].

Results

Baseline characteristics

Transobturator tape surgery was applied to 44 of the participants and laser treatment was applied to 35 of them. The mean age of the population in the two groups was as follows: the TOT group, 47.0 ± 9.0 years; and the laser therapy group, 41.2 ± 5.6 years. Baseline mean body weight, BMI values, number of deliveries, and ICIQ-SF scores were found to be lower in the laser therapy group than in the TOT group ($p < 0.05$). The rate of smokers was found to be similar in both groups (Table 1).

Effects of treatment groups on ICIQ-SF score according to BMI classification

The baseline values of the ICIQ-SF score of the TOT and laser groups were 11.7 ± 0.19 and 10.5 ± 0.61 respectively, and was significantly reduced 1 year after the treatment (5.09 ± 0.14 and 5.97 ± 0.16 respectively, $p < 0.001$). In patients who received laser treatment, ICIQ-SF was significantly reduced after treatment compared with pretreatment ($p < 0.001$). Considering the group and time interaction effect, it remained statistically significant ($P_{time*group} < 0.001$, η2p: 0.176 [large effect size]; Fig. 1). A pairwise comparison

Table 1 Patients' characteristics in relation to type of treatment

	TOT ($n=44$)	Laser ($n=35$)	Total ($N=79$)	p value
Age (years)	47.0 ± 9.0	41.2 ± 5.6	44.5 ± 8.2	0.001*
Body weight (kg)	70.0 ± 7.2	63.4 ± 4.1	67.1 ± 6.9	< 0.001**
BMI (kg/m^2)	26.5 ± 2.7	23.1 ± 1.9	25.0 ± 2.9	< 0.001**
BMI groups				
Normal	12 (27.3%)	27 (77.1%)	39 (49.4%)	
Pre-obese	21 (47.7%)	8 (22.9%)	29 (36.7%)	< 0.001**
Obese	11 (25.0%)	0 (0.0%)	11 (13.9%)	
Smoking				
Yes	12 (27.3%)	10 (28.6%)	22 (27.8%)	0.898*
No	32 (72.7%)	25 (71.4%)	57 (72.2%)	
Number of births	5.3 ± 1.1	3.2 ± 0.70	4.4 ± 1.4	< 0.001**
ICIQ-SF (baseline)	11.7 ± 1.3	10.5 ± 0.61	11.2 ± 1.2	< 0.001**
ICIQ-SF groups (baseline)				
Moderate	33 (75.0%)	35 (100.0%)	67 (86.1%)	0.001*
Severe	11 (25.0%)	0 (0.0%)	11 (13.9%)	

Numerical variables are presented as mean ± standard deviation. Nominal variables are shown as percentage (frequency)

BMI body mass index, *ICIQ-SF* Incontinence Questionnaire-Urinary Incontinence Short Form

p values were derived by independent t test and Pearson's Chi-squared test respectively

*$p < 0.01$; **$p < 0.001$

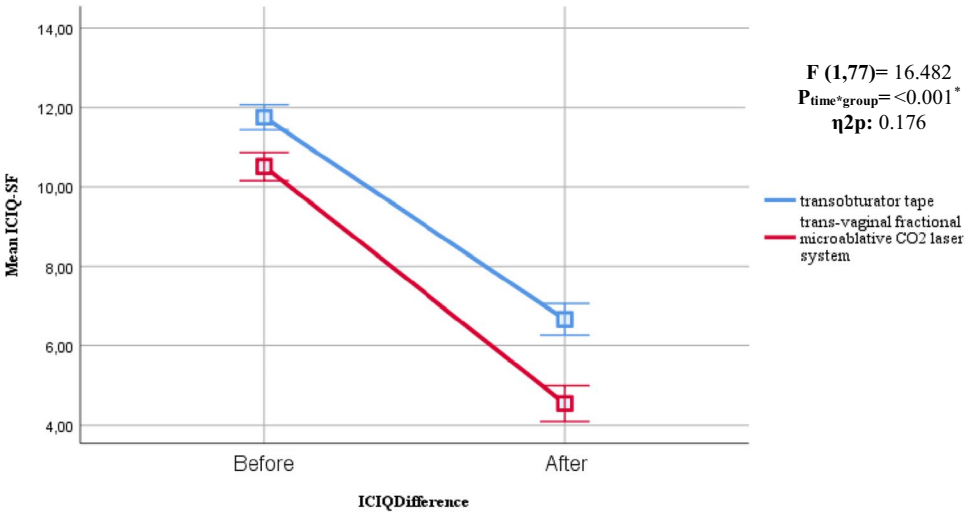

Fig. 1 Change in Incontinence Questionnaire-Urinary Incontinence Short Form (*ICIQ-SF*) before and 1 year after TOT surgery (*blue line*) and laser therapy (*red line*) intervention. Error bars show ± 1 standard error. Significant differences between groups are marked with an *asterisk* (*$p < 0.05$). *η2p* partial eta squared

test was performed to examine which treatment type had a greater effect on the ICIQ-SF level. Accordingly, the mean difference in ICIQ-SF score between pre-treatment and post-treatment in the TOT group was 5.0 ± 0.14, whereas it was 5.9 ± 0.16 in the laser group. The mean difference in ICIQ-SF scores was higher in the laser group than in the TOT group, and the difference was statistically significant ($p < 0.001$; Supplementary File 1).

Table 2 shows the mean difference values of ICIQ scores before and after treatment between BMI < 25 kg/m^2 (normal) and BMI ≥ 25 kg/m^2 (pre-obese + obese) groups, regardless of treatment types. There was a greater decrease in ICIQ-SF scores after treatment in the normal group than in the pre-obese + obese group ($P_{time*group} = 0.045$, η2p: 0.050 [moderate effect size]).

When the multiple comparison tests were performed according to the type of treatment and BMI classification, the difference in ICIQ-SF scores before and after treatment was found to be similar in all subgroups. The interaction effect of the groups and time was not significant. However, there was a significant decrease in ICIQ-SF scores in all subgroups over time (Table 3).

Effect of treatment groups on change in SUI symptom severity according to BMI classification

In Table 4, we examined the change in categorical variables for the severity of SUI symptoms (none, mild, moderate, and severe respectively) in the same subject before and after the treatment by treatment types and BMI categories. We observed significant improvements in patients in all BMI categories of both TOT and laser groups ($p < 0.05$). However, the statistical significance of the improvement

Table 2 Mean difference between pre- and post-treatment of Incontinence Questionnaire-Urinary Incontinence Short Form (*ICIQ-SF*) level in normal vs preobese + obese groups

BMI groups	Mean difference (B-A)	SE	95% CI	P_{time} value	$P_{group*time}$ value	η2p
<25.0 kg/m^2 ($n=39$)	5.7	0.16	(5.3–6.0)	<0.001**	0.045*	0.050
≥25.0 kg/m^2 ($n=40$)	5.2	0.16	(4.9–5.5)	<0.001**		

Pairwise comparison tests were performed according to Bonferroni correction

A after, *B* before, *BMI* body mass index, *SE* standard error, *CI* confidence interval, *η2p* partial eta squared

p values for time by group interaction from repeated measures ANOVAs

*$p < 0.05$; **$p < 0.001$

Table 3 Mean difference between pre- and post-treatment of ICIQ-SF level by treatment type and BMI classification

Operation type	BMI groups	Mean difference (B-A)	SE	95% CI	P_{time} value	$P_{groups*time}$ value	η2p
Transobturator tape	<25.0 kg/m^2 ($n=12$)	5.1	0.28	(4.6–5.7)	<0.001	0.783	0.001
	≥25.0 kg/m^2 ($n=32$)	5.0	0.17	(4.7–5.4)	<0.001		
Laser system	<25.0 kg/m^2 ($n=27$)	5.9	0.18	(5.5–6.3)	<0.001		
	≥25.0 kg/m^2 ($n=8$)	6.0	0.34	(5.3–6.6)	<0.001		

p values for time by group interaction from repeated measures ANOVAs. Pairwise comparison tests were performed according to Bonferroni correction

A after, *B* before, *BMI* body mass index, *SE* standard error, *CI* confidence interval, *η2p* partial eta squared

Table 4 Change in the severity grade of SUI patients with normal or preobese + obese before and after the transobturator tape (*TOT*) or laser treatment in a contingency table

Operation type	BMI groups	SUI severity		ICIQ-SF (A)			*p* value[a]
				Mild	Moderate	Severe	
TOT	<25.0 kg/m^2	ICIQ-SF (B)	Mild	0	0	0	0.025*
			Moderate	2	7	0	
			Severe	0	3	0	
	≥25.0 kg/m^2	ICIQ-SF (B)	Mild	0	0	0	<0.001***
			Moderate	7	17	0	
			Severe	0	8	0	
Laser system	<25.0 kg/m^2	ICIQ-SF (B)	Mild	0	0	0	<0.001***
			Moderate	21	6	0	
			Severe	0	0	0	
	≥25.0 kg/m^2	ICIQ-SF (B)	Mild	0	0	0	0.008**
			Moderate	7	1	0	
			Severe	0	0	0	

[a]Stuart–Maxwell test

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

A after, *B* before, *BMI* body mass index, *ICIQ-SF* Incontinence Questionnaire-Urinary Incontinence Short Form, *SUI* stress urinary incontinence

*$p < 0.05$; **$p < 0.001$

rate was higher in participants with BMI <25 kg/m^2 than in those with BMI ≥25 kg/m^2 in the laser group (improvement rate: 21/27 and 7/8; p value < 0.001 and 0.008 respectively), whereas the opposite result was found in the TOT group. Furthermore, 45.4% (20 out of 44) of the participants improved in the TOT group, and this rate was 80.0% (28 out of 35) in the laser group without BMI categories.

In Table 5, we examined the change in categorical variables for the symptoms of SUI (not at all, occasionally, frequently, and daily respectively) in the same subject before and after treatment by treatment types and BMI categories. In all subgroups, all patients reported improvement in SUI symptoms. In the TOT group, 58.3% (7 out of 12) of participants with a BMI <25.0 kg/m^2 for post-treatment reported no SUI symptoms at all compared with 25.0% (8 out of 32) for participants with a BMI ≥25 kg/m^2. In the laser group, although the majority of BMI <25.0 kg/m^2 participants (88.8%) did not report any SUI symptoms 1 year after the treatment, it was observed that all participants had occasional SUI symptoms in the other group.

Discussion

In this study, the effects of laser therapy and transobturator tape (TOT) operations on the symptoms and severity of SUI were compared and the role of BMI in the success of the treatment of patients with SUI was also examined. The ICIQ-SF scores of the patients who received laser treatment after 1 year were found to be lower than those of the TOT procedure group. Patients with ideal BMI had better results in the quality of life scores, independent of treatment after the intervention, and more significant improvements in the severity of SUI symptoms were observed with laser treatment. The results gathered from this study need to be confirmed by further studies with higher numbers of patients.

Stress urinary incontinence is a significant condition affecting women's physical, mental, and social well-being. Transvaginal fractionated CO_2 laser therapy was shown to improve vaginal tissue health in women with vaginal atrophy [20]. Since 2014, an increasing number of studies have been published investigating the use of transvaginal laser therapy for gynecological conditions such as SUI, mixed UI (MUI), and genitourinary symptoms of menopause (GSM) [21]. The first report indicates that laser therapy may be used for vaginal relaxation, SUI, pelvic organ prolapse, and vaginal atrophy, with no serious adverse effects [22]. Subsequently, many reports have been presented regarding the improvement effect of laser therapy on SUI symptoms in women. In the findings of our study, it was observed that the 1-year ICIQ-SF scores of the patients decreased by approximately 50% as a result of both laser treatment and TOT surgery. Furthermore, laser therapy was found to be superior to the TOT surgical procedure with regard to quality of life. When laser treatment was compared with TOT and TVT surgical procedures in 50 Japanese women diagnosed with SUI and mixed urinary incontinence (MUI), the change in the quality-of-life scores of women with SUI was found to be similar in both groups. However, the change in the quality of life score of women with MUI who underwent laser treatment was found to be higher than in those undergoing TOT and TVT surgery [23]. Erel et al. examined the effect of laser therapy on the symptoms of SUI patients who had previously undergone unsuccessful TOT/TVT procedures. Accordingly, laser therapy is an alternative treatment option for SUI patients who have failed previous TOT/TVT procedures, especially in younger patients [24].

Although laser therapy, which has fewer side effects and is a non-invasive treatment, has positive effects on the symptoms of the disease, it is thought that the effects of this treatment are temporary and usually effective for a limited number of years. Furthermore, long-follow-up cohort research on this matter is limited. In the current study, 175 women with SUI and MUI symptoms underwent laser therapy, and 77% of women demonstrated significant improvement 3 months after the intervention [21]. In a cohort study [25] surveying 73 women, it was demonstrated that Er:YAG laser therapy in women has produced a clinically relevant, short-term improvement of stress urinary incontinence, with minimal adverse events of a transient nature. Another prospective cohort study using lasers to treat SUI demonstrated similar positive results [17]. These reports are consistent with the findings of our study. However, a shortcoming of laser therapy is that it is effective for only a few years, according to

Table 5 Changes in stress incontinence symptoms in women who underwent fractional CO_2 laser or transobturator tape (*TOT*) at pre-treatment and 12–month post-treatment by body mass index (*BMI*) categories

Operation type	BMI groups	SUI symptoms (B)	SUI symptoms (A)	
			Not at all	Occasionally
TOT	<25.0 kg/m^2	Frequently	7	5
	≥25.0 kg/m^2	Frequently	7	13
		Daily	1	11
Laser system	<25.0 kg/m^2	Frequently	24	3
	≥25.0 kg/m^2	Frequently	0	8

A after, *B* before, *SUI* stress urinary incontinence

the literature [25]. From a positive point of view, laser therapy is considered safe, because even if unexpected adverse effects occur, they are reversible. Accordingly, it may be beneficial for women who desire temporary treatment and who do not want an artificial object inside them [26].

The relationships between obesity and SUI symptoms are well documented and have become a global problem. In our study, it was found that individuals with ideal weight responded better to treatment than overweight individuals, regardless of the type of intervention. It was suggested that the increased intra-abdominal pressure of obese individuals negatively stresses the pelvic floor and contributes to the development of SUI [27]. Furthermore, it was demonstrated that obesity was a risk factor for peripheral nervous system dysfunction and conduction parameters were affected in median, peroneal, sural, and tibial nerves [28]. There may be a potential link between obesity and the neurogenic contribution of SUI. In an observational study, obese women with SUI had twice as many SUI complaints as normal-weight women [29]. Brennand et al. found that obese women had lower quality-of-life scores after 1 year than normal-weight women, and the rate of obese women leaking in the pad leak test was almost twice as high as normal women after TOT/TVT surgery in 182 women [30]. In another study, TVT-A or TVT-E procedures were applied to 426 women with SUI. As a result, 36 months after the intervention, the ICIQ-SF score of normal-weight patients was 2 points lower than that of obese patients. The results of these reports are consistent with the findings of our study [31]. Furthermore, normal-weight women who underwent laser treatment had a more significant improvement in SUI symptoms than obese women in our findings. Although the majority of normal-weight women (approximately 90%) who receive laser treatment completely recover from SUI symptoms after 1 year, there are no obese patients who fully recover. Normal-weight patients with TOT procedures had a 2.33-fold higher rate of complete resolution of SUI symptoms than obese patients. There are no studies examining whether obesity is a risk factor for the success of the laser protocol in the treatment of SUI to our knowledge. In a meta-analysis review, it was found that obese participants were 1.65 times more likely to fail different surgical interventions than ideal-weight patients with SUI (CI: 1.39–1.96, $p < 0.001$). It was concluded that weight loss should be achieved through the nutrition programs of obese individuals, especially before starting treatment [32].

The main limitation of this study was the fact that it was not a randomized control study. The other limitation was regarding the number of patients. The small sample size is a handicap that limits the scope of detailed statistical analysis. In addition, there were no patients with obesity in the laser therapy group. Another limitation may be the subjectivity of ICIQ-SF that was used to evaluate the symptoms of SUI. Furthermore, the baseline mean ICIQ-SF scores of the patients in both groups were different, which can be seen as a limitation when comparing the treatments. The participants' quality of life was evaluated only 1 year after the relevant treatment protocols were applied. Patients should be followed for a longer time as laser therapy may lose its effectiveness in a few years. In this study, we examined whether obesity was also a risk factor for treatment failure. But, the diet, physical activity, and lifestyle factors of the patients were not queried in detail during the 1-year follow-up period. The patients' awareness of the treatment received may be biased in terms of their responses to questionnaires.

Conclusion

Laser therapy demonstrated more statistically positive results in women with SUI than the TOT protocol. Therefore, micro-ablative fractional CO_2 laser treatment appears to be a promising, nonsurgical, nonhormonal, minimally invasive, low-risk treatment option for women with SUI in a 12-month study. Moreover, it was demonstrated that being overweight might be a risk factor for the failure of laser therapy. Therefore, it was concluded that overweight women should lose weight with lifestyle factors such as nutrition and exercise before treatment. Last, future studies with longer follow-ups are needed to understand whether the efficacy of treatment is long-term.

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Author contributions F. Çağiran Yilmaz: designed research, conducted research, wrote the paper; M. AAçik: analyzed data or performed statistical analysis, wrote the paper; F. Çağiran: designed research, conducted research. All authors had primary responsibility for the final content and read and approved the final manuscript.

Data availability Data may be shared by the corresponding author when necessary.

Declarations

The presented study was conducted according to statements in the Declaration of Helsinki. A detailed consent form was provided. Diyarbakır Gazi Yasargil Training and Research Hospital Clinical Research Ethics Committee authorized the presented study by the number 2022–02-18.

Conflicts of interest The authors declare that they have no conflicts of interest.

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