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## Original Article

## The short-term outcome of laser in the management of female pelvic floor disorders: Focus on stress urine incontinence and sexual dysfunction

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## ABSTRACT

**Objective:** Female pelvic floor disorders, including female stress urinary incontinence (SUI) or sexual dysfunction are notorious for affecting the quality of women's life. It is reported that laser therapy might result in collagen remodeling and improvement in tissue firmness. The study was conducted to evaluate the short-term outcome of female pelvic floor disorders treated by laser therapy.

**Materials and methods:** Women with self-reported symptoms of female pelvic floor disorders (limited to SUI and sexual dysfunction) were included in the study. The participants were treated with the Er:YAG laser or the fractional microablative carbon dioxide (CO<sub>2</sub>) laser system. The therapeutic effect was focused on SUI symptoms and sexual dysfunction.

**Results:** There were 31 women underwent laser treatment, including 21 patients treated with Erbium:YAG laser and 10 treated with CO<sub>2</sub> laser. In the Erbium:YAG laser group, International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form (ICIQ-SF) scores were dropped from  $8.25 \pm 5.66$  to  $5.00 \pm 3.99$  ( $P = 0.007$ ); and in the CO<sub>2</sub> laser group, scores were dropped from  $11.11 \pm 6.85$  to  $6.44 \pm 4.25$  ( $P = 0.035$ ), contributing to the drop of ICIQ-SF scores from  $9.14 \pm 6.08$  to  $5.45 \pm 4.05$  for all enrolled patients ( $P = 0.001$ ). However, objective measure using pad test did not show a statistically significant difference between before and after treatment (from  $3.20 \pm 5.84$  g to  $1.54 \pm 3.18$  g,  $P = 0.224$ ). Sexual dysfunction was improved in 13 patients (44.83%), but Female Sexual Function Index (FSFI) scores were not different before and after laser treatment ( $44.22 \pm 23.36$  vs.  $44.09 \pm 24.51$ ,  $P = 0.389$ ).

**Conclusion:** Laser therapy either by Erbium:YAG laser or CO<sub>2</sub> laser seemed to be useful for female pelvic floor disorders, especially on improvement of SUI symptoms; however, the effectiveness needs further confirmation.

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## Introduction

Female pelvic floor disorders, which is a term that refer to a broad range of clinical scenarios, including lower urinary tract excretory and defecation disorders, such as urinary incontinence (stress urinary incontinence: SUI) and anal incontinence, overactive bladder (OAB), and pelvic organ prolapse (POP), as well as sexual disorders have a significant impact on women's daily lives and also present a

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financial burden on the health care systems [1–4]. Treatments include pelvic floor muscle training, behavioral therapies, oral medications, neuromodulation, intradetrusor medications, and surgery [5–10]. Surgery with a midurethral sling to provide urethral support and tighten the supportive tissue for the lower urinary tract is the treatment of choice for SUI [11–13]. However, perioperative complications such as bladder perforation, major bleeding requiring blood transfusion, hematuria or bowel injury may occur, and post-operative urine retention is also under concern [11,14]. Pelvic floor muscle training (PFMT) is also widely used to treat women with SUI, but it requires consistent efforts of practice and is very time consuming [15]. Therefore, it is worthwhile to find a minimally invasive and non-hormonal strategy to restore urogenital physiology and improve the quality of women's lives [16,17].

Erbium:YAG and CO<sub>2</sub> laser shares overlapping absorption spectra (mostly water absorption) and is feasible to apply on human mucosal tissue, such as vaginal mucosa. Its minimally invasive and non-surgical characteristic is also attractive to patients [18,19]. The specific photothermal effects of de novo synthesis of connective tissue can result in collagen remodeling, tightening of the supportive tissue and improvement in tissue firmness [20,21]. Since female SUI is resulting from diminished pelvic floor support with reduced collagen content, laser-mediated heat treatment of vaginal mucosa may achieve reinforcement of the pelvic floor. Recently, a study demonstrated the use of the three cycles of carbon dioxide (CO<sub>2</sub>) laser after failure of topical nonestrogenic therapy in 82 breast cancer survivors and found that comparison between pre and post-treatment, the differences in mean visual analogue scores (VAS) were significant for sensitivity during sexual intercourse, vaginal dryness, itching/stinging, dyspareunia and dysuria ( $P < 0.001$  for all), bleeding ( $P = 0.001$ ), probe insertion ( $P = 0.001$ ), and movement-related pain ( $P = 0.011$ ) [21]. In addition, two Taiwanese reports showed the potential benefits of laser therapy for female SUI and sexual function [16,17]; however, both studies used the Erbium:YAG laser system (a Fortona Dynamis Er:YAG laser (2940 nm) system (XS dynamis, Forona, Slovenia). Therefore, we conducted this retrospective study to evaluate the effectiveness and safety of laser therapy either from Er:YAG or CO<sub>2</sub> systems for female stress urinary incontinence and sexual function.

## Material and methods

### Patient and design

This was a prospective study conducted at Kaohsiung Veterans General Hospital in Taiwan from October 2015 to March 2016. All participants provided written informed consent.

Patients were evaluated for study eligibility by assessing inclusion and exclusion criteria, medical history, and by physical examination findings. Women with self-reported symptoms of SUI were eligible. Normal Papanicolaou cytology and integrity of the vaginal mucosa without injuries were confirmed. Subjects were excluded if they had following conditions: pregnancy, poor controlled diabetes, gynecological cancer history, advanced pelvic organ prolapse (more than POP-Q stage II), taking medications that caused photosensitivity, vaginal bleeding, or an infection in the area to be treated. Each woman who completed the 2-month follow-up was included in the final analyses.

The severity of SUI and its impact on quality of life was assessed using the International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form (ICIQ-SF) and pad test. ICIQ-SF has been validated in the Chinese versions and for use in the Taiwanese population [3,9,16]. Assessment of patients' satisfaction of sexual function was also reported using the Female Sexual Function Index (FSFI) [16,17,22,23]. The participants completed all

the evaluation and questionnaires at the baseline and 2 months after the last laser therapy.

### Treatment protocol

All patients were informed about the laser procedure and its potential adverse effects. These procedures were performed in our outpatient department. Patients who visited in October received the Er:YAG laser treatment, and in December received CO<sub>2</sub> laser treatment due to the availability of the laser machine. Each study participant underwent a routine per-vagina examination by the authors. One-hour pad weight tests were performed to determine the volume of urine leakage during activities, cough, and standardized exercises. Patients completed validated questionnaires related to urinary incontinence symptoms and sexual function. At the follow-up exam performed 2 months post-treatment, the same outcome measurements were repeated. We considered a subjective improvement in SUI as a lower ICIQ-SF score and an objective improvement as less urine leakage on pad test. We considered an improvement in patients' satisfaction of sexual function as a higher FSFI score after treatment than that reported prior to treatment. The differences between both scores and severity stages per patient were tested for statistical significance with the Wilcoxon signed-rank test at a confidence level of 95%.

### Procedures

During the intervention, patients were lying in a normal gynecological lithotomy position and received no anesthesia. The participants treated using a 2940 nm Er:YAG laser (FotonaSmooth™ SP, Fotona, Ljubljana, Slovenia) were treated in smooth mode after insertion of the vaginal speculum. First, the R11 handpiece (with full beam) with circular adapter was used to laser irradiate the whole vaginal wall for two passes under a fluence of 3 J/cm<sup>2</sup>. Second, using the PS03 handpiece (with 7 mm spot-size) with angular adapter, the anterior vaginal wall was irradiated from the most distal portion toward the introitus with a fluence of 6 J/cm<sup>2</sup>. The treatment was applied along the anterior vaginal wall for 6 longitudinal passes each in a different angle (30° between each other). In the final step, irradiation of the vestibule and the introitus was performed with the PS03 handpiece (with 7 mm spot-size) with straight adapter and fluence of 10 J/cm<sup>2</sup>.

For women receiving the fractional microablative CO<sub>2</sub> laser system (SmartXide<sup>2</sup>, Monalisa Touch, DEKA, Florence, Italy), the treatment was performed with dot power 30 watt. The laser beam was introduced using a vaginal probe gently inserted up to the top of the vaginal canal and subsequently withdrawn and rotated to provide a complete treatment of the vaginal wall. At the level of the vaginal introitus, we decreased the dot power to 20 watt.

All patients were advised to avoid intercourse for at least 7 days after laser application. Additional clinic appointment is available if any unwanted side effect occurred.

### Outcome parameters

The primary endpoint of this study was the improvement in the severity of stress urinary incontinence, using the subjective assessment tool ICIQ-SF and the objective measure with pad test.

The secondary outcomes were changes in patients' satisfaction of sexual function using FSFI questionnaires.

### Statistical analysis

Statistical evaluations were obtained by using SPSS 18.0 (SPSS Science, Chicago, IL). For a normal distribution, data were expressed

as the means and standard deviations (SD). The outcome measures and associated clinical variables were analyzed using the chi-square test, and the Wilcoxon signed-rank test, at a confidence level of 95%, as appropriate. A *p* value of 0.05 was significant.

## Results

There were 31 women underwent laser treatment, including 21 patients treated with Er:YAG laser and 10 treated with CO<sub>2</sub> laser. The basic characteristics of the patients including patient age, body mass index (BMI), parity, and menopausal status were presented (Table 1). Mild irritation of the introitus was noted during the procedure, but resolved spontaneously after therapy. There were no major side effects reported after the laser treatment, and every patient tolerated the procedure well.

After laser therapy, improvement in SUI symptoms and quality of life was noted. At the 2-month follow-up, 15 patients (51.72%) felt improved, 11 patients' (37.93%) SUI grades remained unchanged, while 3 patients (10.34%) presented with worse symptoms (Fig. 1A). Compared to pre-treatment, ICI-Q-SF scores after treatment were significantly lower (pre-laser versus post-laser,  $9.14 \pm 6.08$  versus  $5.45 \pm 4.05$ ,  $P = 0.001$ ) (Fig. 1B). Objective 1-h pad weight tests also revealed improvement after laser therapy (from  $3.20 \pm 5.84$  g at baseline to  $1.54 \pm 3.18$  after treatment,  $P = 0.224$ ), although the improvement was not statistically significant (Fig. 1C).

We further investigated the differences between the Er:YAG laser and CO<sub>2</sub> laser on SUI. Both patients treated with the Er:YAG laser and the CO<sub>2</sub> laser showed significant improvement in SUI symptoms and quality of life (ICI-Q-SF scores, Er:YAG laser  $8.25 \pm 5.66$  to  $5.00 \pm 3.99$ ,  $P = 0.007$ , CO<sub>2</sub> laser  $11.11 \pm 6.85$  to  $6.44 \pm 4.25$ ,  $P = 0.035$ ) (Fig. 2A). The objective 1-h pad weight test also revealed improved scores from both laser therapies (Er:YAG laser  $3.42 \pm 6.31$  to  $1.48 \pm 3.18$ ,  $P = 0.139$ , CO<sub>2</sub> laser  $2.71 \pm 4.98$  to  $1.74 \pm 3.56$ ,  $P = 0.593$ ), although the results were not statistically significant (Fig. 2B).

Regarding patient's satisfaction of sexual function, improvement was noted in 13 patients (44.83%), whereas 3 patients (10.34%) remained unchanged and 7 patients (24.14%) presented with worse sexual function (Fig. 3A). Compared with baseline, the overall satisfaction of FSFI scores did not improvement after laser treatment (FSFI total scores, pre-laser versus post-laser,  $44.22 \pm 23.36$  versus  $44.09 \pm 24.51$ ,  $P = 0.389$ ) (Fig. 3B). Nonetheless, there's still some difference between the two groups. Patients treated with the Er:YAG laser did not show improvement in FSFI total scores ( $48.22 \pm 20.28$  versus  $46.11 \pm 22.02$ ,  $P = 0.775$ ), while patients treated with the CO<sub>2</sub> laser showed little improvement in FSFI total scores ( $28.5 \pm 29.69$  versus  $31.17 \pm 30.86$ ,  $P = 0.066$ ) (Fig. 2C). According to above data, laser treatment failed to show benefit on sexual function in this study.

**Table 1**

Baseline characteristics of the study population.

Variable	Value
Age (years)	$48.43 \pm 12.75$
Body mass index (kg/m <sup>2</sup> )	$21.97 \pm 2.12$
Parity (n)	$2.14 \pm 0.83$
Vaginal deliveries	
1	17.2%
2	31.1%
3	37.9%
Cesarean section	13.8%
Menopause	44.8%
DM	13.8%

Data are given as mean  $\pm$  standard deviation, *n* (%) or mean  $\pm$  standard deviation (SD).

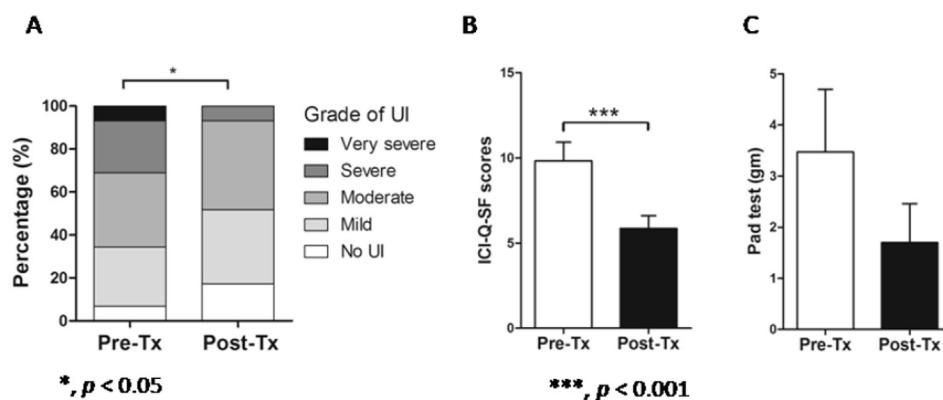
## Discussion

Laser therapy is well known as a minimally invasive, non-hormone, well-tolerated, and thus practical treatment [16,17]. Through a photothermal effect, both the Er:YAG and CO<sub>2</sub> laser therapies can increase vaginal epithelial thickness and enhance the storage of glycogen in epithelial cells. This in turn induces tissue remodeling and the cytokine pathway of tissue repair, which strengthens urethral support and tightens the supportive tissue and thus partially restore urogenital physiology. Our study demonstrated that both CO<sub>2</sub> and Er:YAG lasers laser therapy could be used to successfully treat SUI and improve the quality of women's lives.

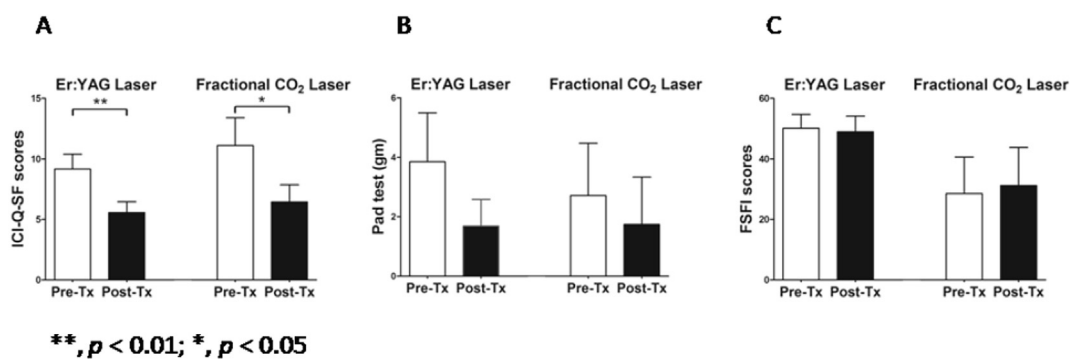
Laser treatment has been popular in plastic reconstruction and skin rejuvenation for years due to its convenience and effectiveness. It is promising to extend the field of minimally invasive laser treatment to SUI. Our study demonstrated that Er:YAG and CO<sub>2</sub> laser therapy could be used to treat SUI and improve the quality of women's lives. When compared with surgical treatment for SUI, laser therapy is much easier to practice and safe, as only minimal side effects occurred after laser therapy. Both Tien's [16] and Ogrinc' studies [24] discovered that the Er:YAG laser could be a promising treatment strategy for SUI, with positive benefits of treatment lasting at least one year. Tien et al. also found that the effect of the Er:YAG lasers for mild SUI was moderate at the 6-month follow-up, but the procedure was not effective for pad weight  $>10$  g [16]. By contrast, the Er:YAG laser does not seem to be an appropriate treatment for addressing mixed urinary incontinence [24]. In our study, we found that laser therapy could improve SUI and quality of women's lives. Since most studies suggest that a more appropriate protocol would be for women to receive two or three sessions of laser treatments at monthly intervals [21,25–27], the appropriate treatment protocols for patients need further modification in the future.

Both Er:YAG and CO<sub>2</sub> lasers have been explored as possible treatments for SUI. While various lasers possess distinct properties, there have been limited studies comparing the clinical outcomes and adverse effects of these two lasers. Manuskiatti et al. demonstrated two laser systems for treatment of atrophic scars in dark-skinned patients provided comparable outcomes, but the CO<sub>2</sub> laser was associated with greater treatment discomfort [28]. Szyfte et al. found similar usefulness of CO<sub>2</sub> and Er:YAG lasers in stapes surgery [29]. In our study, we also found that both Er:YAG and CO<sub>2</sub> laser showed promising and comparable improvement for treatment of SUI. The total anatomic depth of tissue necrosis, including residual thermal damage, is a primary determinant of both efficacy and healing time with laser treatment. High-energy CO<sub>2</sub> lasers (10,600 nm) allow clinicians to induce tissue remodeling, but the use of the CO<sub>2</sub> laser is limited by treatment discomfort and the high incidence of prolonged postoperative erythema [30]. In contrast the Er:YAG laser (2940 nm) produces less residual thermal injury and hence less total depth of tissue necrosis, resulting in faster healing [31]. Therefore, with a higher number of Er:YAG laser passes required to achieve a similar depth of tissue necrosis compared with conventional CO<sub>2</sub> laser remodeling, the efficacy of the lasers was similar, but the Er:YAG laser group tends toward faster healing [31,32].

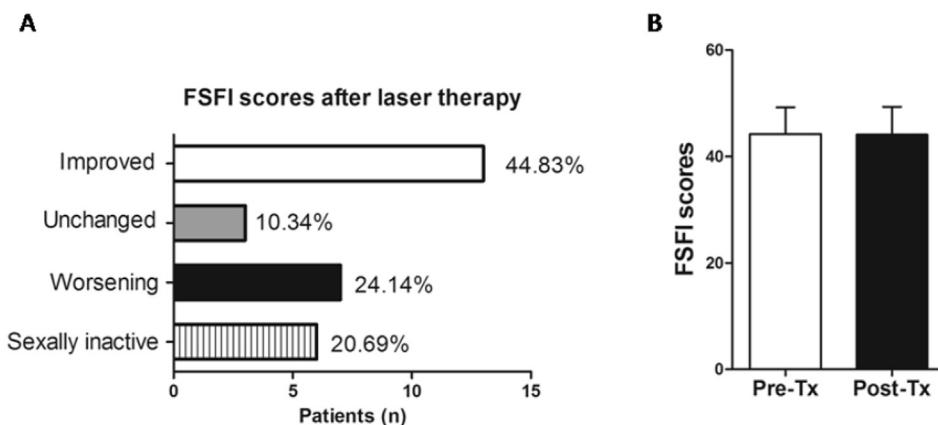
The strength of the current study was that the two laser systems were applicable for women with SUI, which differs from the only one laser system (Er:YAG) applicable in the previous studies from Taiwan [16,17]. However, limitations of the current study included a non-randomization study design. In addition, the placebo effect of hypothesis of the laser therapy cannot be overruled because of the absence of a control group. Therefore, we evaluated the changes pre and post-laser therapy in women with SUI and did not seek to compare its effectiveness with other treatment modalities [33–35].



**Fig. 1.** The effect of laser therapy on the improvement in female stress urinary incontinence. (A) Plots show the distribution of patients (in %) by grade of incontinence (mild, moderate, severe, very severe) before treatment and at follow-up. (B) The International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form (ICI-Q-SF) results and (C) 1-h pad weight test decrease following therapy. Data are presented as the means and SD. \*\*\* $p < 0.001$ .



**Fig. 2.** Effect of Er:YAG and CO<sub>2</sub> laser therapy on stress urinary incontinence and sexual satisfaction using ICI-Q-SF scores, the pad test and FSFI scores. Data are presented as the means and SD. \*\* $p < 0.01$ ; \* $p < 0.05$ .



**Fig. 3.** The effect of laser therapy on sexual function and overall satisfaction. (A) Plots show the distribution of patients (in %) according to improvement status after therapy. (B) The change of sexual function questionnaire (Female sexual functional index, FSFI) before and after therapy.

In addition, a lot of Taiwanese women are sexually inactive after mid-age, so using a validated questionnaire to evaluate the treatment effect and efficacy on sexual function may not be suitable for this population [36]. Other limitations included the small sample size and relatively short-term follow-up. There is a large multi-center study evaluating the efficacy and safety of vaginal laser for the treatment of SUI called the Vaginal Erbium Laser Academy Study (VELAS) [37,38]. This trial might clarify the role of vaginal laser for those women with SUI.

Minimally invasive laser therapy is a promising therapeutic option for women with clinical signs and symptoms of SUI, especially those who only have mild to moderate SUI. In addition, with an increasing elderly population, age-related health problem, such as SUI, and pelvic floor disorders are increasing continuously; any new technology, such as Er:YAG and CO<sub>2</sub> lasers as shown in the current study and biomaterial development [39–42], with a minimized risk of tissue reaction after treatment may play a critical role for patients' care about the topic of female pelvic floor



disorders in the future. We concluded that both the Er:YAG and CO<sub>2</sub> lasers could successfully be used to treat SUI and improving the quality of women's lives. Additional large prospective and randomized studies to optimize treatment timing and protocols are worthwhile and necessary.

### Conflicts of interest statement

The authors have declared that no conflict of interest exists.

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### References

- [1] Yount SM. The impact of pelvic floor disorders and pelvic surgery on women's sexual Satisfaction and function. *J Midwifery Wom Health* 2013;58:538–45.
- [2] Bozkurt M, Yumru AE, Şahin L. Pelvic floor dysfunction, and effects of pregnancy and mode of delivery on pelvic floor. *Taiwan J Obstet Gynecol* 2014;53:452–8.
- [3] Wang H, Lau HH, Hung MJ, Huang WC, Zheng YW, Su TH. Validation of a Mandarin Chinese version of the pelvic organ prolapse/urinary incontinence sexual questionnaire IUGA-revised (PISQ-IR). *Int Urogynecol J* 2015;26:1695–700.
- [4] Nazarpour S, Simbar M, Tehrani FR. Factors affecting sexual function in menopause: a review article. *Taiwan J Obstet Gynecol* 2016;55:480–7.
- [5] Elser DM. Recognizing and managing common urogynecologic disorders. *Obstet Gynecol Clin N Am* 2017;44:271–84.
- [6] Lo TS, Pue LB, Tan YL, Long CY, Lin YH, Wu PY. Tension-releasing suture appendage on single-incision sling device: a novel approach to postoperative voiding dysfunctions. *Taiwan J Obstet Gynecol* 2016;55:519–24.
- [7] Chang KM, Hsieh CH, Chiang HS, Lee TS. Trends in inpatient female urinary incontinence surgery and costs in Taiwan, 1997–2011. *Taiwan J Obstet Gynecol* 2017;56:32–6.
- [8] Chen SL, Ng SC, Huang YH, Chen GD. Are patients with bladder oversensitivity different from those with urodynamically proven detrusor overactivity in female overactive bladder syndrome? *J Chin Med Assoc* 2017;80:644–50.
- [9] Lee FK, Horng HC, Wang PH. Two distinct entities: bladder oversensitivity and detrusor overactivity. *J Chin Med Assoc* 2018;81:291–2.
- [10] Hsu LF, Chang LY, Liao YM, Yeh SD, Tsai PS. Trends in urodynamic procedures, surgical procedures, and overall health resource utilization in the adult Taiwanese population with urinary incontinence: a secondary data analysis. *J Nurs Res* 2017 Dec 4. <https://doi.org/10.1097/jnr.0000000000000254>.
- [11] Chang CP, Chang WH, Hsu YM, Chen YJ, Wen KC, Chao KC, et al. Comparison of single-incision mini-slings (Ajust) and standard transobturator midurethral slings (Align) in the management of female stress urinary incontinence: a 1-year follow-up. *Taiwan J Obstet Gynecol* 2015;54:726–30.
- [12] Sun MJ, Sun R, Tseng SH. Is single incision midurethral sling effective in patients with low maximal urethral closure pressure? *Taiwan J Obstet Gynecol* 2016;55:20–5.
- [13] Lo TS, Chua S, Kao CC, Uy-Patrimonio MC, Ibrahim R, Tan YL. Five-year outcome of MiniArc single-incision sling used in the treatment of primary urodynamic stress incontinence. *J Minim Invasive Gynecol* 2018;25:116–23.
- [14] Wu LY, Yang TH, Kung FT, Chuang FC, Huang KH. Comparison of the clinical outcomes of transobturator and single-incision slings for stress urinary incontinence. *Kaohsiung J Med Sci* 2016;32:367–72.
- [15] Osborne LA, Whittall CM, Emanuel R, Emery S, Reed P. Randomized controlled trial of the effect of a brief telephone support intervention on initial attendance at physiotherapy group sessions for pelvic floor problems. *Arch Phys Med Rehabil* 2017;98:2247–52.
- [16] Tien YW, Hsiao SM, Lee CN, Lin HH. Effects of laser procedure for female urodynamic stress incontinence on pad weight, urodynamics, and sexual function. *Int Urogynecol J* 2017;28:469–76.
- [17] Lin YH, Hsieh WC, Huang L, Liang CC. Effect of non-ablative laser treatment on overactive bladder symptoms, urinary incontinence and sexual function in women with urodynamic stress incontinence. *Taiwan J Obstet Gynecol* 2017;56:815–20.
- [18] Yin R, Lin L, Xiao Y, Hao F, Hamblin MR. Combination ALA-PDT and ablative fractional Er:YAG laser (2,940 nm) on the treatment of severe acne. *Laser Surg Med* 2014;46:165–72.
- [19] Tierney EP, Eisen RF, Hanke CW. Fractionated CO<sub>2</sub> laser skin rejuvenation. *Dermatol Ther* 2011;24:41–53.
- [20] Nesi-Reis V, Lera-Nonose DSSL, Oyama J, Paula Silva-Lalucci MP, Demarchi IG, Aristides SMA, et al. Contribution of photodynamic therapy in wound healing: a systematic review. *Photodiagn Photodyn Ther* 2018;21:294–305.
- [21] Pagano T, De Rosa P, Vallone R, Schettini F, Arpino G, Giuliano M, et al. Fractional microablative CO<sub>2</sub> laser in breast cancer survivors affected by iatrogenic vulvovaginal atrophy after failure of nonestrogenic local treatments: a retrospective study. *Menopause* 2018;25:657–62. <https://doi.org/10.1097/GME.0000000000001053>.
- [22] Lau HH, Huang WC, Su TH. Urinary leakage during sexual intercourse among women with incontinence: incidence and risk factors. *PLoS One* 2017;12:e0177075.
- [23] Sakinci M, Ercan CM, Olgan S, Coksuer H, Karasahin KE, Kuru O. Comparative analysis of copper intrauterine device impact on female sexual dysfunction subtypes. *Taiwan J Obstet Gynecol* 2016;55:30–4.
- [24] Ogrinc UB, Sencar S, Lenasi H. Novel minimally invasive laser treatment of urinary incontinence in women. *Laser Surg Med* 2015;47:689–97.
- [25] Sokol ER, Karram MM. An assessment of the safety and efficacy of a fractional CO<sub>2</sub> laser system for the treatment of vulvovaginal atrophy. *Menopause* 2016;23:1102–7.
- [26] Salvatore S, Nappi RE, Parma M, Chionna R, Lagona F, Zerbinati N, et al. Sexual function after fractional microablative CO(2) laser in women with vulvovaginal atrophy. *Climacteric* 2015;18:219–25.
- [27] Perino A, Calligaro A, Forlani F, Tiberio C, Cucinella G, Svelato A, et al. Vulvovaginal atrophy: a new treatment modality using thermo-ablative fractional CO<sub>2</sub> laser. *Maturitas* 2015;80:296–301.
- [28] Manuskiatti W, lamphonrat T, Wanitphakdeedecha R, Eimpunth S. Comparison of fractional erbium-doped yttrium aluminum garnet and carbon dioxide lasers in resurfacing of atrophic acne scars in Asians. *Dermatol Surg* 2013;39:111–20.
- [29] Szyf W, Mielcarek-Kuchta D, Mietkiewska-Leszniowska D, Młodkowska A, Laczowska-Przybylska J. Comparison between 2 laser systems, Er-Yag and CO<sub>2</sub>, in stapes surgery. *Otol Neurotol* 2013;34:29–35.
- [30] Kauvar AN, Waldorf HA, Geronemus RG. A histopathological comparison of "char-free" carbon dioxide lasers. *Dermatol Surg* 1996;22:343–8.
- [31] Hohenleutner U, Hohenleutner S, Bauml W, Landthaler M. Fast and effective skin ablation with an Er:YAG laser: determination of ablation rates and thermal damage zones. *Laser Surg Med* 1997;20:242–7.
- [32] Khatri KA, Ross V, Grevelink JM, Magro CM, Anderson RR. Comparison of erbium:YAG and carbon dioxide lasers in resurfacing of facial rhytides. *Arch Dermatol* 1999;135:391–7.
- [33] Horng HC, Chen YJ, Wang PH. Urinary incontinence: is vaginal delivery a cause? *J Chin Med Assoc* 2017;80:465–6.
- [34] Yang TH, Wu LY, Chuang FC, Kung FT, Huang KH. Comparing the midterm outcome of single incision vaginal mesh and transobturator vaginal mesh in treating severe pelvic organ prolapse. *Taiwan J Obstet Gynecol* 2017;56:81–6.
- [35] Lo TS, Yusoff FM, Kao CC, Jiali S, Uy Patrimonio MC. A 52-month follow-up on the transvaginal mesh surgery in vaginal cuff eversion. *Taiwan J Obstet Gynecol* 2017;56:346–52.
- [36] Chen FP, Chang CJ, Chao AS, Huang HY, Huang JP, Wu MH, et al. Efficacy of Femarelle for the treatment of climacteric syndrome in postmenopausal women: an open label trial. *Taiwan J Obstet Gynecol* 2016;55:336–40.
- [37] Gambacciani M, Torelli MG, Martella L, Bracco GL, Casagrande AG, Albertin E, et al. Rationale and design for the Vaginal Erbium Laser Academy Study (VELAS): an International multicenter observational study on genitourinary syndrome of menopause and stress urinary incontinence. *Climacteric* 2015;18:43–8.
- [38] Gambacciani M, Levancini M, Cervigni M. Vaginal erbium laser: the second-generation thermotherapy for the genitourinary syndrome of menopause. *Climacteric* 2015;18:757–63.
- [39] Wang PH, Huang BS, Horng HC, Yeh CC, Chen YJ. Wound healing. *J Chin Med Assoc* 2018;81:94–101.
- [40] Horng HC, Lee FK, Wang PH. Pelvic organ prolapse. *J Chin Med Assoc* 2018;81:387–9. <https://doi.org/10.1016/j.jcma.2017.11.001>.
- [41] Huang F, Zhou Q, Leng BJ, Mao QL, Zheng LM, Zuo MZ. A bibliometric and social network analysis of pelvic organ prolapse during 2007–2016. *J Chin Med Assoc* 2018;81:450–7. <https://doi.org/10.1016/j.jcma.2017.08.012>.
- [42] Horng HC, Chang WH, Yeh CC, Huang BS, Chang CP, Chen YJ, et al. Estrogen effects on wound healing. *Int J Mol Sci* 2017;18:E2325.